How Natural Resources Affect Authoritarian Leaders' Provision of Public Services: Evidence from China

Ji Yeon Hong, Hong Kong University of Science and Technology

This article examines the effects of natural resource extraction on authoritarian governments' provision of public services, using subnational data from China. Facing no electoral constraint that would reflect the policy preferences of citizens, Chinese local leaders instead allocate public funds differentially based on their need for quality labor in local economic development, a critical criterion for their political success. When the local economy benefits from natural resources, the need for skilled local labor dissipates, and leaders invest less in social services that enhance labor productivity. Using panel data across all prefecture-level cities (1992–2010), I find evidence that mineral resource abundance leads local governments to provide fewer public services for education and health care. Meanwhile, services unrelated to labor quality remain unaffected. The results are robust to the inclusion of key confounding factors such as FDI inflows and state-owned enterprises' output contributions. Additional analyses reject alternative mechanisms including political turnover.

How does the presence of natural resources shift authoritarian leaders' incentives to invest in public services? One perspective holds that authoritarian leaders, who are not subject to effective electoral constraints, nevertheless spend windfall wealth on improved public benefits in order to ensure social stability and prevent uprisings (Acemoglu and Robinson 2006; Morrison 2009). Others claim that authoritarian leaders reduce social expenditures owing to the fact that their economic gains are less dependent on the cooperation of citizens (Bueno de Mesquita et al. 2003). In keeping with the latter perspective, I argue that nondemocratic leaders whose political economic gains depend less on labor force participation indeed spend less on public services, specifically those related to human capital development. Mineral resources provide authoritarian leaders with labor-independent economic production, thus encouraging reduced provisions of services like public education and health care. To support these claims empirically, this study analyzes the effects of fuel mineral resources on local governments' provision of public services across 288 Chinese prefectural cities from 1992 to 2010.[1]

The social policy choices of authoritarian regimes are distinct from those of democracies in that citizens under authoritarian rule are not given access to effective electoral institutions through which their policy preferences can be revealed. In this study, I argue that, without electoral constraints on leadership, the level of public spending that authoritarian governments commit to labor quality depends on the extent to which they need labor to generate economic gains. When the necessity for labor is high, an authoritarian ruler benefits from investing in labor-related social services, because such spending is important to boosting his or her future economic revenue. Thus, labor-dependent dictators tend to invest a substantial share of public funds in education and health care. When the primary industry is labor-intensive manufacturing, for instance, an autocrat must invest significant state resources in public education to ensure that workers have the skills to perform productively in the aggregate. By contrast, if the source of economic revenue is less dependent on labor, the incentive of nondemocratic leaders to invest in the enhancement of labor productivity diminishes. Natural resources, particularly mineral resources, fit this description;

Ji Yeon Hong (jyhong@ust.hk) is an assistant professor in the division of social science at the Hong Kong University of Science and Technology, Clearwater Bay, Kowloon, Hong Kong.

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1. Throughout the article, references to prefectural cities include all 284 prefecture-level cities and four province-level municipalities in China.

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they reduce the provision of labor-enhancing public services by providing an authoritarian leader with economic revenue that is largely labor-independent.[2]

Swenson (2002) and Mares (2003) propose similar arguments to counter traditional class conflict theory in the literature on redistribution and welfare states (Esping-Anderson 1990; Meltzer and Richard 1981; Roberts 1977; Romer 1975). Mares (2003) claims that the business sector has an incentive to promote social policy if potential risks in the labor market reduce employees' incentive to invest in their own productivity. Scholars of varieties of capitalism (VOC) also argue that different economic production structures bring about different welfare regimes (Hall and Soskice 2001; Iversen 2005). In this article, I further argue that industrial needs and the structure of economic production shape authoritarian leaders' incentive to provide welfare services to the public. A key distinction in this study is the lack of electoral mediation that might otherwise link the economic structure to welfare institutions (Iversen and Stephens 2008). Without an effective electoral constraint, how might these structural economic incentives be reflected in the policy choices of authoritarian leaders? I argue that this structural mechanism binds when the political prospects of authoritarian leaders are attached to economic performance under their leadership.

A direct empirical test of this claim would evaluate the degree of labor force participation in industrial sectors over spatial variation in social expenditures in an authoritarian setting. The problem with a research strategy of that nature, however, is that the link between social service provisions and the location of manufacturing companies may be endogenous: the development of manufacturing industries may be a result, rather than a cause, of high levels of public spending on human capital development. Natural resources, especially mineral resources, offer a solution to that problem, as their allocation is exogenous.

Recently, a growing body of literature has begun investigating the domestic effects of natural resource extraction on public welfare provisions, with many subnational studies on the topic suggesting a positive relationship. For instance, scholars find positive effects of oil production on the provision of local public services in the United States (Michaels 2011), Indonesia (Olsson and Valsecchi 2012), and Iran (Mahdavi 2015).[3] The major difference between those studies and this research again lies in the availability of an electoral mechanism. In previous subnational studies, electoral constraints are viewed as a central mechanism shaping the incentives of local leaders regarding public welfare distribution. Monteiro and Ferraz (2010) conclude that a democratic election system is "crucial to avoid the negative effects of resource abundance." In China, excepting rural villages, such electoral institutions are unavailable. This article thus explores whether the effects of natural resources on the domestic distribution of social welfare differ in an authoritarian regime, where no effective electoral system exists.

China provides an ideal set of subnational samples for empirical examination of the labor-dependency argument in the absence of electoral checks. First, China's economic success in recent decades has been achieved primarily through labor-intensive manufacturing, which, given its status as the most populous country in the world, provides China with an obvious comparative advantage. To sustain that economic growth, the Chinese government has emphasized public investment in education and health care. Yet, China also has massive deposits of various mineral resources: China is the largest coal producer and the fourth largest crude oil producer as of 2011. The geographic contrast between these industries provides a unique opportunity to study the subnational effects of natural resources within a growth-oriented authoritarian country. In addition, local governments are largely responsible for implementing social programs and delivering actual public services to citizens. This decentralized administrative system generates notable variation in social service provisions across the country. Given the scarcity of private options as substitutes for public services, and the limited liberty of residents to migrate and benefit from other region's public services, public services provided by local governments have a critical impact on the quality of ordinary citizens' lives. This study thus exploits the diverse sources of local economic development across Chinese localities, and the decentralized local administrative system, to investigate how leaders' incentives to provide social services change with the presence of natural resources.

Several recent studies on China examine the role of political pressure in the allocation of public goods and services through village-level elections or informal groups (Luo et al. 2010; Martinez-Bravo et al. 2012; Padro-i-Miguel, Qian, and Yao 2012, 2015; Tsai 2007; Zhang et al. 2004). The findings so far suggest that the introduction of democratic mechanisms at the local level induces Chinese leaders to provide more public services to citizens. In this study, I further argue that, even without political pressure from society, dependence on labor force participation has the structural effect of leading nondemocratic leaders to provide a certain level of public goods to citizens to encourage labor productivity.[4] Mean-

2. Using the same logic, I show that abundance in oil leads to significantly lower levels of social spending for public education and health by authoritarian governments across countries, using cross national time-series data (1972–2008). Among democracies, however, oil wealth has no discernible impact on social expenditures (Hong, forthcoming).

3. Caselli and Michaels (2013) and Monteiro and Ferraz (2010) find that oil extraction has a modest effect on local public services in Brazil.

4. Political rewards for economic growth in the decentralized system—a fairly unique aspect of the Chinese political system—constitutes a key feature

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while, authoritarian leaders with rich resource endowments have little incentive to invest in the enhancement of labor quality.

The empirical approach of this study differs from previous research in several ways. First, in order to estimate the effects of natural resource endowments with better spatial accuracy, I conduct a prefecture-city level analysis.[5] Second, I use outcomes of public service provisions, instead of aggregate government expenditures, as the main dependent variables. The outcome variables include detailed indicators of public services, such as the numbers of schools and teachers, hospitals, hospital beds, and medical experts. Finally, this study focuses not only on the general impact of mineral resource endowments but also on how different natural resources affect the provision of social services in distinct ways.

The empirical analysis shows that cities with more mineral resources provide fewer public services, especially those that enhance labor productivity. The quality of education is hampered by both crude oil and coal production: coal production negatively affects the number of schools across primary, secondary, and tertiary levels of education, while oil production leads to fewer teachers after controlling for the number of students. Both coal and oil production induce an increase in the number of hospitals. I interpret this as related to the environmental hazards of fuel energy production, the central government's increased interest in those hazards, and the frequent occurrence of coal-mine accidents. Nevertheless, the increase in the number of hospitals does not necessarily indicate an improvement in public health services: the number of hospital beds and the number of medical trainees decrease with coal and oil production, respectively. The negative trends remain robust after controlling for foreign direct investment (FDI) inflows in the manufacturing sector and for the economic output of state-owned enterprises (SOEs), both of which potentially confound with natural resources in explaining local public services. Furthermore, these negative effects are specific to public service provisions related to human capital. Other public services that are not directly related to labor productivity are not negatively associated with oil or coal production.

Although the coal and oil industries in China are distinct from one another in terms of their industrial structure and the labor intensity of the production process, I find similar negative impacts of both resources on labor-enhancing public services. I argue that these findings reflect a fundamental similarity in the two industries, that their production does not depend on local labor quality. Although the coal industry cannot function without the manpower of miners, it requires little skill. Hence, coal-mine workers in China are mostly unskilled migrant workers. From the perspective of local authorities, an improvement in public education to nurture skilled local labor is thus unnecessary. Furthermore, migrant workers have little incentive to demand local public services, especially education, as they live apart from their families due to the restrictions of the current household registration system. The oil industry, meanwhile, discourages local human capital development as a result of its high capital intensity. Oil companies certainly need skilled workers as managers, engineers and, technicians, but given the wider pool of human capital from which they can draw employees, that does not provide enough incentive for local leaders to promote local education or health services. Highly educated workers within large SOEs have particularly strong labor mobility prospects in China.

AUTHORITARIANISM, NATURAL RESOURCES, AND PUBLIC SERVICES

Mineral resources constitute a prime example of economic revenues that depend little on labor productivity, so we should expect authoritarian leaders in mineral abundant areas to provide fewer social services to enhance labor productivity. In the Chinese subnational context, this mechanism is closely related to the political evaluation system, the fiscal system, and the household registration (*hukou*) system, as well as the structural features of resource industries. In a democratic country, citizens have options to punish ineffective local leaders; where elections take place, residents can simply vote out a leader who underperforms. If local elections are not available, citizens in those contexts may instead move to another district to enjoy better public services. In China, however, neither option is currently available to citizens.

Without a practical punishment mechanism available to citizens, the major source of pressure on Chinese local authorities derives from top-down personnel control exerted by higher levels of government, forcing those local officials to provide good governance.[6] As far as the criteria for evaluation go, scholars agree that high performance in terms of local

in this article's research design. Nevertheless, the implications of this study can be applied generally to authoritarian regimes. Without effective electoral control, authoritarian governments share the fundamental characteristic of upward accountability. The criteria for political competition may differ from growth, but the critical mechanism that incentivizes politicians' behavior remains the same.

5. Zhan et al. (2015) present empirical evidence linking natural resource extraction to smaller government expenditure on human capital using provincial expenditure data.

6. Kung and Chen (2014) study another type of windfall revenue in this context, land conveyance fees obtained by local authorities from selling land use rights. The authors find that windfall revenue from land sales undermined the effectiveness of the promotion system for government officials and fueled corruption.

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economic growth, measured by local GDP growth or revenue increases, is the most essential factor in the cadre evaluation system (Chen, Li, and Zhou 2005; Guo 2009; Landry and Lü 2014; Li and Zhou 2005; Yao and Zhang 2015).[7] Another constraint binding local officials is time pressure. Formally, local politicians are bound either by designated terms (five years at the prefecture level) or retirement age (60 for male and 55 for female cadres at the prefecture level). Even beyond those formal time limits, turnover of local leaders is frequent in China: in the case of prefectural leaders, the average stay in office is just 3.8 years (Yao and Zhang 2015).

Local authorities must keep this short period of time in mind when making policy decisions and allocating public expenditures to achieve economic growth in their divisions. Furthermore, since the current fiscal system in China imposes the responsibility for public expenditures on local governments, these local authorities have wide latitude to allocate resources for local public services based on their own political incentives. Natural resource endowments, as a less labor-reliant source of revenues, free local leadership from dependence on the labor force, especially skilled workers, to meet their political goals. Moreover, recent price changes in global mineral markets offer even more expansive gains to mineral-producing localities.[8] These exogenously given endowments and externally induced price changes enable local authorities in mineral-rich cities to reap even higher local GDP and revenue growth gains without relying much on the value added by labor.

One might ask why any local leader would have an incentive to invest in labor productivity, given that he/she stays in office only for a few years. Public investment in human capital accumulation typically requires a formidable period of time to generate economic returns. Hence, it appears to be a risky long-term investment for a local politician, given the uncertainty about how long he/she might stay in office. Nevertheless, I argue that even in the face of short-term stays in office, leaders with few resource endowments have stronger incentives to maintain public investments in labor productivity, compared to their counterparts with large resource endowments.

Where few resource endowments are available for extraction, local economic development must rely on outside financial investments. Therefore, a priority for local leaders with no resource endowment is to attract as much outside investment as possible in their divisions, in competition with other localities in China. For outside investors interested in capitalizing on the abundant labor force in China, labor quality is a key factor in the determination of an investment location. Unsurprisingly, a positive link between local labor quality and FDI inflows is well-established in the literature (Boermans, Roelfsema, and Zhang 2011; Fung et al. 2002, 2003; Kang and Lee 2007; Sun, Tong, and Yu 2002).[9] These studies all use some indicator of public education to measure the quality of local labor. More importantly, they typically employ not only current measures of labor quality, such as literacy levels (Broadman and Sun 1997; Coughlin and Segev 2000; Fung et al. 2002), the share of secondary school graduates (Chen 2009; Gao 2005), or the share of engineers, scientists and technicians (Sun et al. 2002), but also measures of the future quality of human capital including the share of secondary school students (Kang and Lee 2007; Zhang 2001), the number of students enrolled in higher education (Cassidy and Andreosso-O'Callaghan 2006; Du, Lu, and Tao 2008; Yin, Ye, and Xu 2014; Zhang and Song 2000), the number of all schools (Na and Lightfoot 2006), and the number of universities (Sun et al. 2002).[10]

These findings suggest that the best strategy for a resource-poor local leader is to invest in future human capital to a certain extent, even under great uncertainty regarding time in office. *Ex ante*, local leaders do not know when an external investor may consider an investment in their locality, and they are thus unaware of when the quality of their local labor may

7. It is debatable whether economic growth or fiscal extraction is a credible signal of a public official's competence: some scholars argue that growth generation is most important (Chen et al. 2005; Li and Zhou 2005; Yao and Zhang 2015), while others suggest that revenue promotion constitutes the key incentive for political leaders (Guo 2009; Landry and Lü 2014). However, output growth and revenue growth are not entirely separable. Landry and Lü (2014), who highlight the importance of fiscal extraction, note that a crucial function of revenue collection is sending a credible signal of an official's ability to promote economic growth. The economic benefits of resource endowment in this article include both output growth and revenue increases.

8. Although price changes in global mineral markets over the last decade have been closely related to the Chinese economy, given that the influence from China has been on the demand side, the global price changes have functioned as an external shock to resource-producing cities in China.

9. Broadman and Sun (1997) further argues that labor quality is particularly critical due to the inflexible wage system in China. Other studies find that the local education level is particularly important to attract FDI from developed counties, such as the United States, Japan, and Western European countries, since these investments are typically related to relatively capital-intensive and high-tech manufacturing industries (Cassidy and Andreosso-O'Callaghan 2006; Du et al. 2008; Fetscherin, Voss, and Gugler 2010; Fung et al. 2002; Gao 2005; Zhang 2001; Zhang and Song 2000).

10. The prefecture-level data also support this argument. Table A.20 suggests that the average amount of FDI in the 2000s is positively and significantly associated with average levels of public education services in the 1990s, particularly with regard to secondary and tertiary education. Here I conduct a long-term analysis instead of a short-term year-to-year DID analysis, as labor quality is just one of the factors that investors consider. In short, quality labor is an important but not a sufficient condition for FDI attraction. Thus, investments aimed at improving local labor do not automatically increase future FDI inflows, particularly in the short run.

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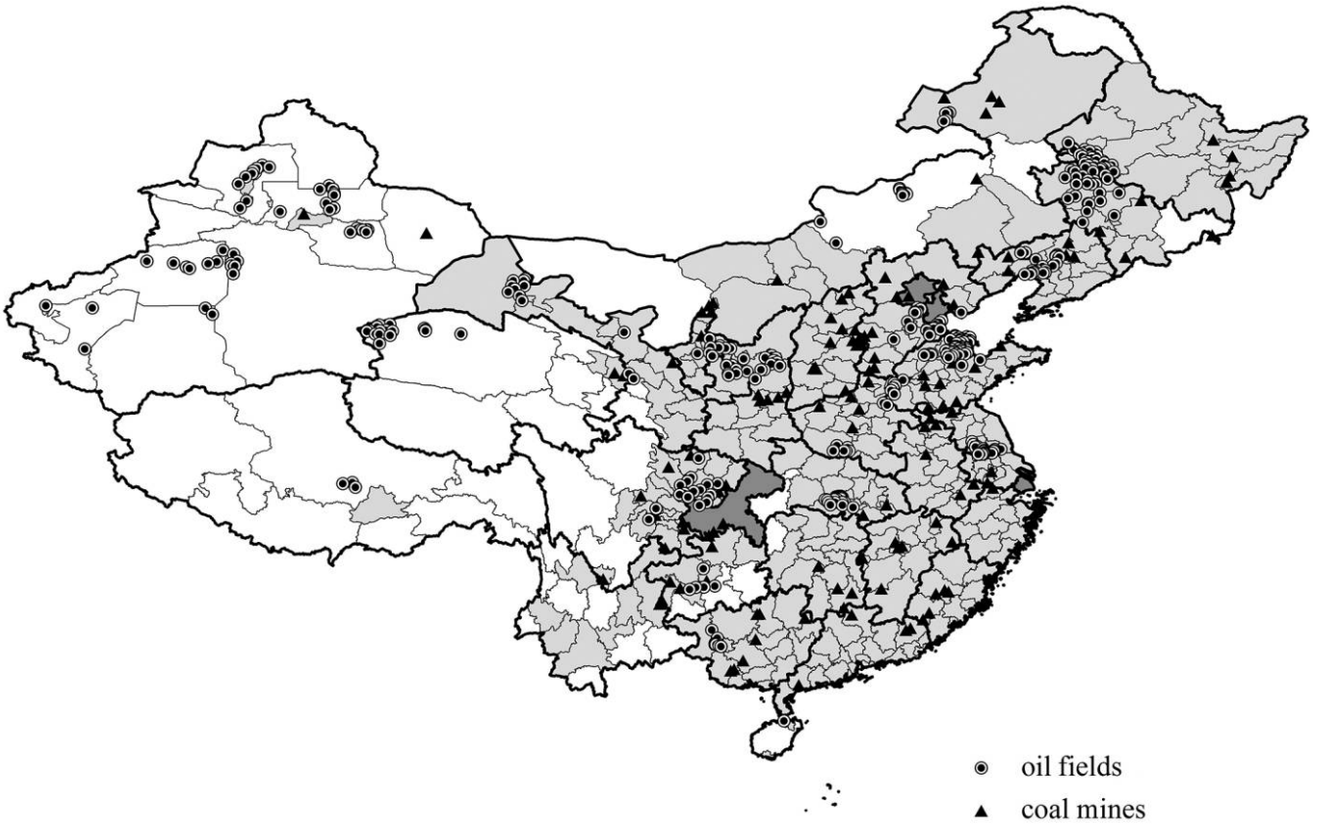

Figure 1. Overlapped map (prefecture cities and mineral production sites). Source: USGS (2001), *China City Statistical Yearbook* (2010)

be evaluated. This is critical because the shadow of the future is longer for investors: once an investment is made, the consequences of the investment, in terms of established firms and branches, factories, and stores, remain in the same city for an extended period. Therefore, a considerable improvement or deterioration in the education system relative to that of other cities is a potentially important signal to outside investors, especially those from other countries, about the future quality of labor in the area.

When a locality is endowed with an abundance of natural resources, however, local leaders' incentive to improve human capital wanes, as natural resources serve as an easily accessible source of economic development without notable skilled labor requirements. Nationally speaking, China benefits from an abundance of fuel mineral resources. However, as figure 1 shows, reserves of mineral resources are widely and unevenly scattered across the country. This distribution provides spatial variation in resources within China, creating both resource-poor areas, which must import mineral resources from outside, and resource-rich areas where mineral production represents the centerpiece of local economic production.

Resource production contributes not only to local economic output but also to government revenue, as resource-producing companies pay various taxes, fees, duties and surcharges to the government. Taxes levied on mineral production include the corporate income tax, a value added tax (VAT), and a resource tax. Since 2006, oil companies selling crude oil have also been subject to a windfall tax, a special petroleum profit tax on production volume when the crude oil price exceeds 55 dollars per barrel. All firms extracting mineral resources in China must also pay mineral resource compensation fees to the government. Transfers of resource development rights are subject to a business tax. Resource-producing companies pay additional duties and surcharges such as a customs duty, city construction and maintenance taxes, national education surcharges, local education surcharges, and so forth.

According to the tax sharing system in China, taxes on resource production are divided between the central and local governments. Corporate income tax is shared by the central and relevant local governments at a ratio of 60:40.[11] The VAT is shared by the central and the relevant subnational governments at a ratio of 75:25. The resource tax from inland resource production is assigned exclusively to the local governments. In 2010, the Chinese government changed the collection base for the resource tax from production volume

11. The provincial, prefectural, and county governments split local tax revenues according to negotiated rates.

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to selling value, which resulted in an increase in local governments' budgetary revenue from the resource production. Finally, a mineral resources compensation fee is evenly split between the central and the local governments. Table A.1 (tables A.1–A.24 available online) summarizes the taxes to which natural resource producing companies are subjected, and the tax revenue sharing ratios between the central and local governments. According to the tax rates and the tax sharing ratios, when a company produces and sells 100 dollars' worth of mineral resources, the central government collects an estimated 20–23 dollars, while the local governments claim 14–22 dollars.[12] Although the central government collects more from resource production, it is clear that local authorities also raise a substantial amount of tax revenue from resource production.

In addition to the tax revenue, local governments also collect a substantial amount of extra-budgetary and off-budgetary revenues. Unlike the tax revenues that are shared by the central and local governments, these nonbudgetary funds are almost exclusively levied by local authorities based on ad hoc standards (Zhan 2013). For example, environmental protection funds and sustainable development funds are widely collected from local mineral producers, especially in the coal industry (Zhan, Duan, and Zeng 2015). Local governments also often require coal producers to sponsor public service provisions such as road or school construction projects (Zhao 2014).

Finally, it is worth noting the firm structure of the Chinese oil and coal industries. The Chinese oil industry is monopolized by two large SOEs, the China National Petroleum Corporation (PetroChina) and the China Petroleum and Chemical Corporation (Sinopec). Coal production is also driven by seven large coal-mining SOEs,[13] although smaller local mining companies also still exist. Thus, unlike the concern raised in recent studies regarding state capacity and resource extraction (Haber and Menaldo 2011; Tsui 2011), the capacity of local governments in China does not substantially affect firms' resource extraction capabilities, given that both industries are run by a small number of nation-level conglomerate SOEs.[14]

DATA AND MODEL

The data for the study are collected from a number of public sources. Geospatial data for oil fields, coal mines, and gas fields are incorporated from the database of the US Geological Survey (USGS; Karlsen et al. 2001). The data on mineral production quantities are collected from the *China Energy Statistical Yearbook* series. Price and reserves data are drawn from various sources. The price of minerals varies widely according to mineral type and quality, production costs, location of production sites, and market conditions. Therefore, I use the annual average price as the most appropriate proxy. For crude oil, I use the Daqing oil price incorporated from information provided by Sublime China Information Group Co., Ltd.[15] The national average coal price is collected from Wu, Wang, and Zhang (2010), and complemented using the ex-factory price indices published in the *China Statistical Yearbook*.[16]

The dependent variables, which capture levels of local public service provisions, and most control variables are incorporated from the *China City Statistical Yearbook*. Most provinces are comprised entirely or nearly entirely of prefectural-level cities (see the gray areas in fig. 1). Only autonomous prefectures and considerably rural areas are not yet promoted as prefectural cities. Prefectural city residents accounted for 92.2% of the total population in 2010. Several variables are incorporated from other sources. For example, output of SOEs comes from annual industrial censuses, and the school age population of localities is calculated from the 2005 1% population census. Summary statistics are available in table A.2.

As for the primary statistical model, I use a panel data analysis of 288 prefectural cities (1992–2010) with both city fixed effects and year fixed effects, which is a generalized form of difference-in-differences identification (Angrist and Pischke 2009). In all specifications, I cluster the standard errors at the province level, which is one level above the prefecture, to control for potential serial correlation over time and across cities within a province. My main specification is represented as follows:

$$y_{i,t} = \alpha_i + \lambda_t + (\text{RESOURCES}_{i,t-1})\beta + X_{i,t}\phi + \varepsilon_{i,t}, \quad (1)$$

where y_{it} are local public service outcomes in city i in year t: for labor-enhancing public services, the number of primary,

12. This estimation excludes the petroleum special profit tax applied to oil.

13. Coal mining SOEs include Shenhua Group, China Coal, Shaanxi Coal and Chemical Industry, Shanxi Coking Coal Group, Datong Coal Mine Group, Jizhong Energy, and Shandong Energy.

14. In contrast, the level of public services is likely to reflect the local government's capacity as well as local leaders' intentions, as the authority and responsibility are given to local governments. For this reason, this study employs a difference-in-differences approach using prefecture and year fixed effects, which estimates the annual change in public service provisions, rather than general levels, in comparison to that of other localities. Even if the historical state capacity of local government is a key omitted variable, it should be absorbed by the prefecture fixed effect.

15. See http://sci99.com/, accessed January 23, 2017.

16. The natural gas price is incorporated from Shi, Ma, and Li (2012). Data on natural gas prices are missing for several years; for those years, I use the price of the previous year weighed by the price trend. I provide data on annual price trends (table A.21), the list of large oil fields (table A.22), and lists of endowed cities (tables A.23, A.24) in the appendix.

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secondary, or tertiary schools, the number of teachers in primary, secondary, or tertiary schools, and the numbers of hospitals, hospital beds and medical experts; and for non-labor-related public services, construction area, construction area of housing, the number of post offices, green areas, and sewage disposal rates. Also, α_i represents city fixed effects; λ_t denotes year fixed effects; and X_{it} is a vector of control variables, which always includes local GDP,[17] population size, urbanization, and land area, in order to account for scale effects and development effects. The degree of urbanization is measured using the share of population residing in urban districts. When the dependent variable is the number of schools or teachers, I also control for the number of students at the same level. All dependent and control variables are transformed into logarithms. In an additional analysis, I also control for the size of FDI inflows in the manufacturing sector—measured by the production of foreign invested companies multiplied by the share of employment in the manufacturing sector—and the share of output by SOEs. And $\varepsilon_{i,t}$ represents robust standard errors clustered at the province level.

In this specification, β is the estimate of interest; it represents the average effect of mineral resource endowment on the outcomes of interest for mineral-producing prefectural cities. A vector of RESOURCES contains the key independent variables, which are various measures of fuel mineral resource endowments—crude oil, coal, and natural gas.[18] I rely primarily on sales revenue as a measure of mineral endowment. Sales revenue is the product of the amount of resource production multiplied by the natural log of the domestic resource price.[19] As a robustness check, I also use production quantity and potential sales revenue from the oil reserves.[20] All independent variables are lagged by one year, for two reasons. First, the main dependent variables in this study are public service provisions, which require a period of time to reflect the changes brought about by resource production. Furthermore, by employing lagged independent variables, I minimize the possibility of reverse causality that could emerge if local leaders under pressure to expand public services increase the amount of mineral production.

Original mineral production data report only the province-level quantity; to my knowledge, no systematic production data are available in greater detail than the provincial level. In order to obtain prefecture level production data, I proportionally assign the production amount according to the number of production sites within each prefecture in the province.[21]

EMPIRICAL FINDINGS

Main results

The empirical analyses show that the production of oil and coal is negatively associated with the provision of public services that enhance local human capital development. However, some nuanced differences are observed across minerals and types of public services. The first six columns in table 1 present estimation results regarding public education. Coal production is negatively related to the number of schools across all levels of education (models 1–3), while oil production is estimated to lower the number of teachers at all levels of schooling (models 4–6). It is notable that both oil and coal have a negative influence on secondary and higher education in particular, which is largely believed to be critical for nurturing skilled labor (Barro 2013; Goldin and Katz 1998). The negative impact of oil and coal production on secondary and higher education is robust to various specifications used as robustness checks, which leads to a conclusion that the expansion of fuel mineral production hinders the development of local skilled labor.

It is worth noting the impact of China's educational reform in the 1990s. With a decreasing number of students due to the one-child policy, the central government has pursued various educational reforms to enhance the quality of education (Tsang 2000). In particular, the declining number of students led to an inevitable pattern of closing and merging schools, especially the rural community-based

17. While necessary to account for the size of local economies, the inclusion of local GDP as a control variable may raise concerns regarding masking effects, as the change in local GDP is not independent from the level of mineral production (Ross 2012). To address this concern, I run the same statistical models without controlling for local GDP as the first robustness check.

18. While it is important to explain the effect of the newly emerging natural gas industry, estimating the general impact of natural gas production is inevitably rather limited as the production of natural gas is, unlike coal and oil, recent and highly concentrated in a few locations such as Sichuan, Xinjiang, and Inner Mongolia. In that regard, this study focuses primarily on the comparison between crude oil and coal, the largest mineral industries in China.

19. I examine the level effect of oil prices, not the growth effect, to prevent overemphasizing the effect of short-term price changes (Dube and Vergas 2013).

20. I also conduct a series of analyses to separately test the effects of extraction quantity and price changes in the robustness checks section.

21. For instance, suppose Province X consists of City A with three oil fields, City B with two oil fields, and City C with no oil field. Last year the crude oil production of Province X was 100 million barrels. I thus estimate that City A produced 60 million, City B produced 40 million, and City C produced zero barrels. This method inevitably assumes that the production amount is evenly distributed across the production sites within a province. In spite of the potential measurement error, the method allows for differentiation in the impacts of resource production across large resource-producing prefectures, small producers, and prefectures with no production.

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Table 1. Effect of Resource Extraction on Labor-Related Public Services (1992–2010)

	Schools			Teachers			Health		
Dependent Variable	Primary (log) (1)	Secondary (log) (2)	Higher (log) (3)	Primary (log) (4)	Secondary (log) (5)	Higher (log) (6)	Hospital (log) (7)	Doctor (log) (8)	Beds (log) (9)
Oil sales (lagged, 1 year)	.009	−.015**	.010	−.023**	−.020*	−.064*	.124*	−.032***	−.031
	(.021)	(.006)	(.035)	(.010)	(.011)	(.037)	(.071)	(.012)	(.019)
Coal sales (lagged, 1 year)	−.029*	−.021*	−.024**	−.003	−.008	.008	.043***	−.003	−.033**
	(.016)	(.012)	(.011)	(.011)	(.009)	(.018)	(.013)	(.010)	(.012)
Gas sales (lagged, 1 year)	−.007*	.002*	−.003	.003*	.002	.003	−.012	.008***	−.001
	(.004)	(.001)	(.003)	(.002)	(.002)	(.003)	(.008)	(.001)	(.003)
Local GDP (log)	−.087*	−.006	.102	.067*	.066**	−.071	.091*	.125***	.127**
	(.050)	(.051)	(.065)	(.037)	(.024)	(.049)	(.048)	(.040)	(.057)
Population (log)	.832***	.630***	.420***	.601***	.409***	.125	.666***	.565***	.583***
	(.297)	(.151)	(.141)	(.093)	(.061)	(.085)	(.125)	(.084)	(.071)
Urbanization (%)	−.153	.003	.390***	.170*	.039	.102	−.046	−.026	.016
	(.229)	(.099)	(.132)	(.085)	(.063)	(.075)	(.201)	(.113)	(.101)
Land area (log)	−.006	−.052	−.046	.016	−.026	−.026	.123	−.049	−.056
	(.074)	(.060)	(.064)	(.040)	(.031)	(.049)	(.078)	(.063)	(.062)
Students (log)	.576***	.311***	.110***	.411***	.531***	.632***			
	(.125)	(.068)	(.009)	(.078)	(.045)	(.020)			
N	3,759	3,759	3,587	4,533	4,533	4,263	4,526	4,526	4,525

Note. Robust standard errors clustered at the province level are shown in parentheses. "Students" represents log of number of students at the relevant level. For example, the number of students in primary schools is employed for models 1 and 4, the number of students in secondary schools for models 2 and 5, and the number of students in higher education institutes for models 3 and 6. "Sales" is a multiplication of quantity of production in the given prefecture-city and domestic price (log). Variables not shown include prefecture fixed effects and year fixed effects.

* $p < .1$.

** $p < .05$.

*** $p < .01$.

(*minban*) schools, which had been promoted heavily during the Mao era (Wang 2002). Accordingly, rural community-based teachers have either lost jobs or been converted to public (*gongban*) teachers.

While it is critical to understand the nature of these educational reforms, the negative findings in table 1 remain substantively unchanged, taking the reform effect into consideration. Given that both the one-child policy and educational reform were led by the central government, the tendency toward declining numbers of students and schools has been nationwide; it is thus captured by the year-fixed effects included in all models. Therefore, the negative estimates in table 1 capture only the idiosyncratic deviations of coal-producing and oil-producing cities from the nation's average trend.[22] Moreover, it remains a matter of debate as to whether the decrease in schools and teachers is necessarily a net human capital negative, since the reforms were aimed at enhancing education quality (Wang 2002). While it is clear that community-based schools and teachers lagged behind in educational quality, the removal of those schools and teachers created an education deficit primarily in rural Chinese areas where public schools are sparsely established. Furthermore, the estimates represent changes in the numbers of schools and teachers not explained by changes in the number of equivalent-level students. In other words, the negative estimates in table 1 indicate that the decrease in schools and teachers in coal and oil cities has been faster than the decrease in the number of equivalent-level students.

Mineral resource production also has noteworthy, though somewhat mixed, effects on public health services (models 7–9

22. It is still possible that the pace of reform might have been different across cities and that the resource-rich cities might experience the largest outflow of students. To address this issue, I regress student population on resource production to examine whether resource-rich cities present different trends in student population change. Table A.19 in the appendix shows that resource-rich cities did not go through significantly different changes in student population at any level of education.

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in table 1). Both coal and oil increase the number of hospitals. This positive relationship reflects the increased need for expansive health services, as both coal and oil production are associated with hazardous effects on public health and the environment.[23] Nonetheless, measures of quality in health services do not correspond with the increase in the number of hospitals: the number of medical trainees and hospital beds do not increase with resource sales. Rather, the number of medical experts decreases significantly as oil production increases, and the number of hospital beds decreases as a city produces more coal. This suggests that fuel mineral production may lead to greater physical access to medical institutions, but that the quality of service in those institutions in fact does not improve and even declines.

In table 2 I investigate the possibility that two potential alternative public service providers, manufacturing firms established by FDI and SOEs, may alter the findings. Recalling the argument outlined above, city leaders without access to extractable natural resources will maintain human capital investments because they need to attract external investments to achieve local economic growth, thereby maximizing their odds of political success. Although this argument does not directly imply any positive effects of FDI receipts on future public service provisions, it is not impossible that FDI firms might demand or even provide greater public goods to enhance future labor productivity. Another possible driver of public services, particularly in the Chinese context, is the SOEs. Scholars of SOEs note that social welfare costs are a major source of inefficiency for SOEs (Dong and Putterman 2003; Lin and Li 2008), which could induce those firms to contribute to human capital development. The results in table 2 suggest, however, that the negative effects of oil and coal extraction remain significant even with the inclusion of these two potential alternative welfare providers.

Interestingly, neither FDI in manufacturing nor SOE contributions to social welfare significantly affect the level of public services. Because FDI decisions would likely prioritize the places with higher labor quality beforehand, the growth in labor-related public services would not necessarily be larger in cities which just received FDI compared to other cities receiving no or less FDI. On the contrary, the growth in public services might be larger in cities with unsuccessful FDI records, because their leaders may face strong incentives to enhance the probability of successful FDI attraction in the future. This argument stands in contrast to Malesky (2008), who finds, using subnational data from Vietnam between 1990 and 2000, that local FDI attraction increases local policy autonomy from the central government. The difference arises because, unlike Vietnamese local leaders, Chinese leaders are tied to the central party by dint of the centralized personnel system (Malesky 2008, 102). Sheng (2010) even claims that this monopolized personnel system helps the central government to gain even greater control over local leaders governing economically successful regions.

Finally, to determine whether mineral production leads to a deterioration of public services in general or whether the negative impacts are specific to labor-related services, I test the effects of resource production on non-labor-related public services. I analyze four different types of public services provided by local governments: construction permission (measured by the area under construction), the number of post offices, green areas, and the sewage disposal rate. The results in table 3 demonstrate that public services not related to the quality of local labor are either not affected by the resource abundance of a city or are positively affected, except for the sewage rate in coal-producing cities.[24] The analysis of non-labor-enhancing public services also shows that crude oil and coal production is associated with an increase in the area under construction in localities (models 1 and 6), and that the magnitude of the impact is notable. The construction area reserved for housing, however, does not increase, implying that the boost in construction is largely generated by commercial or fixed asset construction.

Alternative mechanisms

One possible alternative mechanism linked to local leaders' career incentives is the priority and fulfillment of local responsibilities. As natural resource production provides important growth in GDP and government revenue, local leaders may have little incentive to fulfill other criteria, such as providing social welfare, since they already fulfill the more important criterion necessary for promotion. To address this possibility, I evaluate the personnel data of all party secretaries who served in prefecture cities during the period of analysis, to determine whether the political leaders of

23. In particular, coal mining cities were under significant political pressure during the 2000s to improve public safety and health measures, as coal mining has been a notorious cause of death in China, and deadly accidents at coal production sites have generated significant attention from the central authority. Furthermore, occasional protests in coal cities have also encouraged local governments to provide a certain degree of social services to mine workers and residents suffering from the side effects of the coal industry.

24. The decrease in the sewage rate is likely to be related to the coal cleaning process. Raw coal is mixed with impurities and a washing process conducted at or near the coal production site is an alleged major source of water pollution in coal-producing areas.

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Table 2. Addressing FDI Inflows and SOE Contribution (1998–2007)

	Schools			Teachers			Health		
Dependent Variable	Primary (log) (1)	Secondary (log) (2)	Higher (log) (3)	Primary (log) (4)	Secondary (log) (5)	Higher (log) (6)	Hospital (log) (7)	Doctor (log) (8)	Beds (log) (9)
Oil sales (lagged, 1 year)	.030	−.009	−.066*	−.043*	−.038**	−.215***	.201***	−.026***	−.043**
	(.035)	(.010)	(.033)	(.023)	(.017)	(.056)	(.045)	(.009)	(.017)
Coal sales (lagged, 1 year)	−.037*	−.017*	−.035*	−.003	.003	−.025	.031	−.0001	−.043*
	(.022)	(.010)	(.019)	(.011)	(.013)	(.039)	(.023)	(.017)	(.024)
Gas sales (lagged, 1 year)	−.005	.001	.002	.006*	.004	.015**	−.025***	.007***	−.002
	(.006)	(.001)	(.004)	(.003)	(.003)	(.006)	(.004)	(.001)	(.003)
FDI in manufacturing sector	−.012	−.008	−.025	−.001	.021	.009	−.007	−.001	−.003
	(.017)	(.005)	(.018)	(.006)	(.014)	(.035)	(.014)	(.006)	(.011)
SOE production (%)	.004	−.001	−.001	−.002	−.0001	.003	−.004	.0001	−.002
	(.003)	(.001)	(.002)	(.003)	(.001)	(.007)	(.004)	(.001)	(.002)
Local GDP (log)	−.142	−.009	.196*	.063	.037	−.047	.043	.116**	.181*
	(.089)	(.068)	(.102)	(.047)	(.048)	(.086)	(.066)	(.049)	(.104)
Population (log)	.658**	.531***	.563***	.449**	.408**	.164	.676***	.338***	.475***
	(.304)	(.136)	(.136)	(.166)	(.163)	(.125)	(.197)	(.096)	(.143)
Urbanization (%)	−.193	−.053	.233	.029	.014	.206	.562***	.152**	.275**
	(.174)	(.042)	(.137)	(.050)	(.041)	(.253)	(.203)	(.063)	(.129)
Land area (log)	.150***	.030	−.060	.012	.005	−.008	.134***	.028	.001
	(.036)	(.018)	(.038)	(.050)	(.045)	(.067)	(.027)	(.030)	(.030)
Students (log)	.597***	.271***	.112***	.372***	.342***	.614***			
	(.130)	(.082)	(.011)	(.085)	(.092)	(.034)			
N	2,220	2,220	2,172	2,220	2,220	2,176	2,217	2,217	2,217

Note. Robust standard errors clustered at the province level are shown in parentheses. "Students" represents log of number of students at the relevant level. "Sales" is a multiplication of quantity of production in the given prefecture-city and domestic price (log). FDI in manufacturing sector is measured by the production of foreign invested firms (including Hong Kong, Macau, and Taiwan investment) multiplied by the share of employment in manufacturing sector in total employment. SOE production is the share of SOE output in local GDP. Variables not shown include prefecture fixed effects, year fixed effects, and constants.

* $p < .1$.

** $p < .05$.

*** $p < .01$.

resource-rich cities have higher odds of promotion or a lower probability of demotion. The estimates in table 4 show that resource extraction does not boost the political careers of local party secretaries: I find neither positive effects of resource sales revenue on promotion nor negative effects on the probability of demotion. Rather, the promotion prospects of coal city leaders deteriorate when coal production increases. These results indicate that resource revenue per se does not guarantee the political success of a local public official.

Another possible channel to poorer public service provisions in resource abundant areas may lie in the turnover pattern. For example, if the leaders of resource-rich cities have systematically shorter tenure than others, this may lead them to neglect long-term investment in social services. Confronting this possibility is important to ensure that the negative effects of resources on public goods occur through the incentive system that local officials face, and not through central leaders' incentives regarding the governance of resource-rich

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Table 3. Effect of Resource Extraction on Non-labor-Related Public Services

Dependent Variable	Construction Area (log) (1)	Residential Construction (log) (2)	Post Office (log) (3)	Green Area (log) (4)	Sewage Rate (%) (5)	Construction Area (log) (6)	Residential Construction (log) (7)	Post Office (log) (8)	Green Area (log) (9)	Sewage Rate (%) (10)
Oil sales (lagged, 1 year)	.139***	.145	.042	−.011	−.422	.063	.060	−.004	−.040	−2.953
	(.032)	(.106)	(.055)	(.030)	(2.504)	(.042)	(.140)	(.046)	(.035)	(2.998)
Coal sales (lagged, 1 year)	.068*	−.007	.003	.043	−3.037**	.078*	−.005	.015	.092	−6.242***
	(.037)	(.039)	(.018)	(.042)	(1.272)	(.040)	(.078)	(.024)	(.064)	(1.439)
Gas sales (lagged, 1 year)	−.011**	−.015	.001	.009**	−.468	.005	−.019	.010	−.008**	−.471
	(.005)	(.011)	(.006)	(.004)	(.511)	(.008)	(.019)	(.007)	(.003)	(.781)
Local GDP (log)	−.283	−.165	.136	.258***	12.184	−.427**	.131	.062	.168	12.729
	(.241)	(.361)	(.091)	(.091)	(8.482)	(.187)	(.203)	(.201)	(.163)	(8.932)
Population (log)	.888	1.415*	.629***	.281	−19.331*	−.275	−.375	.664**	.242	−24.639***
	(.576)	(.763)	(.080)	(.167)	(9.617)	(.214)	(.366)	(.258)	(.194)	(5.920)
Urbanization (%)	1.298*	1.123	−.007	.423*	−24.435	1.109*	.963	.001	.972***	−20.360
	(.691)	(1.084)	(.127)	(.233)	(20.679)	(.590)	(.608)	(.146)	(.350)	(19.930)
Land area (log)	−.193	1.064	.172*	−.191	−10.206	.115	2.456**	.155**	−.159	−6.158
	(1.286)	(1.524)	(.095)	(.130)	(9.373)	(1.903)	(1.009)	(.071)	(.116)	(7.511)
FDI in manufacturing						.017	−.115**	−.018	.055*	.854
						(.081)	(.030)	(.036)	(.027)	(1.539)
SOE production (%)						−.009**	.010**	.002	−.003	.082
						(.004)	(.004)	(.004)	(.005)	(.268)
N	2,242	2,238	4,512	4,527	2,210	1,480	1,480	2,206	2,218	1,517

Note. Robust standard errors clustered at the province level are shown in parentheses. Sales is a multiplication of quantity of production and domestic price (log). Variables not shown include prefecture fixed effects, year fixed effects, and constants.

* $p < .1$.

** $p < .05$.

*** $p < .01$.

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Table 4. Alternative Mechanisms: Political Turnover and Tenure

	Promotion		Demotion		Turnover Frequency		Tenure (Duration Analysis)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Oil sales (lagged, 1 year)	−.008	−.038	.0002	.004	−.001	−.050**	−.032	−.551
	(.014)	(.040)	(.001)	(.003)	(.005)	(.021)	(.198)	(.872)
Coal sales (lagged, 1 year)	−.018***	−.022*	.003	.005	−.003	−.011	.083	.357
	(.004)	(.013)	(.003)	(.004)	(.006)	(.007)	(.111)	(.226)
Gas sales (lagged, 1 year)	.004**	.009***	−.0001	−.001**	.001	.002	.010	.059
	(.001)	(.003)	(.0001)	(.000)	(.001)	(.002)	(.025)	(.061)
Years to retire	.143***	.080	−.0001	.037	−.327***	−.394***	−3.009***	−5.715***
	(.037)	(.080)	(.010)	(.026)	(.080)	(.083)	(.524)	(1.552)
Years to retire^2	−.064***	−.062	−.001	−.023	.080**	.054	.990***	2.133**
	(.020)	(.048)	(.004)	(.015)	(.033)	(.040)	(.231)	(.856)
Years in office	−.184***	−.168***	−.013***	−.015**	−.574***	−.543***		
	(.018)	(.019)	(.004)	(.006)	(.032)	(.031)		
Years in office^2	.018***	.016***	.001***	.002**	.055***	.051***		
	(.002)	(.002)	(.0001)	(.001)	(.005)	(.005)		
GDP growth (%)		.124**		−.015		.056		.326
		(.056)		(.013)		(.045)		(.206)
Revenue growth (%)		.002		−.004*		−.008		−.071
		(.003)		(.002)		(.007)		(.070)
N	2,897	1,487	2,897	1,487	2,897	1,487	2,897	1,487

Note. Dependent variables are political career indicators of party secretaries at the prefecture level (1992–2010). Robust standard errors clustered at the province level are shown in parentheses. Models 7 and 8 employ parametric survival models with Weibull survival distribution. "Tenure" denotes the number of years in the current office. Variables not shown include prefecture fixed effects, year fixed effects, and constants.

* $p < .1$.

** $p < .05$.

*** $p < .01$.

cities. The results in models 5 and 6 in table 4 show that the frequency of leadership change is not particularly high in resource abundant cities. On the contrary, leadership changes appear less frequent when a city produces more oil. Subsequently, I investigate the tenure length of local party secretaries using duration analysis with a Weibull survival distribution. The estimates in models 7 and 8 suggest that there are no statistical grounds to believe that resource production leads to longer or shorter tenures for local leaders.

A third possible explanation to consider is that natural resource revenue may not be distributed adequately to local governments. If this were true, local governments would not have enough fiscal power to provide social services to the public. Although this concern is partially rejected by the tax estimation in the previous section, which indicates that local governments collect 14%–22% of sales revenues from the resource companies, it is worth examining whether an increase in resource production indeed results in increased government finances, as expected. The statistical analysis in table 5 rejects the possibility that resource-rich cities are financially starved. Model 1 shows that local GDP grows significantly as mineral production increases. Models 2 and 3 reveal that mineral resources increase local government finances, both in terms of revenues and expenditures. However, the increase in government revenues and expenditures does not result in a significant increase in educational or public health spending, especially in the case of coal. Models 4 and 5 show that both education and health spending as a share of total local government spending are reduced when more revenue comes from resource extraction.

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Table 5. Alternative Mechanisms: Mineral Production, Local Income, and Government Finance

	Local Income	Local Government Finance				Transfer from Central Government	
Dependent Variable	Local GDP (log) (1)	Local Government Revenue (log) (2)	Local Government Expenditure (log) (3)	Local Government Expenditure on Education (% of exp.) (4)	Local Government Expenditure on Health (% of exp.) (5)	Earmarked Transfer (log) (6)	Teacher Salary Transfer (log) (7)
Year	1992–2010	1992–2010	1992–2010	1992–2010	2002–4	1998–2004	2000–2004
Oil production	.044***	.044*	.019	−.142	−1.074	.025	−.182
	(.010)	(.023)	(.019)	(.121)	(4.792)	(.084)	(.161)
Coal production	.041*	.059***	.046***	−.400**	−4.654***	−.035	−.016
	(.020)	(.015)	(.012)	(.181)	(1.591)	(.063)	(.020)
Gas production	.005*	.012**	.010***	−.046**	−2.272***	−.030	.014
	(.003)	(.006)	(.003)	(.017)	(.773)	(.024)	(.015)
Population (log)	.722***	.495**	.423*	2.658*	−7.720	.038	−.859
	(.124)	(.226)	(.208)	(1.333)	(22.104)	(.234)	(1.575)
Urbanization (%)	.190	.128	−.116	6.011***	3.227	−.313	.095
	(.115)	(.187)	(.222)	(1.942)	(5.895)	(.186)	(.458)
Land area (log)	.020	−.054	.072	−.208	9.801	−.010	.523
	(.095)	(.155)	(.121)	(.668)	(10.586)	(.061)	(.550)
N	4,536	3,575	3,575	3,572	833	1,812	852

Note. Robust standard errors clustered at the province level are shown in parentheses. Variables not shown include prefecture fixed effects, year fixed effects, and constants. In model 7, the number of primary and secondary school students (log) is included as an additional control variable.

* $p < .1$.

** $p < .05$.

*** $p < .01$.

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Relatedly, it is possible that the central government reduces the amount of transfers to resource-wealthy cities substantially when resource production or prices rise. If this discrimination mechanism is at work, local governments, which depend on the central government for a significant amount of fiscal transfers, may face more stringent budget constraints despite increased revenue from resource production. I examine whether this mechanism is plausible using fiscal transfer data from *Financial Statistics for Prefectures, Cities, and Counties*. I use two transfer items: earmarked transfers and a transfer for rural compulsory education (a subsidy for teachers' salaries) introduced in 2001.[25] As the last two columns of table 5 show, the central government transfers neither less nor more to resource-abundant local governments.

Finally, it is possible that potential collective action is a major concern for local leaders, as education is likely to promote political participation (Bourguignon and Verdier 2000; Glaeser, Ponzetto, and Shleifer 2007). While most labor protests in China have taken place in manufacturing cities (Friedman 2014; Lee 2007), perhaps precisely because of education, it is also the case that protests occur in coal cities for labor and environmental reasons. One possible way to empirically test the collective action mechanism is to see if a notable discontinuity in public service provisions is apparent in coal cities before and after 2007. In 2007, the central government shut down almost 10,000 small-sized coal mines principally responsible for the industry's negative externalities. Thus, if concerns over future collective action were the key reason for lower public services in resource-rich cities, the negative relationship between coal and public services should decrease significantly after 2007. To test this possibility, I limit the sample to post-2007 city-year observations. In table A.3, I find that the negative effects are even larger than the effects found in the full-sample analyses. These results suggest that collective action concerns are not the major mechanism driving the findings.

Robustness checks

In the appendix, available online, I provide a series of robustness checks to further bolster the empirical evidence. To address Ross's (2012) concern associated with controlling for the income variable, I reanalyze the data without controlling for local GDP. Table A.4 demonstrates that the concern of Ross (2012) is valid to some extent: excluding the local GDP variable does change the estimates, increasing the size of the standard errors and resulting in several estimates that are statistically insignificant by a small margin. Nevertheless, it is critical to note that the results remain generally the same, especially in terms of size and direction: resource production still has a negative and significant impact on local education, particularly secondary education, and on public health care services. Ross (2012) also claims that oil income per capita is an unbiased measure of oil wealth. Although per capita measures may be highly unstable in a subnational setting due to migration, it is worth examining whether the negative relationship holds in analyses with per capita measures. Table A.5 presents the results from analyses in which I convert all measures to per capita terms. These results suggest that the negative findings are consistent with, or even stronger than, the previous findings using absolute measures.

Second, I attempt to separate the effects of production quantity and price change. While the production quantity is likely endogenous to the price level, it is worth examining which component of sales revenue brings about larger negative impacts. Thus, I examine the effects of production quantity without incorporating annual domestic price information (table A.6), and I also run separate analyses for price bust (1992–2003) and boom (2004–10) periods (tables A.7, A.8). The findings suggest that the negative effects of oil are not driven solely by extraction quantity, whereas the effects of coal do appear to be largely a function of production quantity. The estimates reveal that the negative impact of oil and coal emerged primarily during the boom period (2004–10), providing suggestive evidence that positive price shocks play a critical role in the negative effects of natural resource development on public services. These results combined suggest that the natural resource price, which is largely exogenous to a resource city's economic conditions or policy decisions, can significantly impact the city's long-term economy by reducing its investment in human capital, particularly for oil cities. These findings are consistent with the growing body of literature emphasizing the role of resource price fluctuation in the effects of natural resources (Brückner, Ciccone, and Tesei 2012; Hendrix, forthcoming; Ramsay 2011; Tsui 2011).

Third, it is possible that local governments respond to future demand for social services rather than to current demand, which is captured by student population and total population. To respond to this potential concern, I construct new variables measuring demand for future public services, such as birth rate and population under age five. Prefecture-level data on birth rates and infant mortality are not available. Therefore, I first use the natural population change, which denotes the population change due to births and deaths, to calculate the approximate birth rate. Tables A.9 and A.10

25. Unlike the tax rebate and the general purpose transfers, the central government has wide discretion over the allocation of earmarked transfers (Shih, Zhang, and Liu 2008).

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show that the negative effects of natural resources are robust to additional controls for short-term and long-term future demands. I additionally employ the 2005 census to calculate the future school-age population size in table A.11, which again does not alter the previous findings.

The main analyses of this article employ one-year lagged independent variables. However, one year is an arbitrary choice. If for some reason there exists a gap between resource production and its beneficial social effects, resources may benefit the citizens in the longer term. In tables A.12 to A.15, I employ longer time lags (three years and five years) and average production over those periods (three years and five years) as alternative independent variables. The results show that the negative effects of natural resources are stable over time, as the size and significance of estimates do not vary substantially with longer lags or averages. Conversely, estimates without lagging cause some findings to lose statistically significance (table A.16). I suggest this reflects the necessary time gap between resource extraction and public service outcomes.

Finally, some other channels are worth investigating. To address the potential endogeneity issue in the production and sales data, I employ the quantity of proven oil reserves (Haber and Menaldo 2011; Tsui 2011).[26] To incorporate oil reserves data, I collect oil field-level reserves reports for 2010 from various sources. I then split the amount of reserves according to the number of production sites to assign a relevant quantity of reserves to each prefecture. Using the reserve data, I construct a potential sales revenue variable, the product of proven oil reserves multiplied by the natural log of the annual domestic oil price. Despite the data accuracy issue, the estimates in table A.17 are largely consistent with the results of prior estimations. In addition, I investigate the possibility of nonlinearity between resource production and public services following recent findings of curvilinear effects from oil (Basedau and Lay 2009; Sala-i-Martin and Subramanian 2003). The quadratic regression analyses in table A.18 suggest little support for a nonlinear relationship.

CONCLUSION

With limited electoral oversight from citizens, the political incentives of the ruling group function as a key determinant of social policy in authoritarian regimes. Using subnational variation within China, this study shows that natural resource endowment reduces political leaders' incentives to invest in human capital development, by enabling economic growth without significant skilled labor involvement.

The Chinese central government's long-standing policy focus on economic growth has evidently enhanced important welfare outcomes, not only through increased incomes but also through improvements in the public services provided by local governments. Yet this study suggests that the same policy focus may have resulted in different consequences in mineral-producing areas where economic growth is significantly less dependent on local labor quality. As Lü (2015) and Zhan et al. (2015) suggest, to assure universal improvements in public education and other social services, it is critical that the central government make local authorities directly accountable for the actual provision of those public services.

Finally, this research suggests an important implication for social policy in authoritarian countries. Unlike in democratic settings where demands for social services are addressed through elections, top-down incentives and the upward accountability of authoritarian leaders shape social service provision in authoritarian settings, driving unequal distributions of public welfare. Natural resources, by creating substantial economic revenue without significant value added by labor, reduce those leaders' incentives to invest in public spending to promote labor productivity. In time, these reductions in social services may have serious consequences for long-term economic development in these countries, or at least in cities with depletable resources.

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26. Note that Laherrere (2001) questions whether current measuring systems of proven oil reserves represent exogenous oil endowment.

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