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Natural resources, rent dependence, and public goods provision in China: evidence from Shanxi's county-level governments

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Abstract

This paper investigates how natural-resource endowments affect the provision of local public goods in China. According to fiscal sociology, due to the rentier effect, resource-rich local governments tend to have more state autonomy and are less responsive to society, resulting in poor governance. Moreover, due to political myopia, resource-abundant local governments tend to neglect the accumulation of human capital. Shanxi's county-level governments are excellent samples to test these hypotheses. Statistical results show that resource-abundant local governments tend to spend less on social expenditures as well as specific education, social security and healthcare, and environmental protection expenditures. Meanwhile, coal-rich governments spend significantly more on self-serving administrative expenditures. The results suggest that negative impacts of natural resources on governmental fiscal extraction and expenditure behaviors are an important causal mechanism of the resource-curse hypothesis. To curb this problem, the current fiscal system needs to be reformed accordingly.

Keywords: Resource curse, Coal, Public goods provision, Shanxi Province

Introduction

Why are developing countries and regions rich in natural resources often characterized by slow economic growth? Exploring this "resource curse," economists, political scientists, and sociologists have put forward various causal mechanisms and explanations. Economists first proposed a series of explanations, asserting that abundant resources have a negative impact on domestic economic structure. These earlier studies often regard governmental behavior as a constant, which underestimates the role of government in economic development. Political scientists and sociologists then studied the resource curse from the aspects of political science and fiscal sociology. With the combined contributions of economics, political science, and fiscal sociology, scholars to date widely agree that political and fiscal-related factors such as institutions, fiscal capacity, and infrastructural capacity play important roles in explaining the resource-curse hypothesis. From the political aspect, resource rent has a negative effect on the time horizons of policy makers and government behaviors. From the perspective of fiscal sociology, various types of government-revenue composition greatly influence the state-society relationship, thus leading to various levels of governmental performance.

Since fiscal revenue extraction and expenditure allocation play important roles in governance, a relatively new approach to studying the causal mechanisms of the resource curse has been investigating the effect of rich resource rent on government fiscal extraction and spending behaviors. This paper follows this approach and examines the effect of natural resources on public expenditure allocation in China's context. Scholars have produced a large number of studies on China's resource curse over the past two decades. However, some drawbacks still exist. First, most existing studies are produced by economists, while research from political scientists and sociologists is rare, unlike their counterparts in the English-speaking world. Second, methodologically, previous cross-sectional studies often control little if any political and institutional factors. Third, many existing studies mix together different kinds of resources like coal, petroleum, gas, and even other hard-rock minerals, which makes it difficult to clearly separate their individual contribution to the resource-curse hypothesis.

Addressing these unsolved problems, this paper employs a county-level dataset from Shanxi Province to explore the effect of coal resources on government expenditure allocation. Counties in Shanxi Province are quite similar in terms of institutions, policy implementation, culture, language, and natural conditions, which maximally alleviates potentially disturbing factors. Coal is widely distributed in Shanxi and contributes significantly to the local economy, while its distribution varies substantially among the different counties. The statistical yearbook of Shanxi Province provides the volumes of coal sales of all counties from 1994 to 2008. By calculating the ratio of coal sales to regional GDP, we can obtain a key independent variable measuring coal resource abundance. As for the dependent variables, the *Fiscal Statistics of Prefectures, Cities and Counties 2007* provides the ratios of social and administrative expenditures to overall public expenditures. By combining these data, this study presents a series of statistical models to explore how natural resources affect the provision of local public goods. As the hypotheses of fiscal sociology and political science expect, this work finds that coal-rich local governments tend to spend less on social expenditures, as well as on the specific expenditures of education, environmental protection, and social security and healthcare. Meanwhile, coal-rich governments spend significantly more on administrative expenditures. The results suggest that the negative impact of natural resources on fiscal extraction and expenditure behaviors of government are an important causal mechanism of the resource-curse hypothesis. To curb this problem, the current fiscal system must be reformed accordingly.

The remainder of this paper proceeds as follows. In the following section, I briefly review the existing literature on the resource-curse hypothesis. The subsequent section explains the reasons for and advantages of choosing Shanxi counties as samples. In the fourth section, hypotheses are generated, and statistical models are specified. The fifth section presents the results and analyzes them. The last section concludes the study.

Literature review

In the 1950s, some scholars noted that economic stagnation often occurs in resource-abundant developing economies (Prebisch 1950; Singer 1950). A study of 30 states in sub-Saharan Africa finds a negative correlation between the share of mineral resources in total exports and economic performance (Wheeler 1984). Between 1971 and 1983 during the oil booms, the economic performances of large oil and mineral exporters

were worse than their resource-poor counterparts (Gelb 1988). To date, most scholars agree that abundant resources are a curse rather than a blessing for developing economies (Auty 1993; Gelb 1988). However, a few scholars disagree with this argument and believe that there is no resource curse (Davis 1995). To test this hypothesis, numerous large-sample statistical analyses and comparative case studies have been conducted. Most of these studies confirm the resource-curse hypothesis at the cross-national and cross-subnational level (Sachs et al. 1995; Johnson 2006). However, scholars rarely agree on what factors cause this problem and how.

Economists were the first to notice this phenomenon and they generated various economic explanations, most from the structural perspective. Among them, three arguments are notable. First, some economists argue that minimally processed natural-resource exporters suffer from a decline in the terms of trade in the long run, which will continuously widen the price gap between manufactured goods and the primary commodity (Prebisch 1950; Singer, 1950). Second, a branch of scholars note that international commodities are subject to large price fluctuations. This leaves resource-exporting industries vulnerable to the vicissitudes of the global market, where it can be transferred to the domestic economy, resulting in an unstable macroeconomic environment (Nurkse 1958). Third, some economists point out that the dominance of foreign multinationals in resource extraction and export contributes little to the local economy. Before the 1970s many resource industries in developing countries were controlled by large foreign companies, casting doubt on whether foreign multinationals would stimulate local growth if they were allowed to repatriate their profits. These three explanations generally fail to pass empirical tests. During the 1970s when two oil booms occurred, oil-rich economies in the Middle East did not perform any better than their resource-poor counterparts in East Asia even though oil prices surged and oil-export nations controlled most of the oil industry.

The "Dutch Disease" was a fourth explanation proposed by economists. It is named after the fact that the economy of the Netherlands stagnated after rich natural gas was found in the 1960s. Two effects are thought to cause this problem. First, a sharp increase in natural-resource exports lead to the appreciation of the real exchange rate. Second, if the resource sector booms quickly, it draws capital and labor away from the agricultural and manufacturing sectors (Ross 1999). The combination of these two reasons results in a decline in the export of agricultural and manufactured goods, but a cost rise in non-importable goods and services. The Dutch Disease was a promising theoretical framework at first, but a closer look at this explanation finds it poorly fits the cases of developing countries. It assumes that the capital and labor in a developing economy are fixed and fully employed, yet developing countries often have labor surpluses and their resource windfall could easily attract foreign capital and labor to offset local scarcities (Benjamin et al. 1989; Gelb 1988). Davis (1995) even argues that if a crowding-out effect does exist, it is a comparative advantage rather than a disadvantage to the country.

These four previous economic explanations explore the resource curse from a similar viewpoint by investigating how resource exports influence the domestic economic structure. They all assume the role of government as a constant, that is, governments have neither willingness nor capacity to mitigate those adverse effects brought by natural resources. This assumption runs counter to the reality that most resource-rich

governments actually have a large say in their resource sector and have the policy tools to intervene. For instance, governments can use their natural windfalls to invest in and promote manufacturing and agricultural sectors, they can increase foreign currency reserves to prevent their real exchange rates from appreciating, and they could set up stabilization funds and use careful fiscal policies to buffer against the vicissitudes of international commodity markets (Ross 1999).

Reflecting on these earlier economic explanations, scholars came to realize that explaining the resource curse must include addressing the question of why governments fail to take corrective measures. Theoretical frameworks proposed by political scientists and fiscal sociologists gradually came into being. These later explanations believe that resource windfalls have a detrimental impact on government behaviors such as the time horizons of policy makers, institutional development, methods of government-revenue extraction, and the composition of government expenditures (Collier and Hoeffler 2004, 2005; Mehlum et al. 2006; Moore 2001, 2004; Torvik 2009). These explanations can generally be categorized into two approaches: the cognitive explanation and the state-centralism explanation, which focus on the shortsightedness of political leaders and the state-society relation in revenue extraction and public spending, respectively (Ross 1999).

The cognitive explanation. This approach suggests that resource wealth will shorten the time horizons of policy makers and private actors, which is detrimental to the long-term interests of resource-rich areas. More specifically, three effects may occur (Robinson et al., 2006). First, human capital accumulation may be neglected. A booming resource sector not only attracts labor and capital from other industrial sectors but also induces a myopic sloth among policy makers and private actors. Many manufacturing industries are characterized by "learning by doing", which requires persistent investments in technology innovations and human capital. However, resource wealth produces a get-rich-quick mentality among businessmen and policy makers, leading them to underprovide those investments beneficial to manufacturing industries in the long run.

The second effect is social rigidity. Resource-related industries may utilize their abundant income to enlarge their political influence. They may try to capture some regulators in the government and lobby legislators in the parliament to seek rent and influence industrial policies in their favor. By doing so, they protect their own interests at the expense of the whole society, and thus hindering the overall economic growth (Olson 1982; Shafer 1994; Stigler 1971).

Third, resource wealth may increase the risk of military conflicts. The large and rich resource rents make rebellions and coups financially feasible and one-time gain even more attractive. Thus, rulers or insurgents would heavily discount the future, and the risk of military conflicts would substantially increase (Collier and Hoeffler 2004, 2005).

The state-centralism explanation. Fiscal sociology suggests that various types of government-revenue composition would greatly affect state-society relations. Based on whether states derive revenue mainly from state-owned properties, resource rents, or taxation, states can be classified into domain states, rentier states, tax states, or fiscal states. Among these states, the rentier state derives the dominant share of its revenue from resource rent. Fiscal sociology argues that resource rent dependence would have a detrimental influence on state building and institutional development for several

reasons (Moore 2001, 2004). First, since the rentier state extracts revenue mainly from resource industries, it has less incentive to satisfy citizens' demands and provide public goods. The rentier state's overdependence on resources and a reduced dependence on taxation undermine its state-society connection and increase its state autonomy from the taxpayers. Since the rentier state is not heavily reliant on taxation, it would not be subject to full parliamentary scrutiny. In addition, since it can easily extract large and rich revenue rents from a relatively small number of resource enterprises, the rentier state has less incentive to develop a sophisticated bureaucratic institution and tax apparatus to fully penetrate the society (Moore 2004; Skocpol 1985). Second, the rentier state can use its rich rents to buy off citizens by providing them with benefits without a high level of taxation, making social mobilization and protest against the resource economy and government policy less likely to occur (Paler 2013). Third, also thanks to its rich resource rents, the rentier state can establish a powerful armed force to maintain internal security and keep the public demobilized (Ross 2001).

To date, research on the resource curse in the English-speaking world has gradually turned to an emphasis on the political, institutional, and fiscal factors. Nevertheless, research in China's context lags behind since most studies are still carried out primarily from the economic perspective. For example, by utilizing cross-provincial data, some studies find that the resource curse does exist in China (Hu and Xiao 2007; Shao and Qi 2009; Xu and Wang 2006; Zhang et al. 2008). In contrast, other studies based on cross-prefectural data find that the correlation between resource abundance and economic performance is not clear (Ding et al. 2007; Fang et al. 2011). These studies all adopt an economic perspective and underestimate political and institutional factors since they merely control certain political variables such as corruption (Shao and Qi 2009), government efficiency (Fang et al. 2011), and governmental intervention (Ding et al. 2007) in their statistical models.

Zhan's and Hong's articles constitute exceptions in the existing literature focusing on China's resource curse. Their studies are conducted from the viewpoint of political science and fiscal sociology. By comparing two neighboring counties in Guizhou Province and employing cross-prefectural and cross-provincial panel datasets, Zhan and Hong find that resource abundance breeds corruption, decreases government spending on human capital accumulation, and increases the likelihood of social instability (Hong 2013; Zhan 2013, 2015; Zhan et al. 2015). However, these studies still have some drawbacks in their methodology, as does the previous research by economists. First, there are still many unmeasurable or uncontrollable factors in their models, such as institutional, cultural, social, and geographical factors, which may reduce the efficiency of the models. Second, varying kinds of resources like coal, petroleum, gas, and other hard-rock minerals are often mixed together to denote a simple independent variable, making it hard to clearly separate their individual contribution to the resource curse.

Dealing with these problems and applying a theoretical framework based on political science and fiscal sociology, this paper employs a dataset of county-level governments in Shanxi Province to study how resource endowments influence the provision of local public goods. Before moving to the sections on hypothesis generation and model specification, it is necessary to briefly state the reasons for and the advantages of choosing Shanxi's county-level governments as samples.

County-level governments in Shanxi as excellent samples

Although petroleum and natural gas consumption has increased steadily in recent years, coal still remains the top energy source in China. Taking the year 2007 as an example, coal made up 70 % of all domestic energy consumption. Among the major provinces producing fossil fuel, Shanxi, Inner Mongolia, and Guizhou produce coal exclusively. Utilizing these provinces as cases can avoid the problem of mixing different kinds of resources together (see Table 1).

In addition, Shanxi has further merits. First, Shanxi Province has a long history and a large amount of coal production where coal is widely distributed among various counties. The coal in Shanxi is of high quality and makes a huge contribution to the local economy. For example, in 2012, the coal production of Shanxi was 0.913 billion tons, and the sales income was 1187 billion yuan, which nominally accounted for 98 % of the provincial GDP. It has been calculated that since 2000, the real annual contribution rates of the coal industry to Shanxi's economy have always been above 40 %, and in 2012, it was 56.6 % (Lu 2010; Liu 2013). Coal is distributed widely in Shanxi. In 2007, among 96 counties and county-level cities, 69 produced coal. Other hard-rock resource production such as iron and bauxite accounted for less than 1 % of that of coal in terms of sales. We thus do not consider other hard-rock minerals due to their small contributions. The land income of local governments also has some rentier features. Since counties and county-level cities in Shanxi are similar in their geographical locations, we can easily control the effect of land income by adding regional GDP per capita to the statistical models.

Second, in many counties, coal-related industries are the pillars of the local economy, and thus, these governments' revenues are highly dependent on coal-related rents. Among the top ten counties in terms of regional GDP, the coal sales volume of Xiaoyi,

Table 1 Fossil fuel energy production by region in 2007

Region	Coal	Crude oil	Natural gas	Region	Coal	Crude oil	Natural gas
	10,000 t	10,000 t	100 million m^3		10,000 t	10,000 t	100 million m^3
Shanxi	63020.93			Ningxia	3771.84		
Inner Mongolia	35437.94			Jilin	3354.18	623.93	5.22
Shaanxi	20353.51	2265.87	110.10	Jiangxi	2997.24		
Henan	19287.15	485.08	15.76	Jiangsu	2480.20	195.72	0.58
Shandong	14518.34	2793.05	7.84	Fujian	2050.00		
Guizhou	10864.18			Hubei	1084.26	85.54	1.17
Heilongjiang	10065.11	4169.83	25.50	Qinghai	963.64	220.66	34.02
Sichuan	9557.74	18.14	187.46	Guangxi	721.48	2.88	
Anhui	9265.65			Beijing	648.80		
Hebei	8662.98	660.01	7.14	Zhejiang	12.33		
Yunnan	7755.19		0.14	Tianjin		1924.28	13.34
Liaoning	6349.09	1207.17	8.72	Guangdong		1261.13	52.48
Hunan	6217.16			Hainan		10.66	2.03
Xinjiang	4915.52	2604.31	210.2	Shanghai		20.69	5.07
Chongqing	4293.63		5.00	Tibet			
Gansu	3949.34	82.88	0.63				

Data source: National Bureau of Statistics, 2008b

Zezhou, Gaoping, Xiangyuan, and Yangcheng in 2007 was over 10 million tons and that of Hongdong and Jiexiu was more than 4 million tons (Shanxi Statistical Bureau 2008). Hejin, a county-level city ranking first in terms of regional GDP despite its low coal sales volume, was also highly dependent on coal-related industries: the profits of non-ferrous metal, coking, and ferrous metal industries accounted for 91 % of all profits of local industrial enterprises above the designated size (Dong 2007). This high coal dependence makes the local economy vulnerable to fluctuations in coal prices and sales volume. For instance, in 2006, the economies of Gujiao and Zuoyun experienced severe recession. Their GDP annual growth rate in nominal terms was −17 and −13 %, respectively, because serious mining accidents and safety problems occurred in that year, leading to a more than 40 % decline in coal production (Dong 2007).

Similar to local economies' dependence, government revenues of resource-rich regions are also highly dependent on coal-related taxes and fees. According to the institutional arrangements of China's fiscal system, coal-related taxes are primarily collected or shared by local authorities. In addition, various non-statutory fees are charged. According to the stipulations of the Shanxi Provincial Government, four types of coal-related fees are charged: (1) 15 items approved by the central government, (2) government funds for education, forest restoration, and other purposes that were approved by the provincial government, (3) service fees for transportation, inspections, and so on, and (4) other miscellaneous fees charged by local governments and trade associations (Shanxi Provincial Government 2014). Most fees of the fourth type are charged without higher-up governments' approval, leaving local governments with significant arbitrary power to collect rents. It is estimated that besides 21 tax items, more than 88 approved and unapproved fees are collected, which together can make up 25–35 % of the coal price (Tian 2014; Zhao 2014).

Third, counties in Shanxi have few differences in ethnic, cultural, and geographic factors, making them better samples than those in Inner Mongolia or Guizhou Province. In the latter two provinces, counties vary significantly in language, culture, and ethnic composition. More specifically, Inner Mongolia has a large territory within which ethnic minorities comprise varying proportions among different areas and enjoy varying preferential policies. Guizhou also has a large proportion of ethnic minorities, and its annual coal production takes up less than one sixth of that in Shanxi. Comparatively speaking, county-level governments in Shanxi thus provide better samples.

Lastly, detailed data of the key explanatory variable are available from Shanxi Statistical Yearbooks. The books contain the sales volume of local coal enterprises (including SOEs at the under-provincial level, collective enterprises, and private enterprises) between 1994 and 2008. In 2007 and 2008, the years before many local coal enterprises were forcibly taken over by provincial- or central-level SOEs, local enterprises produced 335.87 million and 336.93 million tons of coal, respectively, accounting for more than 50 % of total production by all enterprises in each year (Shanxi Statistical Bureau 2008, 2009).[1] Even though this number cannot cover all coal production of enterprises of various ownerships within counties, we argue that using it would not produce systematic bias for the following reasons. First, provincial- and central-level coal SOEs' major mines were often located in coalfields that were also exploited by local-level enterprises (see Table 2). Provincial- and central-level SOEs usually own large mines of good quality and large quantity and leave adjacent coalfields with poorer

Table 2 Coal sales volume of local mine in 2007 (10,000 t)

Region	Sale	Region	Sale	Region	Sale	Region	Sale
Xiaoyi*	1879.23	Heshun*	467.82	Huozhou*	204.71	Pinglu	31.33
Liulin*	1588.65	Hequ	456.43	Yicheng	203.35	Fenyang	29.33
Baode*	1365.60	Puxian*	429.94	Jiaokou	202.29	Hunyuan	27.79
Gaoping*	1256.87	Jiexiu*	427.60	Lingchuan	155.36	Fushan	25.32
Yuxian*	1255.82	Hongtong	426.02	Tunliu*	142.22	Pianguan	19.50
Yangcheng	1216.92	Qinyuan*	425.56	Pingyao	140.60	Datongxian	16.29
Shanyin	1208.00	Xiyang*	413.03	Jiaocheng*	127.69	Loufan	13.31
Zezhou*	1063.06	Anze	381.06	Jixian	104.15	Shilou	11.21
Xiangyuan*	1001.57	Xingxian	372.25	Yuanping*	102.30	Xixian	9.08
Changzhi*	962.97	Fangshan	369.98	Taigu	100.80	Guangling	5.61
Xiangning*	910.66	Gujiao*	361.50	Jingle	89.38	Wutai*	2.15
Shouyang*	909.24	Linxian*	353.34	Hejin	82.13	Shenchi	1.99
Lingshi*	750.80	Zhangzi*	348.20	Huguan	80.12	Licheng	0.17
Zuoyun*	716.15	Pingding*	341.34	Lanxian	68.37	Yangqu	0.10
Ningwu*	560.82	Youyu	327.90	Fenxi	49.60	Xiangfen	0.02
Qinshui*	534.31	Zhongyang	311.72	Lucheng	46.02		
Wuxiang	494.87	Zuoquan	308.27	Wenshui	34.31		
Guxian	485.28	Huairen*	252.49	Daning	33.68		

Note: (1) Regions marked with * are county-level areas in which some large mines owned by central- and provincial-level state-owned coal enterprises were located
(2) Data sources: Shanxi Statistical Bureau, 2008; Chang et al. 2007; State Administration of Work Safety and Coal Mine Safety, 2014

quality and lower quantity to the local enterprises. Due to their geographical overlapping, competition between enterprises of various ownership were often fierce, and disputes sometimes broke out when local-level enterprises encroached on the mining area of central- and provincial-level SOEs. Concerned about losing their market shares, the latter often criticized local-level enterprises, especially those that were privately owned, and reported them to the regulation authorities on the grounds that the local enterprises often disobeyed work-safety rules (Wright 2012). Second, according to China's fiscal rules, central- and provincial-level SOEs have to directly hand over their assigned taxes and fees to the higher-up governments, which alleviates their possible detrimental influences on local governments' behaviors.

For these reasons, we can use the volume of coal sales to calculate to what extent the economy of a specific county relies on coal production by multiplying the volumes with the annual average price of coal and then obtain its share in local GDP. This calculating method of what we call the Coal Dependence Index (CDI) has been widely used in previous research as an indicator of resource dependence (Davis 1995).

Hypotheses, data, and method

Hypotheses

It is widely accepted that taxation in modern states should be based on bilateral agreements in which governments deliver public services in exchange for citizens' agreement to levies. Since taxation is often the key to a country's state capacity and policy implementation, governments often want to exploit it as much as possible. However, taxation

also has a distortion effect in that if governments levy on citizens excessively, it will hinder economic efficiency; in theory, citizens may vote with their feet by choosing to move away. For this reason, no government can levy significantly more taxes than its neighboring governments because it could lead to the outflow of labor and capital (Besley and Case 1995; Tiebout 1956).

In reality, according to China's current Tax Sharing System (TSS) in effect from 1994, under-provincial local governments have little if any arbitrary power to adjust tax rates. The adoption of TSS was designed with the purpose of increasing the central government's share of revenue, which has been successfully achieved. Facing the shortage of fiscal revenue caused by the TSS reform, many provinces similarly introduced intraprovincial fiscal system reforms and concentrated more revenue on the provincial and prefectural levels, leaving county-level and township-level governments with severe fiscal revenue shortages. As a consequence, numerous county- and township-level governments cannot cover public expenditures with their own fiscal revenue and thus have to rely on intergovernmental transfer to fill the gaps. This vertical fiscal imbalance has pushed local governments to develop new ways to make money, such as land finance. Things are different for Shanxi's coal-rich local governments. They can easily extract rich rents from coal-related activities through tax and fee collection. Therefore, the degree of fiscal autonomy of coal-rich local governments is expected to be higher than their coal-poor counterparts. In addition, as mentioned above, miscellaneous coal-related fees and charges are collected. Since they are listed as nontax revenues in the government budget, it can be expected that coal-rich local governments tend to have higher ratios of nontax revenues to total revenues. Utilizing detailed data from *Fiscal Statistics of Prefectures, Cities and Counties 2007*, we measured the degree of fiscal autonomy of local governments by calculating the proportion of their total budgetary revenue to total budgetary spending and measured the nontax revenue ratios by calculating the proportion of nontax revenue to total budgetary revenue. We then drew two scatterplots, using these two variables as dependent variables, and the Coal Dependence Index as the independent variable. These figures demonstrate that the degree of fiscal autonomy and nontax revenue ratios are positively correlated with the Coal Dependence Index, and these correlations still hold if we further include control variables of GDP per capita, population, land-area size, and urbanization ratio (not shown). These results illustrate that coal-related taxes and fees serve as rents for Shanxi's coal-rich local governments. We can thus accordingly propose hypotheses based on the explanations of political shortsightedness and state centralism (Fig. 1a, b).

Chinese governments exercise various state functions that can be categorized into administrative, law and order, economic development, and social development functions (Zhang 2012). The term "administrative function" refers to daily government maintenance and operation activities that support other government functions. The law and order function works to protect citizens from foreign attack and domestic disorder. The economic development function promotes economic development and stabilizes the macroeconomy. The social development function, which emerged most recently, serves to promote citizens' welfare, well-being, and humanitarian development, which includes government services in education, science and technology, cultural development, healthcare, social security, and environmental protection. Whether this function works well is the key to citizens' livelihood and whether citizens enjoy full social rights

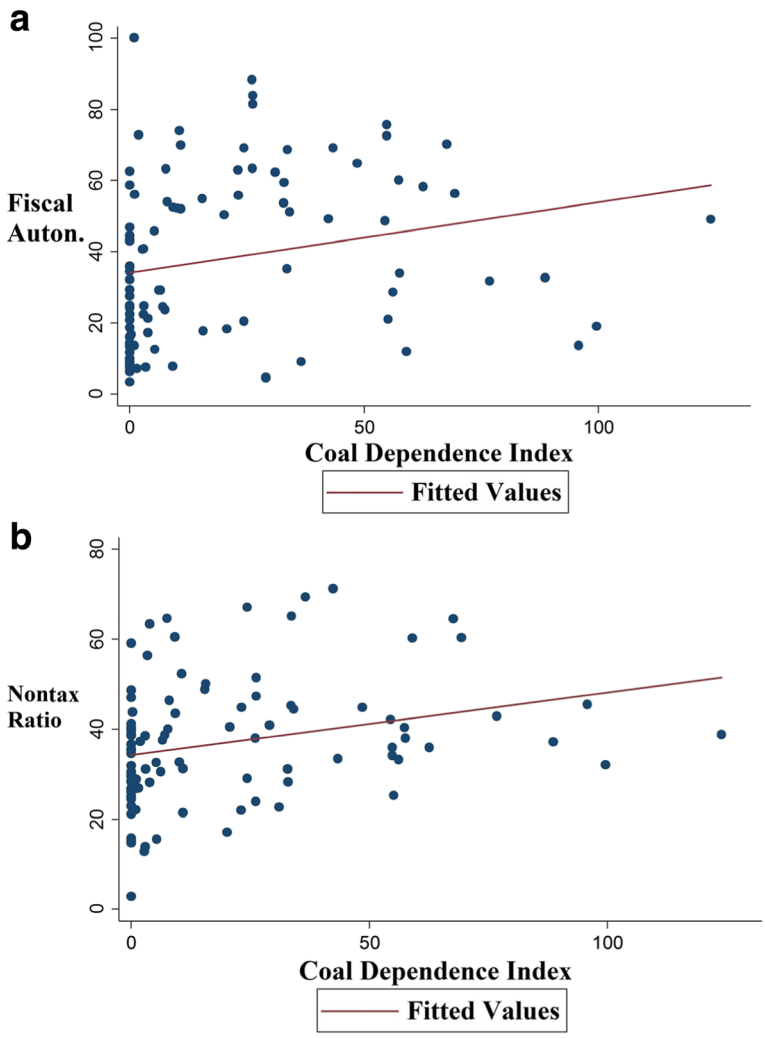

Fig. 1 **a** Coal Dependence Index and degree of fiscal autonomy. **b** Coal Dependence Index and nontax revenue ratio

and decent lives (Esping-Andersen 1990; Marshall 1950). The term "public goods provision" used in this paper mainly focuses on this function. Existing studies typically use three methods to measure the performance of public goods provision (Jia and Lu 2010). The first method is to investigate how much money a government allocates to a certain item, which reveals whether this issue is high on the list of policy priorities. Second, scholars use intermediate output indicators to measure the level of public goods provision. For example, we can use student-teacher ratio and medical beds per capita to measure the levels of education and medical service, respectively. The third method is to examine performance improvement after receiving public services. For instance, we can use the illiteracy rate and average life expectancy to measure the levels of education and medical service, respectively. Each method has its merits; the first method is the most direct one since governments' fiscal capacities are often limited, and the relative shares that a government spends on certain items can reflect their relative position on the list of policy priorities. We thus adopted the first method. According to the new classification of revenue and expenditures adopted by China's fiscal

authority since 2007, we combined public expenditures on education; science and technology; culture, sports, and media development; social security and employment; healthcare; and environmental protection as social expenditures (Ministry of Finance 2006).

How does abundant coal influence social expenditures? According to Wagner's Law, as personal income grows, government functions will also extend, and public expenditures on education, culture, healthcare, and social welfare will accordingly increase (Wagner 1958). However, according to the state-centralism explanation of fiscal sociology, since the economic development of Shanxi's coal-rich counties and their fiscal revenues rely heavily on coal-related rents, the governments will have higher state autonomy and will be less accountable to the public. These governments will thus spend less on social affairs. If this is the case, we could see that the shares of social expenditures are negatively correlated with the Coal Dependence Index.

In addition to the state-centralism explanation, the cognitive explanation argues that rent dependence will generate political shortsightedness among policy makers in specific policy areas. Education is fundamental to human capital accumulation in the long term, and spending on education usually accounts for the largest share of a county's total expenditures. In coal-rich areas, satisfied by the decent coal-related income, many people become "locked" into low-skill intensive coal-based industries and thus have a lower willingness to pursue schooling. Likewise, local governments, satisfied by rich coal rents, may devote inadequate attention to human capital development (Gylfason 2001). We therefore expect that governments with more coal resource will spend less on education. Social security and healthcare are also beneficial to human capital development since the social safety net could protect individuals from falling into extreme poverty, but because of the political myopia brought by rich coal rents, coal-rich governments may underprovide these public services. We thus expect that governments with more coal resources will spend less on social security and healthcare.

Coal production is often linked to deforestation and pollution. According to China's Coal Law and Environmental Law, coal enterprises have an obligation to take measures such as reforestation and sewage treatment to address these issues. Since environmental protection is a kind of public good, coal-rich governments should not only closely monitor the coal mines but also devote some money to addressing environmental problems. If this is the case, it should be found that governments with more coal resources will spend more on environmental protection. However, the coal-rent dependence of governments and the rampant rent-seeking activities within coal-related industries may result in an inverse relationship between coal abundance and environmental protection spending since coal-rich governments may intentionally implement environmental laws laxly. Statistical results will show which hypothesis is the real case. We thus propose the following hypotheses.

Hypothesis 1: The higher the Coal Dependence Index, the lower the share of social expenditures in total government expenditures.
Hypothesis 1a: The higher the Coal Dependence Index, the lower the share of education expenditures in total government expenditures.
Hypothesis 1b: The higher the Coal Dependence Index, the lower the share of social security and healthcare expenditures in total government expenditures.

Hypothesis 1c: The higher the Coal Dependence Index, the higher (or lower) the share of environmental protection expenditures in total government expenditures.

After proposing these hypotheses on social expenditures, we turn to analyzing how coal rents affect administrative expenditures. Public choice theory argues that rational government bureaucrats will always seek to increase their budgets in order to increase their own power (Krueger 1974; Niskanen 1971; Tullock 1965). With the economic development and administrative reform after 1978, China's government institutions have become "fragmented" and rationalized, which provide room for bureaucrats to pursue their own interests (Lieberthal and Oksenberg 1988). Coal mining and production are policy fields in which many regulators such as administrators in work safety, industry and commerce, tax, and environmental protection are involved. In coal-rich areas, this extensive involvement provides those regulators with many opportunities to seek rents. Coal enterprises, willing to reduce costs by adopting lower safety and environmental protection criteria, also seek rents from government officials. As a consequence, collusions between self-interested government officials and coal enterprises should be easily found in coal-rich areas. The possible methods of collusion include corruption during the licensing process, lax regulation implementation, and even shared ownership of coal enterprises by government officials, all of which may lead to more coal safety accidents and extensive corruption in governments (Nie et al. 2013; Wright 2012). One way to examine whether this is the case is to investigate whether the administrative expenditures in coal-rich local governments are higher than their coal-poor counterpart areas. In China's current classification of revenue and expenditures, administrative expenditures are listed as an item of "general public service." According to the explanatory notes given by Ministry of Finance, it includes the basic operation expenditures of administrative departments such as the local party committee, the government general office, the bureau of finance and tax, industry and commerce, and work safety. Besides the proposition of more collusion, the state-centralism explanation of fiscal sociology argues that since rich fiscal revenues are extracted from coal mines rather than from ordinary taxpayers, coal-rich governments have fewer incentives to satisfy public demands and have more arbitrary power on budgetary decisions relative to legislation. This higher degree of state autonomy helps government officials serve their own interests by spending more on administrative expenditures. We thus propose:

Hypothesis 2: The higher the Coal Dependence Index, the higher the share of administrative expenditures in total expenditures.

Data and method

Detailed data on local coal sales volumes are available from the *Shanxi Statistical Yearbooks* before 2008. Since 2009, many local coal enterprises were forcibly taken over by provincial- or central-level SOEs and the data is no longer available. Since fiscal items adopted by the fiscal authorities from 2007 on are not comparable to those from earlier, and the *Fiscal Statistics of Prefectures, Cities and Counties* can only provide detailed data for 2007 (not available in 2008 and 2009), this study employs a cross-sectional dataset comprised of 96 counties and county-level cities in 2007. We

calculated the Coal Dependence Index by multiplying the local sales volumes with annual average coal prices and then divided them by the local GDP (Davis 1995).[2] The shares of various public expenditures were measured by expenditures on various policy fields divided by local total expenditures. As explained earlier, social expenditures include the fiscal items of education; science and technology; culture, sports, and media development; social security and employment; healthcare; and environmental protection. Within the social expenditures category, education expenditures and environmental protection expenditures refer to the items of education and environmental protection, respectively; social security and healthcare expenditures are the sum of the items social security and employment and medical and healthcare. Administrative expenditures come from the item "general public service" (Ministry of Finance 2006).

Figure 2a, b presents two scatterplots. They suggest that, in line with our expectations, the share of social expenditures is negatively correlated with the Coal Dependence Index and the share of administrative expenditures is positively correlated with CDI.

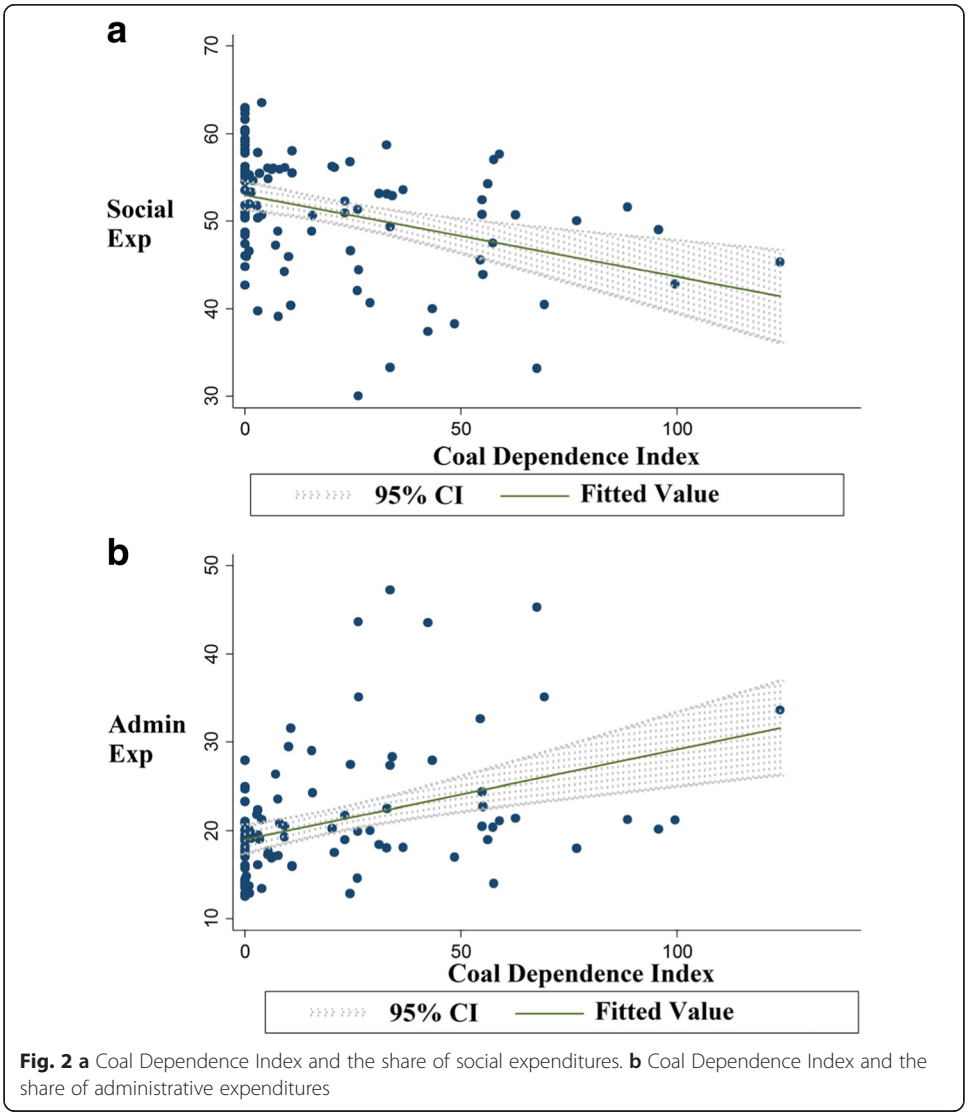

Fig. 2 **a** Coal Dependence Index and the share of social expenditures. **b** Coal Dependence Index and the share of administrative expenditures

To further test the aforementioned hypotheses, we present a branch of regression models employing a cross-sectional dataset of Shanxi Province counties and county-level cities in 2007. The basic regression model is:

$$\ln Y_i = \alpha + \beta \ln \mathrm{Coal}_i + \gamma \ln \mathrm{Control}_i + D\mathrm{dummy} + \varepsilon_i$$

where i is the county (or county-level city); Y_i are our dependent variables, i.e., the shares of various expenditures in total expenditures; α is the constant; Coal_i refers to the Coal Dependence Index, the key independent variable in this paper; and β is its coefficient. $\mathrm{Control}_i$ denotes a vector of control variables, and γ are their coefficients. The term *dummy* denotes the administrative level of counties, and D is its coefficient. The term ε_i is the random error.

Other than the key independent variable, we introduced a series of control variables such as GDP per capita, the ratio of urban population, total population, land-area size, and a dummy variable of county-level city (see Table 3). GDP per capita and the ratio of urban population to total population are the proxies for economic development. Total population and land-area size were used to control the scale effect. The dummy variable of administrative level was coded as 1 if it is a county-level city and ordinary counties were coded as 0. In addition, in specific models, some other variables were further controlled, such as transfer dependency (the ratio of budgetary fiscal transfers to total expenditures), the number of students in elementary and middle school per 10,000 persons, and the number of hospital beds per 10,000 persons (both are proxies for the demands of local public services). Except for the dummy variable, all variables were logged to alleviate heteroscedasticity. Potential endogeneity problems could arise

Table 3 Descriptive summary of variables (2007)

Variables	Mean	Std. dev.	Min	Max
Independent variables				
Coal Dependence Index (%)	20.33	27.02	0	123.954
GDP per capita (yuan)	13061.03	8639.64	2357	49,566
Ratio of urbanization (%)	30.70	10.02	12.240	70.640
Total population (person)	257380.40	132707.30	62,201	740,341
Land area (km^2)	1471.09	589.32	221	3166
County-level city (dummy variable)			0	1
Transfer dependency (%)	61.946	23.403	0	96.542
Number of students in primary and middle school (per 10,000 persons)	1732.632	280.900	1212.391	2766.479
Number of beds in healthcare institutions (per 10,000 persons)	24.909	10.249	6.363	56.789
Dependent variables				
Share of social expenditures (%)	51.062	7.018	30.033	63.490
Share of education expenditures (%)	23.999	4.919	13.850	37.608
Share of social security and healthcare expenditures (%)	19.533	4.986	8.909	31.523
Share of environmental protection expenditures (%)	5.337	3.222	0.987	15.652
Share of administrative expenditures (%)	21.039	7.171	12.489	47.244

Notes: (1) $N = 96$. When calculating the shares of various expenditures in total expenditures, both budgetary and extrabudgetary expenditures were included. The share of own revenues in expenditures in the Hejin county-level city of Yuncheng is 117 %, and we take it as 100 %. Its transfer dependency (the ratio of transfers to total expenditures) is then 0 %. Therefore, we took the log of transfer dependency as log $(x + 1)$. Similarly, when taking the log of the Coal Dependence Index, we used the same method

(2) Data source: Ministry of Finance, 2011; National Bureau of Statistics, 2008a, c; Shanxi Statistical Bureau, 2008

since government spending may have reverse impacts on economic development and coal sales. To deal with this empirical challenge, we also ran two-stage least squares (2SLS), using a 1-year lag of the Coal Dependence Index and 1-year and 2-year lags of GDP per capita as instruments in the regression. These instrumental variables satisfy two conditions: (1) they are not correlated with the error term in the model; (2) they are partially correlated with the endogenous explanatory variables.

Results and discussion

Results

Tables 4 and 5 present empirical results obtained by using Ordinary Least Square (OLS) and 2-Stage Least Square (2SLS) estimates. In the over-identifying test, the *p* values of Hansen J statistics are larger than the critical value of 0.05, indicating that the instruments adopted are all exogenous and valid. The Cragg-Donald Wald F statistics for weak identification test are far higher than 19.9, and their significant levels are under the

Table 4 Coal dependence and various government expenditures in Shanxi Province (2007)

	Share of social expenditures		Share of administrative expenditures	
	(1) OLS	(2) 2SLS	(3) OLS	(4) 2SLS
Coal Dependence Index	−0.027***	−0.032***	0.078***	0.081***
	(0.008)	(0.008)	(0.016)	(0.017)
GDP per capita	0.050	0.078**	−0.004	−0.042
	(0.038)	(0.039)	(0.078)	(0.079)
Transfer dependency	0.136**	0.151**	−0.091	−0.116
	(0.062)	(0.064)	(0.116)	(0.121)
Ratio of urbanization	−0.029	−0.046	−0.131	−0.105
	(0.062)	(0.060)	(0.105)	(−0.099)
Total population	0.096***	0.094***	−0.137***	−0.136***
	(0.024)	(0.023)	(0.051)	(−0.049)
Land area	0.043	0.057*	−0.097	−0.113*
	(0.031)	(0.029)	(0.066)	(−0.065)
County-level city	0.088	0.099*	−0.163	−0.180*
	(0.061)	(0.060)	(0.112)	(0.108)
Number of students	0.121	0.123		
	(0.107)	(0.102)		
Number of hospital beds	−0.001	−0.003		
	(0.025)	(0.032)		
Constant	0.661	0.327	6.100***	6.56***
	(1.187)	(1.142)	(1.415)	(1.467)
R square	0.3862	0.3803	0.3473	0.3448
Hansen *J* test *p* value		0.3225		0.6684
Cragg-Donald Wald F		262.06		253.65
Hausman specification P		0.0207		0.2171

Notes: (1) $N = 96$. Except for the administrative level dummy, all variables are in logarithms. Numbers in table are unstandardized coefficients. White's heteroscedasticity-robust standard errors are in parentheses below the coefficients
(2) $*p < 0.10$, $**p < 0.05$, $***p < 0.01$

Table 5 Coal dependence and various government expenditures in Shanxi Province (continued, 2007)

	Share of education expenditures		Share of social security and healthcare expenditures		Share of environmental protection expenditures	
	(5) OLS	(6) 2SLS	(7) OLS	(8) 2SLS	(9) OLS	(10) 2SLS
Coal Dependence Index	−0.017	−0.025**	−0.035**	−0.034**	−0.080**	−0.083**
	(0.012)	(0.012)	(0.016)	(0.017)	(0.037)	(0.037)
GDP per capita	0.040	0.042	0.026	0.073	0.051	0.071
	(0.042)	(0.041)	(0.081)	(0.083)	(0.142)	(0.141)
Transfer decency	0.096*	0.089*	0.273**	0.307**	−0.132	−0.122
	(0.057)	(0.050)	(0.114)	(0.125)	(0.089)	(0.086)
Ratio of urbanization	−0.230***	−0.227***	−0.120	−0.088	0.312	0.300
	(0.068)	(0.064)	(0.120)	(0.119)	(0.253)	(0.244)
Total population	0.243***	0.239***	0.170***	0.169***	−0.598***	−0.600***
	(0.034)	(0.033)	(0.051)	(0.050)	(0.115)	(0.112)
Land area	0.035	0.046	0.033	0.046	0.293**	0.305**
	(0.046)	(0.044)	(0.059)	(0.056)	(0.140)	(0.139)
County-level city	0.134*	0.130*	0.026	0.050	0.109	0.116
	(0.079)	(0.075)	(0.098)	(0.096)	(0.253)	(0.242)
Number of students	0.244**	0.240**				
	(0.120)	(0.115)				
Number of hospital beds			0.144**	0.139**		
			(0.064)	(0.061)		
Constant	−1.872	−1.863	−1.534	−2.071	5.910**	5.671**
	(1.192)	(1.123)	(1.504)	(1.537)	(2.290)	(2.242)
R square	0.4801	0.4774	0.3692	0.3649	0.2989	0.2987
Hansen *J* test *p* value		0.5686		0.7686		0.0642
Cragg-Donald Wald F		257.339		256.269		253.652
Hausman specification P		0.0464		0.0364		0.8909

Note:(1) $N = 96$. Except for the administrative level dummy, all variables are in logarithms. Numbers in table are unstandardized coefficients. White's heteroscedasticity-robust standard errors are in parentheses below the coefficients (2) $*p < 0.10$, $**p < 0.05$, $***p < 0.01$

critical value of 0.05. They indicate that the null hypothesis that the instruments are weak can be rejected (Stock and Yogo 2005).

The results estimated by OLS and 2SLS are quite consistent. Considering which results are preferred, we used the Durbin-Wu Hausman test. The *p* values of this test between models 1 and 2, models 5 and 6, and models 7 and 8 are smaller than 0.05. We therefore reject the null hypothesis and believe the estimators of 2SLS are better, thus models 2, 6, and 8 are preferred. The *p* values of this test between models 3 and 4 and models 9 and 10 are larger than 0.05. We thus believe that there is no significant difference between the OLS and 2SLS estimators and adopt the OLS estimators (models 3 and 9) since they are more efficient (Hausman 1978). The R-squared of these models indicate that 30 to 48 % of the variation in the dependent variables can be explained.

Model 2 shows that the coefficient of the Coal Dependence Index is negative and statistically significant at the 1 % level. This result conforms to the expectant hypothesis of state-centralism explanations. Among other control variables, transfer dependency is positive and statistically significant, which suggests that transfers from upper levels

could stimulate local governments to increase the share of social expenditures in total expenditures. The coefficients of GDP per capita, population, and county-level city are positive and statistically significant, suggesting that local governments with higher economic development will spend more on social affairs. The coefficient of land area is positively significant at the 10 % level, which implies that as the land-area size increases, local governments will increase public spending on social affairs.

For administrative spending, model 3 shows that, as expected, coal dependence has a significant positive effect on the share of administrative expenditures in total expenditures. Among the 96 county-level governments, administrative expenditures averagely account for 21 % of total expenditures, a smaller percentage than that of social expenditures, which is 51 % (see Table 4). However, the coefficient of the Coal Dependence Index on the former is 0.078, while on the latter, it is −0.032. This shows that administrative expenditures are more sensitive to the coal economy. For control variables, the coefficient of total population is positive and statistically significant, which suggests that there is a scale economy in administrative spending. The negative coefficients of land area and county-level city dummy, although not statistically significant at the 10 % level, also suggest the effect of scale economy.

We now turn to the specific expenditures in the social expenditures category. The results of models 6 and 8 in Table 5 indicate that, as expected, coal dependence has a detrimental effect on both education expenditures and social security and healthcare expenditures. Among other control variables, the coefficients of transfer dependency are significant, suggesting that fiscal transfers can incentivize local governments to provide more public goods services. The coefficients of the number of students in primary and middle school and the number of beds in hospital institutions are positive and statistically significant at the 10 % level, indicating that local governments with larger demands of education and healthcare do spend more on these affairs.

As the law and regulation stipulate, coal-rich governments should devote more money to address coal production-related environmental problems. The results of model 9 are exactly the opposite: governments with more coal endowments spend significantly less on environmental protection, conforming to the explanations of state autonomy and political shortsightedness. On average, environmental expenditures account for 5.3 % of total expenditures among all county-level governments in Shanxi. Compared to education expenditures (24 %) and social security and healthcare expenditures (19.5 %), it is a relatively small expenditure category (see Table 5). However, the coefficient of coal dependence on it stands at −0.080, far larger than that on education spending (−0.025) and on social security and healthcare (−0.043), which suggests that governmental decisions on environmental spending are more sensitive to coal endowment. For other control variables, the coefficient of population is significantly negative and that of land-area size is significantly positive. This implies that there is also a scale economy in environmental protection since the efficiency of environmental spending would increase in an area with a larger population but smaller land-area size. In addition, it is much easier for areas with a small land-area size to free ride the efforts of their neighboring areas, while those with a large land area have to be more self-sufficient.

Discussion

Having provided some evidence in favor of the proposed hypotheses, we now further analyze the transmission channels through which they take place. Local governments in

Shanxi can easily extract rich revenues from the coal-related industries. Since these rich resource rents can cover a larger share of their own expenditures, coal-rich local governments are less dependent on tax extractions and have higher degrees of state autonomy. They are thus less accountable to their taxpayers and less willing to satisfy citizens' social demands. In addition, since local governments could easily extract rich rents from a relatively small number of coal enterprises and from extrabudgetary fees and charges, the budgets of coal-rich local governments are subject to little scrutiny from local People's Congresses. Extensive government regulation of the coal industries creates red tape and generates room for rent-seeking activities and collusion among regulators and regulated firms. More spending on administration can thus be found as local government officials pursue their own individual interests.

Education is an important public service for accumulating human capital. Among China's local governments, education spending usually accounts for the largest portion of county expenditures. The field study we conducted found that the relation between coal endowment and education expenditures is tricky. For example, coal-rich counties often have a better educational infrastructure, and a few counties can even offer free high school education. How then can the negative impact of coal dependence in the statistical model be explained, which runs counter to our field observations? Several reasons may explain this. First, as is the tradition in the era of planned economy, some state-owned coal enterprises may run primary and middle schools themselves for their workers' children. By doing so, they shoulder some of the public service burdens that local governments normally provide. Since their education spending would not be listed in the government budget, coal-rich county governments may have a lower share of educational expenditures. Second, coal endowments tend to decrease local citizens' willingness to pursue education. Similar to previous studies, we find people in coal-abundant areas can easily earn a decent income through various ways related to the coal production. For instance, they can provide food, transportation, security, and other logistical services to coal enterprises, or work as miners or even as shareholders. Most of these jobs do not require higher education degrees. Local habitants are thus locked into low-skill intensive coal industries and local governments accordingly devote less spending to education (Gylfason 2001; Zhan et al. 2015). Since coal-rich areas will eventually run out of their coal resources, these governments should overcome this political shortsightedness and transfer more coal rents into education spending to accumulate human capital.

Expenditures on healthcare and social security are also a kind of human capital investment. They are especially beneficial to disadvantaged individuals since they play an important role in promoting and maintaining people's health conditions and ability to work. Coal mining poses occupational hazards to coal miners since miners are exposed to particulate matter (PM), dust, noise, chemicals, and elemental toxins in coal-mining activities. Previous studies in the USA find that residents in close proximity to coal mines are associated with poorer health status and higher risk for hypertension, cardiopulmonary disease, kidney disease, and chronic lung disease (Hendryx and Ahern 2008; Hendryx et al. 2007). China's Coal Law clearly states that governments and coal enterprises must take measures to protect workplace safety and labor health (Article 8). However, the statistical results show that coal-rich county-level governments actually spend less on healthcare and social security. There are several reasons for this. First, as

the explanations of political shortsightedness and state centralism argue, coal-rich governments tend to neglect the importance of human capital investment and are less responsive to citizens' demands. Second, similar to the reasons for less education expenditures, some large state-owned coal enterprises run their own hospitals, which reduce the governments' expenditures. Third, in field studies, we find that local mines, especially small and private ones, often recruit nonlocal miners based on short-term contracts to reduce their expenditures on social security and healthcare. Unlike large SOEs with soft budget constraints, small and private coal enterprises are more sensitive to the fluctuations of coal prices and demand. By employing miners on an interim basis, they can lower their operational costs. In addition, coal-mine owners prefer nonlocal miners because nonlocals are easier to manage and less likely to engage in labor disputes. When we asked nonlocal miners the reasons why they worked there, many of them stated that they were not well educated and only qualified to do low-skilled work. They are clearly aware of the potential hazards they are facing but are still willing to work because of the relatively decent salary. Their only alternative is to work as farmers for less income. Due to China's household registration system, local governments usually provide little healthcare and social security services to nonlocal workers. Since the proportion of nonlocal coal miners in coal-rich areas tends to be higher, the governments thus spend less on healthcare and social security (Wright 2012; Chen and Zhang 2016).

Coal-mining activities give rise to environmental deterioration and pollution, for which governments are expected to take some countermeasures. However, the statistical results show that as the Coal Dependence Index increases, government spending on environmental protection actually decreases. How can this unexpected result be explained? In the era of planned economy, coal mines were exclusively owned by large state-owned and collective-owned enterprises, and the volume of coal mining was usually low due to the limited demand. As a consequence, at that time, coal production did not cause severe environmental damage. With the rapid economic growth, reform of state-owned enterprises, and the opening of market, the demand for coal production has continuously increased since the mid-1990s. During this period, the number and production volume of local private mines quickly increased and are often under lax supervision. Owing to their private property rights, private mines often have fewer corporate social responsibilities than state-owned and collective mines, resulting in a more environmental damage (Wang and Jin 2007). Since mining in urban areas is strictly limited, local mines especially the private ones, usually exploit rural and township areas. Since the environmental damage caused in these areas often bring less public complaints and it is difficult for upper-level governments to monitor the law-breaking officials, coal production in these areas is often characterized by more collusion between the regulators and the regulated enterprises. In other words, in order to maximally utilize production capacity and earn as much as possible, coal-mine owners often seek rents from the regulators at the cost of the environment. The deteriorating environment has caught the attention of Shanxi's provincial government. Its official documents have admitted several times that coal mining in Shanxi Province has caused severe environmental damage and more efforts should be devoted to protecting the environment in coal-producing areas (Shanxi's General Office of Provincial Government 2007; Shanxi's Development and Reform Commission of Provincial Government 2013).

Conclusion

What are the transmission channels of the resource-curse hypothesis? Employing a dataset of Shanxi's county-level governments and using cross-sectional regressions, we studied the transmission channels through which natural-resource abundance affects governmental fiscal behaviors. We found that in coal-abundant areas, the fiscal revenues of local governments rely more on resource rents. Based on the hypotheses proposed by the explanations of political shortsightedness and state centralism, we explored how rich coal resources affect governments' provision of public goods. We found that due to their higher state autonomy and lower responsiveness to social demands, coal-rich county-level governments spend significantly less on social expenditures, as well as the specific expenditures of education, environmental protection, and social security and healthcare. At the same time, coal-rich governments tend to have a higher share of administrative expenditures in total expenditures. Through these analyses, this paper sheds new light on the causal mechanisms of the resource-curse hypothesis in China's context.

Some measures can be taken to cope with the resource-curse problem. In recent years, since many small-size coal mines in Shanxi have been shut down or taken over by large state-owned coal enterprises, the implementation of work-safety regulations has improved substantially. However, problems like mining accidents, health hazards to miners, neglect of human capital investment, and environmental deterioration are still pervasive. To deal with them, coal-abundant areas should better utilize their rich coal rents and devote more expenditures to human capital accumulation. In the fiscal system area, China has started the reform of coal taxes, transforming coal-related fees into taxes and increasing the central government's share of coal taxes (Ministry of Finance and State Administration of Taxation 2014). By doing so, China can ease the detrimental effect of resource rent on local government behaviors. Further measures should also be considered, such as better fiscal information disclosure.

Due to the limited availability of research data, this paper only employed a cross-county dataset from 2007. Future studies could extend the time period and choose other cases. For other transmission mechanisms, future studies can discuss whether and to what extent resource rents affect the promotion opportunities of local officials, the rampancy of corruption, and the Gini coefficient of residents' income. Since Shanxi's local governments will eventually run out of coal resources, future studies could also address the questions of how the local industrial structure can be transformed, and how local governments can then collect enough revenue.

Endnotes

[1]There are seven provincial-level state-owned coal enterprises and two central-level state-owned coal enterprises in Shanxi. See State Administration of Work Safety and Coal Mine Safety 2014.

[2]In China, the price of coal is divided into thermal and commercial coal. Guided by state policy, thermal coal is cheaper than commercial coal. We used the price of thermal coal in 2007, 230 yuan per ton (230 yuan ≈ 34.40 USD) (Pan 2008). It is conservative to use the price of thermal coal because this does not overestimate the influence of coal production on local economic development.

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Authors' contributions
YZ and GZ conceived the design of the study. YZ carried out the data collection, data cleaning, and statistical analyses. YZ wrote the initial draft. YZ and GZ both revised the paper. Both authors read and approved the final manuscript.

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The authors declare that they have no competing interests.

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References

Auty, Richard M. 1993. *Sustaining development in mineral economies: the resource curse thesis*. London: Routledge.
Benjamin, Nancy C., Shantayanan Devarajan, and Robert J. Weiner. 1989. The "Dutch Disease" in a developing country: oil reserves in Cameroon. *Journal of Development Economics* 30(1): 71–92.
Besley, Timothy, and Anne Case. 1995. Incumbent behavior: vote-seeking, tax-setting, and yardstick competition. *American Economic Review* 85(1): 25–45.
Chang, Yijun, Junming Cui, and Xuezhi Gui. 2007. *Coal resource and valuation of its exploitation strategy*. Beijing: China Coal Industry Publishing House (in Chinese).
Chen, Jiajian, and Qiongwen Zhang. 2016. Fluctuating policy implementation and problems in grassroots governance. *The Journal of Chinese Sociology* 3: 1–19.
Collier, Paul, and Anke Hoeffler. 2004. Greed and grievance in civil war. *Oxford Economic Papers* 56(4): 563–595.
Collier, Paul, and Anke Hoeffler. 2005. Resource rents, governance, and conflict. *Journal of Conflict Resolution* 49(4): 625–633.
Davis, Graham A. 1995. Learning to love the Dutch Disease: evidence from the mineral economies. *World Development* 23(10): 1765–1779.
Ding, Juhong, Yongqin Wang, and Kebin Deng. 2007. Whether "resource curse" occurs in China's economic development. *The Journal of World Economy* 9: 38–46 (in Chinese).
Dong, Xiaoling. 2007. Deep thinking of economic development of Shanxi's counties. Available at http://www.stats-sx.gov.cn/html/2008117215.html (in Chinese).
Esping-Andersen, Gosta. 1990. *The three worlds of welfare capitalism*. Princeton: Princeton University Press.
Fang, Ying, Yan Ji, and Zhao Yang. 2011. Whether "resource curse" occurs in China. *The Journal of World Economy* 4: 144–160 (in Chinese).
Gelb, Alan H. 1988. *Oil windfalls: blessing or curse?* New York: Oxford University Press.
Gylfason, Thorvaldur. 2001. Natural resources, education, and economic development. *European Economic Review* 45(4-6): 847–859.
Hausman, Jerry A. 1978. Specification tests in econometrics. *Econometrica* 46(6): 1251–1271.
Hendryx, Michael, and Melissa M. Ahern. 2008. Relations between health indicators and residential proximity to coal mining in West Virginia. *American Journal of Public Health* 98(4): 669–671.
Hendryx, Michael, Melissa M. Ahern, and Timothy R. Nurkiewicz. 2007. Hospitalization patterns associated with Appalachian coal mining. *Journal of Toxicology and Environmental Health, Part A* 70(24): 2064–2070.
Hong, Ji Yeon (Jean). 2013. How natural resource endowments affect the provision of local public goods and services: evidence from Chinese prefectural cities. Unpublished working paper.
Hu, Yuancheng, and Deyong Xiao. 2007. The threshold of economic growth and the natural resource curse. *Management World* 4: 15–23 (in Chinese).
Jia, Zhilian, and Hongyou Lu. 2010. Fiscal decentralization and effective supply of education and public goods of the people's livelihood. *The Journal of Quantitative & Technical Economics* 6: 139–150 (in Chinese).
Johnson, Ronald N. 2006. Economic growth and natural resources: does the curse of natural resources extend to the 50 US States. In *Explorations in environmental and natural resource economics*, ed. Robert Halvorsen and David F. Layton, 122–136. Cheltenham: Edward Elgar.
Krueger, Anne. 1974. The political economy of the rent-seeking society. *American Economic Review* 64(3): 291–303.
Lieberthal, Kenneth, and Michel Oksenberg. 1988. *Policy making in china: leaders, structures, and processes*. Princeton: Princeton University Press.
Liu, Zhigang. 2013. Sales income of coal set a record at one trillion in Shanxi in 2012. *China Mining News,* Feb. 18 (in Chinese).
Lu, Jianming. 2010. *Energy economy in Shanxi for 60 years*. Beijing: China Statistic Publishing House (in Chinese).
Marshall, Thomas. 1950. *Citizenship and social class*. Cambridge: Cambridge University Press.
Mehlum, Halvor, Karl Moene, and Ragnar Torvik. 2006. Institutions and the resource curse. *The Economic Journal* 116(508): 1–20.
Ministry of Finance. 2006. *2007 Annual government revenue and expenditure categories subjects*. Beijing: China Financial and Economic Publishing House.
Ministry of Finance. 2011. *Fiscal statistics of prefectures, cities and counties 2007*. Beijing: China Financial and Economic Publishing House.
Ministry of Finance and State Administration of Taxation. 2014. *The circular on implementing coal resource tax reform* (Caishui [2014] No. 72)
Moore, Mick. 2001. Political underdevelopment: what causes bad governance. *Public Management Review* 3(3): 385–418.

Moore, Mick. 2004. Revenues, state formation, and the quality of governance in developing countries. *International Political Science Review* 25(3): 297–319.
National Bureau of Statistics. 2008a. *China county (city) socio-economic statistical yearbook 2007*. Beijing: China Statistics Press.
National Bureau of Statistics. 2008b. *China energy statistical yearbook 2008*. Beijing: China Statistics Press.
National Bureau of Statistics. 2008c. *China statistical yearbook for regional economy 2008*. Beijing: China Statistics Press.
Nie, Huihua, Minjie Jiang, and Xianghong Wang. 2013. The impact of political cycle: evidence from coalmine accidents in China. *Journal of Comparative Economics* 41(4): 995–1011.
Niskanen, William A. 1971. *Bureaucracy and representative government*. Chicago: Aldine Atherton.
Nurkse, Ragnar. 1958. Trade fluctuations and buffer policies of low-income countries. *Kyklos* 11(2): 141–154.
Olson, Mancur. 1982. *The rise and decline of nations: economic growth, stagflation, and social rigidities*. New Haven: Yale University Press.
Paler, Laura. 2013. Keeping the public purse: an experiment in windfalls, taxes, and the incentives to restrain government. *American Political Science Review* 107(4): 706–725.
Pan, Wei'er. 2008. An analysis of China's coal economy 2007. *China Coal* 71(3):15–19, (in Chinese).
Prebisch, Raul. 1950. *The economic development of Latin America and its principal problems*. New York: United Nations Press.
Robinson, James A., Ragnar Torvik, and Thierry Verdier. 2006. Political foundations of the resource curse. *Journal of Development Economics* 79(2): 447–468.
Ross, Michael L. 1999. The political economy of the resource curse. *World Politics* 51(2): 297–322.
Ross, Michael L. 2001. Does oil hinder democracy? *World Politics* 53(3): 325–361.
Sachs, Jeffrey D, and Andrew M. Warner. 1995. Natural resource abundance and economic growth. NBER Working Paper.
Shafer, Michael. 1994. *Winners and losers: how sectors shape the developmental prospects of states*. Ithaca: Cornell University Press.
Shanxi Provincial Government. 2014. *Circular on regulations of coal fees in Shanxi Province* (*Jin Zheng Fa* [2014] No. 24).
Shanxi Statistical Bureau. 2008. *Shanxi statistical yearbook*. Beijing: China Statistics Press.
Shanxi Statistical Bureau. 2009. *Shanxi statistical yearbook*. Beijing: China Statistics Press.
Shanxi's Development and Reform Commission of Provincial Government. 2013. *Twelfth five-year plan of coal industry development in Shanxi Province* (*Jin Fagai Guihua Fa* [2013] No.1172).
Shanxi's General Office of Provincial Government. 2007. *Eleventh five-year plan of coal industry in Shanxi Province* (*Jin Zhengban Fa* [2007] No. 96).
Shao, Shuai, and Zhongying Qi. 2009. Energy exploitation and economic growth in Western China: an empirical analysis based on the resource curse hypothesis. *Frontiers of Economics in China* 4(1): 125–152.
Singer, Hans W. 1950. The distribution of gains between investing and borrowing countries. *The American Economic Review* 40(2): 473–485.
Skocpol, Theda. 1985. Bringing the state back in: strategies of analysis in current research. In *Bringing the state back in*, ed. Peter B. Evans, Dietrich Rueschemeyer, and Theda Skocpol, 1–38. Cambridge: Cambridge University Press.
State Administration of Work Safety and Coal Mine Safety. 2014. Production capacity of coal mines in Shanxi. Available at http://www.chinasafety.gov.cn/newpage/zhuantibaodao/mtcngs.html.
Stigler, George J. 1971. The theory of economic regulation. *The Bell Journal of Economics and Management Science* 2(1): 3–21.
Stock, James H., and Motohiro Yogo. 2005. Testing for weak instruments in linear IV regression. In *Identification and inference for econometric models: essays in honor of Thomas Rothenberg*, ed. D.W. Andrews and J.H. Stock, 80–108. Cambridge: Cambridge University Press.
Tian, Guolei. 2014. New policies to alleviate the fee burdens of coal enterprises in Shanxi Province. China Youth Daily, May 29 (in Chinese).
Tiebout, Charles M. 1956. A pure theory of local expenditures. *The Journal of Political Economy* 64(5): 416–424.
Torvik, Ragnar. 2009. Why do some resource-abundant countries succeed while others do not? *Oxford Review of Economic Policy* 25(2): 241–256.
Tullock, Gordon. 1965. *The politics of bureaucracy*. Washington DC: Public Affairs Press.
Wagner, Adolph. 1958. Three extracts on public finance. In *Classics in the theory of public finance*, ed. R.A. Musgrave and A.T. Peacock, 1–15. London: Macmillan.
Wang, Hua, and Yanhong Jin. 2007. Industrial ownership and environmental performance: evidence from China. *Environmental and Resource Economics* 36(3): 255–273.
Wheeler, David. 1984. Sources of stagnation in Sub-Saharan Africa. *World Development* 12(1): 1–23.
Wright, Tim. 2012. *The political economy of the Chinese coal industry: black gold and blood-stained coal*. London and New York: Routledge.
Xu, Kangning, and Jian Wang. 2006. An empirical study of a linkage between natural resource abundance and economic development. *Economic Research Journal* (1): 78–89 (in Chinese).
Zhan, Jing V. 2013. Natural resources, local governance and social instability: a comparison of two counties in China. *The China Quarterly* 213(1): 78–100.
Zhan, Jing V. 2015. Do natural resources breed corruption? Evidence from China. *Environmental and Resource Economics*. http://link.springer.com/article/10.1007/s10640-015-9947-4.
Zhan, Jing V., Haiyan Duan, and Ming Zeng. 2015. Resource dependence and human capital investment in China. *The China Quarterly* 221(1): 49–72.
Zhang, Guang. 2012. Citizen expectations and improvement of government functions: a study of importance and performance of budgetary demands in China. *Australian Journal of Public Administration* 71(2): 148–158.
Zhang, Xiaobo, Li Xing, Shenggen Fan, and Xiaopeng Luo. 2008. Resource abundance and regional development in China. *Economics of Transition* 16(1): 7–29.
Zhao, Chunyan. 2014. Does the turning point of coal price come with the enforcement of a branch of measures? National Business Daily, Oct. 10 (in Chinese).