

The “Curse of Resources” Revisited: A Different Story from China

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Abstract

Whether natural resources boost or deter economic development remains an open question in the literature. Papyrakis and Gerlagh (2007) found a significant negative association between economic growth and resource abundance at a U.S.-state level. They demonstrated that resource abundance crowds out human capital accumulation and R&D investment. This paper performs an empirical analysis on data from 95 cities in China from 1997 to 2005 and finds no obvious evidence of a significant relationship between natural resources and economic development at the city level. By controlling province dummy variables, however, it becomes clear that resource abundance in one city imposes a significant positive “spill-over” effect on the other cities within the same province. Moreover, an analysis on transmission channels of such spill-over effects reveals that resource abundance boosts the manufacturing industry in the other cities, which is consistent with the “big push” theory.

Keywords: Curse of resources; Spill-over effects; Big push

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1. Introduction

Do natural resources serve as an engine or a brake in economic development? There is little consensus on the answer to this question. At some level, it is obvious that natural resources provide impetus to economic growth. For example, Habakkuk (1962) believed that resource abundance is the main reason the U.S. economy surpassed the U.K. in the 19th century. Further, Rosenstein-Rodan (1943) and Murphy et al. (1989) explored the “big push” idea that it would be beneficial for all economic sectors to undergo industrialization simultaneously, and emphasized that the expansion of the domestic market would help firms generate enough sales to adopt increasing returns technologies. By this logic, any demand shocks that expand the domestic market, such as natural resource booms, will fuel industrialization, thus accelerating economic growth.

However, increasing countrywide evidence demonstrates that natural resources may be a “catalyst for economic growth” (Sachs and Warner, 1999), providing support to the “curse of resources” hypothesis that resource-abundant economies perform relatively more poorly than resource-scarce ones. Sachs and Warner (1995) showed that countries with a higher ratio of primary-product exports to GDP experienced slower average GDP growth rates between 1971 and 1989. Even after controlling for initial GDP per capita, trade policies, government efficiency, and investment rates, a negative association between primary-product exports and GDP

growth rates was still observed to exist. These results indicate a surprising feature of modern economic growth—economies with more resources tend to develop more slowly. In a more general application, when Sachs and Warner included geography and climate as the control variables, they found that natural resources affect economic performance only modestly (Sachs and Warner, 2001).

There are various explanations for the disappointing performance of natural resources. One explanation, from the perspective of social psychology, is that “easy riches lead to sloth” (Jean Bodie, 1976, quoted by Sachs and Warner, 1995). On the other hand, Gelb (1988) and Auty (1990) analyzed the “curse of resources” from the perspective of political economy. They suggested that resource-abundant countries tend to carry out more rent-seeking activities, as the government is interested in grabbing rents made available by natural resources. Kronenberg (2004) concluded in his study on transitional economies that “a large part of the variation in growth rates among the transition economies can be attributed to the curse of natural resources. He also found corruption as one of the prime reasons for the curse of natural resources. Angrist and Kugler (2008) suggested that resource abundance abets more frequent political and military conflicts within the region, and sharply increases violent death rates in growing areas, which subsequently reduces economic activities.

In the field of economics, it is generally accepted that natural resources stall economic growth because they crowd out certain activities that drive economic growth. In this sense, natural resources should not to be considered the direct reason for disappointing economic performance; instead, the main reason is what people fail

to do to curtail the potential negative effects of resource abundance.

Although many scholars agree on the crowding-out logic, there are diverse views on what kinds of activities that encourage growth are “crowded-out”. One of the crowded-out sectors is manufacturing activities. Sachs and Warner (1995, 1997, 1999, 2001) developed a “Dutch disease model” following Matsuyama’s (1992) framework. They divided the entire country into tradable natural resource sectors, tradable (non-resource) manufacturing sectors, and non-tradable sectors. They observed that where natural resources are more abundant, more labor and capital—once employed in the manufacturing of goods—switch to the non-tradable goods sector, as resource-abundant countries pay more attention to natural resource goods than manufacturing goods in tradable production. Consequently, the economy may experience a shrink in the manufacturing industry and expansion of non-tradable sectors. However, since the price of the primary goods is lower than the manufacturing ones, and as a result of many countries’ protection policy of the primary import, natural resource–abundant countries may experience economic stagnation.

Aside from manufacturing activities, Gylfason et al. (1999) and Gylfason (2000) also argued the importance of education. They observed that potential entrepreneurs and innovators are tempted to get involved in the natural resource sector due to its wage premium (Sachs and Warner, 2001). Thus, owing to a decline in innovations characterized by “learning-by-doing,” industrialization stalls in resource-abundant countries. Furthermore, a country’s openness will certainly suffer as it protects its

citizens' perceived profits from natural resources.

Complementing the previous studies, Papyrakis and Gerlagh (2007) extended this line of research from country-level to different regions within the same country. The advantage of a within-country analysis versus multiple-country data is that the reduced heterogeneity across different countries may yield more precise estimates. An investigation of 49 U.S. states, under a conditional convergence model, revealed that the economic performance of resource-scarce states exceeded the resource-abundant. Meanwhile, upon comparing the relative importance of transmission channels, schooling was observed to be the most important channel through which resource abundance imposes a negative effect on economic growth. Resource abundance leads to an expanding primary sector, where the human capital accumulation is not a key production factor as it is in the manufacturing sector. In the long run, this restricts future economic development. Similarly, Zhang, etc. (2008) showed that "Chinese provinces with abundant resources perform worse than their resource-poor counterparts in terms of per capita consumption growth" with provincial level data during the period of 1985 to 2005. They attributed the resource curse to the arrangement of property rights on natural resources. In the planned economic era, the Chinese government set low prices for natural resources, and the government and state-owned firms captured most revenues generated from the production of natural resources. However, in the sub-period of 1995-2005, during which most natural resource prices were liberalized, they found that the significant negative linkage between resources and economic development disappeared.

For this paper, we carried out an empirical analysis of data concerning 95 cities in China from 1997 to 2005, and observed no obvious evidence indicating an explicit relationship between natural resources and economic development at the city level in China. An advantage of using city-level data is to overcome the small-sample problem in a cross-sectional regression. However, after controlling the province dummy variables, we observed that resource abundance in one city imposes a significant positive spill-over effect on the other cities within the same province. Moreover, an analysis of the transmission channels of such spill-over effects revealed that resource abundance boosts the manufacturing industry in the other cities, which is consistent with the big-push theory. However, our findings did not contradict the existing results that support a negative relation between resource abundance and economic growth.

The impact of natural resources on economic development is very complicated. The Chinese case tells a different story than the observations of Papyrakis and Gerlagh (2007) in the U.S. We demonstrated that in the early development stage, resource booms can boost industrialization and subsequently provide an impetus to economic growth; however, the long-run impact of resources on economic development remains yet to be unraveled. It is possible that, over the course of time, there is a gradual reversal of the impact of resources. Numerous evidence shows that resources can have both positive and negative channels that affect economic development. In the long run, we believe that “the ability of a country to exploit its resource base depends on the nature of the learning process involved” (Stijns, 2005).

Section 2 of this paper introduces the development of China’s mining industry, the data set, and our cross-sectional empirical model, which we use to determine whether resource abundance slows the pace of economic growth. Section 3 discusses the results of this model: we find that resource abundance does not negatively impact economic growth at the city level in China. However, resource abundance in one city imposes positive spill-over effects on the other cities in the same province. Section 4 investigates the different transmission channels of the positive spill-over effects discussed in Section 3 and these channels’ corresponding spill-over effects. Lastly, our conclusion is presented in Section 5.

2. The “Curse of Resources” Revisited

2.1 Development of China’s Mining Industry and the Emergence of Resource-Based Cities

China is indeed a country well endowed with natural resources. However, little geological survey work was performed before modern times. When the People’s Republic of China was established in 1949, the backward mining industry was poorly developed and had a very small production capacity; China was producing only 32.43 million tons of raw coal, 0.12 million tons of petroleum, 0.59 million tons of iron ore, etc.^①

Today, China is the biggest producer—as well as consumer—of coal in the world. In 2005, raw coal output reached 2.19 billion tons. At the same time, coal

^① Data sources: Publications of China Mining Association, available at www.chinaming.org/Facts/2006-09-19/1158647425d1232.html. Last accessed in August, 2009.

consumption increased from 1.26 billion tons in 1990 to 2.16 billion tons in 2005. Ministry of Land and Resources (MLR) statistics also showed that in 2005 the output of crude oil was 181 million tons; natural gas was 49.953 billion cubic meters; iron ore was 421 million tons; and the output of 10 kinds of non-ferrous metals amounted to 16.35 million tons.^② According to an MLR survey of nationwide state-owned and other types of mining firms, the total output value achieved by all types of mining firms in China reached RMB 454.2 billion in 2002. The output of coal, steel, and ten non-ferrous metals together with concrete ranked as first globally, and the output of crude oil ranked fifth in the world.

The tremendous development of the mining industry started with China's new government in 1949, which quickly recognized that the weak mining industry could not meet the vast demand of large-scale construction outlined in its first five-year plan. Hence, the mining industry entered its first stage of development, the vigorous development stage, from 1949 to 1957. Development in this period focused on mineral energy resources, raw materials for the iron/steel and other heavy industries, and raw materials for chemical fertilizers to serve agricultural development. By the end of this first stage, China saw a great increase in major mineral production and the mineral processing industry.

The second development stage, the tortuous period from 1958 to 1978, coincided with an overall difficult time in China's economic growth. However, this period also marked some of the most remarkable achievements in the mining industry. The

^② Data sources: Publications of China Mining Association, available at <http://www.chinamining.org/Investment/2007-06-28/1183013495d5867.html>. Last accessed in August, 2009.

successful discovery, exploration, and development of a series of large oilfields, including the Daqing and Shengli oilfields, ended the belief that China was poor in petroleum resources. Meanwhile, many large mineral deposits were also discovered. By the end of this stage, the number of mineral resource varieties with explored reserves increased from 74 in 1957 to 132 in 1978.

The economic reforms that started in 1979 began the third stage of the mining industry's development: the rapid-development stage from 1979 to present. Like the rest of the economy, China's mining industry experienced rapid and substantial growth. A large number of nonmetallic mineral deposits were discovered and developed; successful geological exploration in western and sea areas led to new petroleum and natural gas fields; new breakthroughs were also made in the explorations of gold reserves, copper mineral resources, and coalfields.

Today, China ranks third in the world in the scale of its total mineral resources exploitation.^③

The tremendous development of China's mining industry told a story of not only remarkable achievements in mining industry production and technology, but also of the emergence of mining cities and towns, as well as their path of economic development. China's unique economic transition with government-led policies and reforms has always shown a great capacity for mobilizing resources to achieve its economic ambitions, during both the central-planning era as well as the market-reform periods. The three development stages saw the emergence of many

^③ Data sources: Publications of China Mining Association, available at <http://www.chinamining.org/Investment/2006-07-25/1153813195d199.html>. Last accessed in August, 2009.

mining cities and towns across 26 of its 31 provinces, often in remote and wild areas, as a result of the large-scale exploration of mineral resources. These resource-based cities not only became an entity of their own, but also promoted regional economic growth, hired millions of workers, and largely impacted the distribution of China's heavy industries. It is the story of these cities and the role they play in regional economic growth that laid down the foundation of our empirical studies.

2.2 Empirical Model and Data

We used the following cross-sectional model to re-examine whether the “curse of resources” is prevalent in China:

$$\ln Y_i = \alpha + \beta \text{mining}_i + \Pi X_i + u_i \quad (1)$$

where Y_i represents the average growth rate of the logarithm GDP per capita between 1997 and 2005 in the i th city in 2006; mining_i denotes the fraction of mining workers in the local total population in city i , which is the measurement of resource abundance; and X_i includes the other control variables that would exert influence on the long-term economic growth, with u_i as the random error terms.

We believe the fraction of laborers in the mining industry in the local population is a good proxy for measuring natural resource abundance, because mining industry statistics include nearly all the specific industries that are directly related to natural resources, such as coal, oil, natural gas, and metal and nonmetallic ores. Therefore,

this measure can describe a broad and yet precise picture of the natural resources in a particular area, covering all mining-specific industries. Furthermore, using the total local population as the denominator provides the advantage of avoiding the volatility in GDP. To reflect the long-run picture of natural resources throughout China, we considered the average level of natural resource abundance from 1997 to 2005.

Additionally, the other control variables in our model possessed some long-term factors widely used in the literature. *Dlandlock* is the dummy variable indicating a coastal city, while the dummy variable *Dspecial* represents any of the following: a municipality directly under the Central Government, a special economic zone, the capitol of the province, and the city specifically designated in the state plan. The variable $Y_{i,1990}$, denoting the GDP per capita in 1990, is included as the initial GDP per capita, as China's economic system reform took off in most of her big cities in 1990. This is consistent with the "conditional convergence" model in the economic growth theory. Furthermore, we also included a new control variable, *Xinter*, by multiplying *Dlandlock* and GDP per capita in 1990, per the suggestion by Sachs and Warner (1995).

The data used in this study were from either volumes of Chinese Statistical Yearbooks or World Bank Report (2006), covering 95 main cities in China. In 2005, the GDP of these 95 cities accounted for 47.7% of the national GDP. Table 1 lists the number of cities included in our data set for each province, as well as the number of top-30 mining cities located in that same province in our data sample^④. Provinces are

^④ The mining cities are ranked by the fraction of mining workers in the local total population in a city.

ranked by their 2006 GDP per capita value in descending order. For example, Jiangsu Province, the 5th “richest” province in China, has 9 cities in our data set. Among those 9 cities, 4 are in China’s top-30 mining cities.

3. Empirical Results

(insert Table 2 here)

Table 2 shows the relationship between resource abundance and economic development at the city level in China, determined using the classical regression framework. To adjust for heteroskedasticity across the cities, all the standard errors and the corresponding t statistic were calculated using the White procedure. The results demonstrated that there is no significant relation between resource abundance and economic development. On the contrary, the initial conditions were observed to play a crucial role in explaining the variance in economic growth among cities. The significant positive coefficient of the initial condition demonstrated no convergent property, which implies an increasing economic discrepancy among the cities.

Despite the fact that no evidence of “curse of resources” was observed in Chinese cities, we were unable to extend this conclusion to the Chinese provinces. Provinces are entities with relatively independent distribution rights in both administration and economic resources. As a result, it is likely that natural resource–abundant cities would affect the other cities’ economies through a variety of transmission channels, even in the absence of “curse of resources” at the city level. Some examples of

transmission mechanisms include bureaucratism as well as crowding out investments in manufacturing production or human capital in other cities within the same province. Owing to the possibilities, we need to investigate further to determine whether resource-abundant cities impose a spill-over effect on the other cities within the same province, and if so, we must identify the markers of such effects before we draw a more definitive conclusion.

For testing the spill-over effect, we considered the following regression model:

$$\ln Y_i = \alpha + \beta \text{mining}_i + \lambda D_i + \Pi X_i + u_i \quad (2)$$

The only difference between this model and Eq. (1) is the dummy variable D , indicating whether or not the province to which the city i belongs is rich in natural resources. In particular, we considered three criteria for judging resource wealth. By ranking the 95 cities based on the fraction of mining workers in the local population, we assigned 1 to cities located in the same province as the top 10 cities, while the remaining cities were assigned 0, and thus, we obtained $D1$. Similarly, $D2$ was obtained by recognizing 10 cities from the perspective of the absolute amount of mining workers, while $D3$ was obtained on the basis of average energy production. The variable D was established with every effort to document the spill-over effect of the resource-abundant city on the other cities within the same province.

(insert Table 3 here)

By examining the results in Table 3, we can observe that in all the regression models, the OLS estimates of $D1$, $D2$, and $D3$ are positive, indicating that resource-abundant cities may impose a positive spill-over effect on the other cities within the same province. It can be observed that the estimates of the coefficients of $D1$ and $D2$, whose respective values are 0.017 and 0.029, are positive and statistically significant without the presence of other controlled variables. By holding the initial condition with the addition of the dummy variable for the coastal cities, the coefficients of $D1$ and $D2$ still remain statistically significant, with the value of 0.017 (p value 0.056) and 0.030 (p value 0.001), respectively

Since resource abundance is measured based on the share of mining workers in the local population, it's possible that some unobservable shocks exist that impact both the employment rate in the mining industry and economic growth. To mitigate for the potential endogenous variable problem in the above regression, we considered the average level of resource abundance (the share of mining workers in the local population) from 1997 to 2001. We found the main results remained the same.

The empirical analysis shows that although the relationship between resource abundance and economic performance remains insignificant at the city level, resource-abundant cities tend to impose a spill-over effect on the other cities within the same province. This evidence led us to the tentative conclusion that in the current stage, the “curse of resources” hypothesis is subverted and economic development flourishes with abundant resources. Before we examine the impact of this evidence on

the development theory in the subsequent section, we will perform a detailed analysis of the main transmission channels of the spill-over effect of resource-abundant cities.

4. Transmission Channels for Spill-Over Effects

4.1 Empirical Models and Possible Transmission Channels

Our analysis of resource-curse transmissions follows the methodology developed by Papyrakis and Gerlagh (2004), who first investigated the transmission channels through which institution, education, openness, investment, and other factors affect economic growth. Their model is as follows:

$$Z_i = \alpha + \delta \text{min } ing_i + \lambda D_i + \Pi X_i + u_i \quad (3)$$

where D represents the dummy variables defined in Section 2. As $D2$ is, to some extent, robust in variables of regressions, we used $D2$ to describe the spill-over effect of resource abundance in this section. The X_i represents a set of variables, including GDP per capita in 1990, dummy variables for landlocked cities and open cities, as well as an intersection term multiplying the GDP per capita in 1990 by the dummy variable for landlocked cities. The variable Z represents possible transmission channels from one city to the other cities in the same province. This model focuses on two effects, of which coefficient δ measures the crowding-out effect of resource abundance on the city itself, while λ , the coefficient of $D2$, reveals the spill-over effect of resource abundance of one city on the other cities in the same province.

To combine China's real situation with that discussed in the previous studies, the following possible transmission channels were considered: first, government efficiency, the data for which was obtained from World Bank (2006), was used to measure the institution quality. Abundant natural resources may cause people to underestimate the importance of government efficiency in economic growth, which was also considered by Papyrakis and Gerlagh (2004).

Second, the relative scale of the manufacturing industry in an economy was taken into account, which was measured as an average ratio of manufacturing-industry production value to the GDP from 1997 to 2005. Sachs and Warner (1995, 1997, 1999) pointed out the crowding-out effect of resource abundance on manufacturing, which indicates the famous "Dutch disease" effect.

Third, we also considered human capital investment, interpreted as the ratio of the number of teachers from primary schools, middle schools, and universities to the local population. As the primary sector does not need human capital, the human capital investment and accumulation are considered inadequate to support economic growth.

Fourth, we emphasized the importance of R&D, which was calculated by two measurements: the ratio of R&D workers to local population, and the ratio of fiscal expenditure for R&D to GDP.

Fifth, as openness may be affected by resource abundance, in the sense that richness in natural resources may lead people to conservativeness and resistance to reform and openness, we also included openness in our analysis, usually measured by

the ratio of export and import to GDP. However, as these data were not available at the city level, we used the ratio of usage of foreign direct investment (FDI) to GDP.

Finally, we considered the potential effect of entrepreneurship on economic performance, which was first observed by Sachs and Warner (2001), who claimed that abundant resources would “squeeze out” entrepreneurship, thus impairing long-run economic growth. In China, resource abundance is accompanied by more state-owned enterprises and stricter government intervention as well as monopoly, which is unsuitable for the development of other categories of enterprises. In our measurement of entrepreneurship, we used the fraction of population in the private sectors to the local population. All the measurements were observed to be the average values from 1997 to 2005, except for government efficiency.

4.2 Regression Results on Transmission Channels

The investigation of transmission channels yielded very interesting results. It showed that resource abundance can have different impacts on various aspects of social and economic development. While in some cases resource abundance generates either no significant or actually sometimes negative effects, we found that resource abundance can be a good thing for neighboring cities. We will discuss the impacts of resource abundance on *local* development in this section and focus on the positive spill-over effects to neighboring cities within the same province in section 3.3.

(insert table 4 here)

We observed that resource abundance itself exerts no significant effect on local government efficiency. Resource abundance also diminishes the local manufacturing sector, the coefficient of which was observed to be -0.753 , with a p value of 0.001 . Resource abundance was observed to encourage the government to develop mining and primary sectors, instead of the manufacturing sector.

Moreover, we did not observe any evidence that resource abundance diminishes human capital. Instead, the coefficient of mining was 0.036 and the p value was approximately zero. This may be due to the fact that resource-abundant cities, accompanied by more state-owned enterprises, will be equipped with more teachers and schools than many other cities. However, we were unable to find a significant spill-over effect of resource-abundant cities with respect to human capital investment.

Furthermore, we observed that resource abundance imposes a “squeezing out” effect on certain economic activities and economic inputs. For example, resource abundance significantly squeezes out R&D, which is measured by the ratio of fiscal expenditure for R&D to GDP. However, the coefficient was small, with a value of -0.003 , and the p value was 0.01 . We also observed that resource abundance significantly influences openness, the coefficient of which was -2.78 with a p value of 0.013 . Besides, resource abundance was observed to reduce the potential entrepreneur activities, the coefficient of which was -0.454 with the p value of 0.002 . However, we did not observe any spill-over effects of resource abundance on R&D, openness, and entrepreneurship.

4.3 The Positive Spill-Over Effects of Resource Abundance to Neighboring Cities:

While resource abundance suppresses certain economic activities (such as the manufacturing industry) for the local city, it actually boosts industrialization in other cities in the same province. In our regression results, the estimation of the coefficient of $D2$ was 0.016 with a p value of 0.04, which demonstrates the statistically significant positive spill-over effects to the manufacturing sector in other cities.

A brief look at the industrial development history of many Chinese cities confirms such sequential dynamics between “mining cities” that are resource abundant and the other industrial cities located in the same province. The traditional planned-economic approach to organize economic activities certainly played a role in connecting resource-abundant cities to the industrial development of adjacent cities. In addition, economic incentives also brought these cities together during the market-oriented, post-reform era.

Beginning in the 1950s, with the great progress made in large-scale exploration of mineral resources, China built many mining cities. Many of these cities started with nothing more than a state-owned mining enterprise, a process later referred to as “first comes the factory, then the town.” Cities like “Daqing (in Heilongjiang province), Panzhihua (in Sichuan province), Bayan Obo (in Inner Mongolia) etc... [were] formed based on the discovery of large mineral deposits, and successful exploration and mining of mineral resources.”[®] By 2006, there were 12 cities whose mining

[®] Source: “Historical Feats of the Mining Industry,” published by China Mining Industry, available at <http://www.chinamiing.org/Facts/2006-09-19/1158654615d1247.html>.

output value amounted to over 70% of their total urban industrial output value.^⑥

The mining industry in these cities provided crucial energy and raw materials support for regional economic development. For example, the cheap electricity generated by China's vast coal resources helped with the fast-paced industrialization process. It also became an important source for provincial government revenue. For example, Masteel (MaGang) is a major iron and steel complex in China and also the largest enterprise in Anhui province. Masteel is a very important "profit tax account" (Lishui Dahu) to Anhui province. Provinces that became "rich" because of a profitable mining industry have more resources available for building infrastructure that is crucial for industrial development. Also, the competitive market forces that lead enterprises to seek lower production costs make manufacturing firms look for better deals with materials provided by these mining cities in the same province.

Meanwhile, local government often encourages such cooperation between resource-abundant cities and other firms in the same province, which ultimately opens up more sales channels for mining enterprises, as well as increases the competitiveness of other provincial firms. After all, local government understands that when firms do well, the province benefits, too, with higher tax revenue and faster economic growth. In fact, recently, Anhui province organized meetings among Masteel and other major iron-and-steel-using manufacturing firms, hoping to promote trade among these enterprises.^⑦ Mastell anticipates signing new contracts to supply

^⑥ Data reported by China Mining Industry, available at <http://www.chinamiing.org/Facts/2006-09-19/1158654615d1247.html>.

^⑦ Source: 21st Century Economic Reports (21 Shiji Jingji Baodao), available at <http://finance.jrj.com.cn/2009/02/2601083672010.shtm>.

raw materials to car manufacturing and other enterprises in Anhui province.

Such policies, of course, breed local protectionism (which is not the focus of this paper), and explain the relationships between the mining industry in resource-abundant cities and other manufacturing firms in the same province. Baiyin City in Gansu province is another example; its major state-owned mining and mineral-processing enterprises supply their products to other enterprises in a tight “industry chain.”[®]

From the analysis described earlier, we observed that natural resources do have an impact on China’s economic growth through different transmission channels. Though natural resources were observed to diminish the local manufacturing industry, they significantly boost industrialization in the other cities in its province, thus playing a positive role in economic growth at the provincial level. When a large-scale natural resource industry is established with the help of local abundant resources in one city, the energy-intensive manufacturing industry—with inputs of coal, metallic ore, and nonferrous metals—will automatically gather around this city due to geographic factors like transportation cost. Moreover, wealth accumulated from the energy industry must be invested in the manufacturing industry to obtain a higher return rate. These two considerations may facilitate the transformation of resource-abundant provinces from agricultural to industrial societies.

The findings in this study contribute to the “big push” theory, primarily exemplified by Murphy, Shleifer, and Vishny (1989). They emphasized the

[®] Source: <http://www.gspc.com.cn/n850c14.aspx>.

importance of simultaneous industrialization across all sectors in the economy, which may help the sector overcome fixed costs during industrialization. This was confirmed in our studies on the effect of natural resources on economic performance. Natural resource abundance obviously affects the manufacturing industry of the other cities within the same province. Such coordination across different sectors could reduce the industrial cost and augment return on industrialization, which may energize economic performance at the provincial level.

5. Conclusions

Diverse historical evidence from cross-country data and regional analyses have caused doubt about whether natural resources act as a curse or blessing for economic growth, resulting in the fragmentation of various economists' studies into different courses. Although the "big push" theory could provide a reasonable explanation for the positive effect of natural resources on economic performance, increasing emerging experiences from different countries and regions within a country have weakened the theory of resource-led growth. Several possible transmission channels—such as institution, education, R&D, openness, and entrepreneurship—have been identified as the driving force of economic growth but are crowded out by the natural resource boom.

Our study basically rests on the framework established by the previous studies. By regressing the logarithm of GDP per capita in 2006 on the population of mining workers and holding the initial conditions constant, we observed no significant

relationship between natural resources and economic growth, either positive or negative. The obscure correlation between natural resources and economic development was intact even in the presence of alternative measurements for economic growth.

Before concluding that natural resources impose no obvious effect on economic growth, we included a series of dummy variables for provinces on the condition that provincial governments in China have independent rights to distribute administration and economic resources. The results demonstrated that these dummy variables for province are statistically significant and positive, which could be interpreted as a spill-over effect of resource-abundant cities on the other cities within the same province. From studies on various transmission channels, the natural resource was observed to invigorate the manufacturing industry in other cities within the same province and produce simultaneous industrialization across different sectors. Thus, this result adds a different dimension to the impact of resources on economic development in addition to those observed in the previous studies.

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**Table 1: Description of Locations and Resource Abundance
for the Cities in Our Data Set**

	Province (ranked by GDP per capita, descending order)	No. of Cities in the Data Set	No. of Top 30 Mining Cities
1	Shanghai	1	0
2	Beijing	1	1
3	Tianjin	1	0
4	Zhejiang	6	1
5	Jiangsu	9	4
6	Guangdong	8	0
7	Shandong	9	4
8	Liaoning	6	3
9	Fujian	4	1
10	Hebei	6	5
11	Heilongjiang	2	1
12	Jilin	2	0
13	Shanxi	2	2
14	Henan	3	1
15	Hubei	6	1
16	Hainan	2	1
17	Chongqing	1	0
18	Shaanxi	2	1
19	Hunan	6	1
20	Qinghai	1	0
21	Jiangxi	2	0
22	Sichuan	5	1
23	Guangxi	2	1
24	Anhui	3	1
25	Yunnan	2	0
26	Gansu	2	0
27	Guizhou	1	0

Source: China Statistical Yearbooks (various years)

Table 2: A Test of “Curse of Resources” Hypothesis

	(1)	(2)	(3)	(4)	(5)
<i>Mining</i>	0.123 (0.169)	0.130 (0.143)	0.125 (0.148)	0.138 (0.133)	0.136 (0.183)
<i>D_landlock</i>		0.003 (0.847)			0.0005 (0.976)
<i>D_special</i>			0.0003 (0.977)		-0.0007 (0.953)
<i>lnY90</i>				-0.005 (0.558)	-0.005 (0.618)
<i>X_inter</i>				-0.00009 (0.259)	-0.00009 (0.260)
R squared	0.0041	0.0048	0.0041	0.0144	0.0145
Sample Size	95	95	95	95	95

Note: The dependent variable is the average growth rate of the logarithm real GDP per capita. All values in parentheses are p values.

Table 3: A Test of "Spill-Over" Effect at the Provincial Level

	(1)	(2)	(3)	(4)	(5)	(6)
<i>Mining</i>	-0.073 (0.448)	-0.185 (0.025)	0.109 (0.241)	-0.038 (0.760)	-0.190 (0.151)	0.123 (0.196)
<i>D1</i>	0.017 (0.028)			0.017 (0.056)		
<i>D2</i>		0.029 (0.000)			0.030 (0.001)	
<i>D3</i>			0.006 (0.443)			0.004 (0.595)
<i>D_landlock</i>				0.007 (0.692)	0.005 (0.754)	0.00007 (0.996)
<i>D_special</i>				-0.0003 (0.977)	-0.0002 (0.986)	-0.001 (0.920)
<i>LnY90</i>				-0.007 (0.485)	-0.002 (0.842)	-0.005 (0.613)
<i>X_inter</i>				-0.00004 (0.637)	0.00005 (0.557)	-0.00008 (0.317)
R- squared	0.0397	0.1348	0.0107	0.0474	0.1347	0.0175
Sample size	95	95	95	95	95	95

Note: The dependent variable is the average growth rate of the logarithm real GDP per capita. All values in parentheses are *p* values.

Table 4: A Test of "Spill-Over" Effect in the Transmission Mechanism

<i>Variable</i>	<i>Government efficiency</i>	<i>Manufacturing</i>	<i>R&D</i>		<i>Human Capital</i>	<i>Openness</i>	<i>Entrepreneurship</i>
			<i>R&D staff</i>	<i>Expenditure in R&D</i>			
<i>Mining</i>	0.812 (0.370)	-0.753 (0.001)	0.013 (0.621)	-0.0034 (0.011)	0.036 (0.000)	-2.778 (0.013)	-0.454 (0.002)
<i>D2</i>	0.071 (0.059)	0.016 (0.043)	-0.0007 (0.327)	0.0001 (0.146)	-0.0004 (0.256)	0.025 (0.611)	-0.0006 (0.935)
<i>D_landlock</i>	-1.759 (0.001)	-1.107 (0.000)	-0.007 (0.661)	-0.0004 (0.791)	-0.035 (0.000)	0.660 (0.356)	-1.752 (0.000)
<i>D_special</i>	0.066 (0.255)	-0.012 (0.276)	0.003 (0.011)	-0.00006 (0.646)	-0.0007 (0.862)	0.048 (0.457)	0.002 (0.838)
<i>lnY90</i>	-0.349 (0.311)	0.048 (0.000)	0.003 (0.028)	-0.00007 (0.628)	0.0002 (0.477)	0.120 (0.067)	0.031 (0.000)
<i>X_inter</i>	0.202 (0.001)	0.134 (0.000)	0.0006 (0.759)	0.00008 (0.346)	0.0041 (0.000)	-0.070 (0.414)	0.210 (0.000)
<i>R-squared</i>	0.1222	0.6470	0.2550	0.1006	0.3831	0.1561	0.7269
<i>Sample size</i>	95	95	95	95	95	95	95

Note: All values in parentheses are *p* values.