Crowding-out Effect or Institutions? The Resource Curse Revisited with an Investigation of U.S. States

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The phenomenon of low economic growth in resource-rich regions is recognized as the "resource curse". This research empirically shows the existence of a resource curse at the U.S. state level. Of two widely offered explanations for the resource curse, our analysis supports the crowding-out effect in the U.S. rather than the institutional explanation. Investment and R&D are the two main crowded-out factors.

Key Words: Crowding-out, Economic growth, Institution, Resource Curse

JEL Classifications: Q20, Q30, O13, O51, C23

1. Introduction

Economic growth depends on production factors, such as capital, labor, and natural resources. But does resource abundance promote economic development? Although a "yes" answer seems obvious, some of the fastest growing economies over recent decades are regions with little natural wealth, whereas countries with enormous resources suffer from poor economic performance, such as Angola, Sierra Leone and the Democratic Republic of Congo. The phenomenon that resource-rich regions develop less quickly is called the *resource curse*. It is formally presented by Auty in 1993 and, since then, it has become "one of the most intriguing puzzles in economics development and a great example of how organized empirical observations can guide economic theory and inform policy" (James and Aadland, 2011:440).

The resource curse has attracted numerous studies and intensive debate. Two hypotheses have been proposed to explain the phenomenon. The *crowding-out effect* suggests that resource abundance crowds out certain growth-friendly factors such as investment, human capital, innovation and so on, which hinders the growth. On the other hand, the institution explanation argues that whether resource abundance is a curse or not depends on the institutional quality of the resource-rich region. Economic development will not be cursed in the presence of higher institution quality. Both explanations have been supported by certain empirical work (Sachs and Warner, 1995, 1999 and 2001; Mehlum et al. 2006).

Our results show evidence that a resource curse exists at the U.S. state level and that the crowding-out effect accounts for the negative relationship, rather than the institutional explanation. The rest of the paper is organized as follows: section 2 contains a review of the literature on the resource curse, addressing the two explanations. Empirical models and the dataset are specified in section 3, followed by discussion of empirical results in section 4. Our main conclusions are stated in section 5.

2. Literature Review

After the resource curse phenomenon was introduced, numerous theories have been offered to explain the negative correlation between resource abundance and economic growth. The crowding-out effect and institutional explanation are two main streams developed by economists.

The crowding-out effect can be summarized as resource abundance reducing the amount of activity *X*, where *X* drives growth. Different crowd-out stories are based on different *X* factors. Sachs and Warner developed this crowding-out idea (1995, 1999, and 2001), and they identified *X* as tradable manufacturing activities in a Dutch disease model with three sectors: a tradable natural resource sector, a tradable (non-resource) manufacturing sector, and a non-traded sector. In this model, a resource boom raises demand and drives up prices of non-tradable goods. This squeezes profits in the tradable manufacturing sector, which uses the non-tradable goods as inputs and faces relatively fixed international output prices. The shrinking of the manufacturing sector lowers growth in the long run. Further, because of learning-by-doing processes that improve labor effectiveness in the manufacturing sector, the crowding-out factors could be education (Gylfason, 2001), human capital investment (Stijns, 2006), or knowledge creation (Papyrakis and Gerlagh, 2004).

Besides tradable manufacturing activities and human capital related to them, other crowding-out factors have been investigated as well, such as saving, investment and finance development. Saving adjusts downward due to resource income. A windfall from natural resource enhances future income, so that less saving is required. Investment adjusts to savings, which slows the growth process (Papyrakis and Gerlagh, 2006 and 2004). Resource abundant economies are also associated with less development of the financial system. Enterprises receive less external financing and bank loans (Beck, 2011) in resource-abundant economies.

Different X factors addressed in the crowding-out effect imply different answers to what ultimately drives growth. However, no matter how diverse the key X factors are, the logic behind the crowding-out effect suggests that the problem lies in natural resource itself. Some inherent disadvantages of the natural resource industry are embedded in the theoretical model, such as lack of knowledge accumulation (Sachs and Warner, 1995) and fewer backward or forward linkages (Hirschman, 1958).

A competing explanation suggests that whether resources are blessed or cursed depends on the quality of institutions. Rather than Dutch disease models, Mehlum et al. (2006) modeled a resource-abundant economy with grabber-friendly institutions and producer-friendly ones. The allocation of entrepreneurs between production and grabbing (i.e., rent-seeking) depends on the quality of institutions. In a grabber-friendly economy, a resource boom pulls entrepreneurs into grabbing and the drop in production profit increases the number of grabbers even more, which pushes aggregate income down and harms economic development. In order to test the institution hypothesis against the crowding-out explanation, they use Sachs and Warner's dataset and methodology. They concluded that institutions are decisive for the resource curse. Boschini et al. (2007) also argued that the potential problem of natural resource can be countered by good institution quality. Countries rich in minerals are cursed only if they have low-quality institutions, while the curse is reversed if institutions are sufficiently good. Therefore resource abundance is not doomed to be cursed but is conditional on institution quality. We call this point of view as the institution explanation.

In addition, economists have sorted natural resources into diffuse and point resources. The former includes agriculture, forestry, and fishing, while the latter consists of oil, coal, gas, and so on. The type of natural resource matters to the resource curse because point resources generate concentrated production and revenue patterns while revenue flows from diffuse resources spread throughout the economy. It is believed that point resources are more likely to be cursed (Auty, 2001). Murshed (2004) concluded that point resources tend to breed rent-seeking behaviors and harm political institutions such as democracy.

Note that Murshed's argument still lies in the crowding-out explanation camp even though he also recognized institution as the crucial link between resource abundance and growth. The pivotal logical distinction between two arguments rests in the role of institution. With the crowding-out effect, institution development is another growth-friendly factor *X* that is retarded by natural resource endowment, which in turn hampers economic growth (Murshed, 2004). While in the institution explanation, ex-ante institution quality in a resource-abundant economy matters. Though resource rents could be captured by the elite and minority interest groups for personal enrichment, they can be allocated into a productive economy as well. Into which channel it goes depends on the quality of institutions. Therefore, whether the windfall is from either natural resource or foreign aid does not alter the nature of the problem. It is a revenue curse rather than a resource curse (Morrison, 2010).

This paper is most closely related to the work by James and Aadland (2011), and Corey (2009). James and Aadland (2011) investigated 3092 counties across the U.S. and showed clear evidence that a resource curse existed. However, they did not further analyze the transmissions that caused resource curse. Corey (2009) examined the resource curse at the U.S. state level in the institutional explanation framework with an interaction term of natural resource and institution variables in an empirical model, but the potential crowding-out effect was omitted without testing. In addition, both of these studies applied cross-sectional data in their empirical work rather than panel data. Panels contain more information, thus allowing for an increased precision in estimation. In this study, we use panel data of U.S. states to verify the existence of the resource curse and distinguish between the crowding-out and institutional explanations.

3. Empirical Model and Data

3.1 Model Specification

There are two goals in the empirical analyses. The first is to examine the resource curse hypothesis in the U.S. state level. We differentiate among natural resources as diffuse resources, point resources, and a sum of both. A traditional neoclassical model of income convergence (Barro and Sala-i-Martin, 1992, Mankiw et al., 1992) is used to test the curse of natural resource:

$$(1) \quad G_{i,t} = X_{i,t}^{'}\gamma + \beta_0 + \beta_1 lnY_{i,t-1} + \beta_2 Resource_{i,t} + v_{i,t},$$

where *i* indicates state and *t* refers to time. *G* is annual growth in personal income per capita. *Y* is per capita personal income lagged one period. *Resource* is a measure of resource abundance, for which there are three proxies: *Resource_diffuse* stands for diffuse resources, which is the percent earnings from agriculture, fishing, and forestry; *Resource_point* represents point resources and is measured as percent earnings from mining industries; *Resource* is sum of both diffused and point resources earning over gross state product (GSP). *X* is a vector of other controls including investment, human capital, R&D, and institution quality proxies (Table 1). In order to verify the existence of the resource curse in the U.S. state levels, β_2 should be negative, which implies a negative relationship between resource abundance and economic growth.

Second, we will test the two competing hypotheses: the crowding-out effect and the institution explanation. The econometric specification is as follows:

(2) $X_{i,t} = \alpha_0 + \alpha_1 Resource_{i,t} + \alpha_2 lnY_{i,t-1} + \mu_{i,t}$,

(3) $G_{i,t} = X_{i,t}^{'}\gamma + \beta_0 + \beta_1 lnY_{i,t-1} + \beta_2 Resource_{i,t} + \beta_3\left(Resource_{i,t} \times x_{i,t}\right) + \varepsilon_{i,t}$,

In the literature, the crowding-out effect was tested in regressions of growth-friendly factors (controls in *X*) on resource variables (Sachs and Warner, 1995, Shao and Qi, 2009) as in Equation (2). A negative α_1 implies that factor *X* decreases with the resource abundance level so that *X* is crowded-out by the resource boom. Different growth-friendly factors are included in vector *X*, such as investment, human capital, R&D, and good institutions. Expanding the interaction term into the crowding-out empirical framework differentiates this study from others. With the interaction term of the resource variable and *X*, Equation (3) allows us to further test the effect of resource abundance on the marginal effect of *X*: If β_3 is negative, the marginal effect of a certain growth-friendly factor *x*, which is $(\gamma + \beta_3 \times NR)$, is also decreasing in the resource abundance level. The diminishing marginal effect of *x* explains the decline of *x* in a resource-rich region.

The institutional explanation originally introduced an interaction term between the resource variable and institution proxies (Boschini et al., 2007, Mehlum et al., 2006). In Equation (3), when β_2 is negative while β_3 is positive, the institutional explanation is supported because the marginal effect of natural resource is conditional on the level of institution ($\beta_2 + \beta_3 \times Institution$). We continue with this framework to test the institutional explanation.

One empirical concern of the institutional explanation in the state level is the proxies for institution quality. In cross-country studies on the resource curse, scholars have employed different proxies to indicate institution quality, such as the degree of democracy (Murshed, 2004), rule of law and government effectiveness measured by the World Bank (Bulte et al. 2005), transparency (Williams, 2001), and so on. However, proxies relying on trade restrictions, economic turmoil, or civil conflict are unlikely to be the cause of the resource curse across relatively homogeneous U.S. states. Thus, based on literature and data availability, we suggest three indices of institutional quality, including the Fraser Institution's Economic Freedom of North America Index (EFNA), public official corruption conviction data from the U.S. Attorney's offices, and the Ranking of State Liability Systems by the U.S. Chamber of Commerce.

3.2 Data Description

Panel data is used in this study. The dataset covers the 50 states in the United States from 1997 to 2008. Washington D.C. was omitted because of missing data. Except for the three institution proxies, and data of R&D activities is from National Patterns of R&D Resources, 2009 Data Update (2012), other data were downloaded from the U.S. Census Bureau's website.

Across the 50 states, the average growth in annual per capita personal income is 4.51% from 1997 to 2008, while the average fraction of earnings from the resource sectors is 4.51% (Table 1). The variation in resource specialization across U.S. states is substantial, especially for point resources. On the low end, only 0.007% of Delaware's GSP in 2008 is from extraction of point resources while Alaska had 43.24% of earnings derived from point resources extraction in 1998.

For Institution Quality (IQ) indices, both the Economic Freedom Index and the score of state liability system did not show much variation.

4. Discussion of the econometric results

Estimation methods for panel data include pooled OLS, fixed effect, and random effect. Random effect estimation assumes that unobserved individual heteroskedasity is uncorrelated with independent variables, which is a fairly strict restriction on data. In our dataset at U.S. state levels, social norms and psychological behavior patterns enter panels as unobservable common factors. These tend to relate to the independent variables such as human capital, R&D activity, and especially institution quality. A Hausman test rejects random effect as the proper estimation method. Thus, we apply fixed effect as our estimation method due to its reduced constraint on data. In addition, Driscoll and Kraay standard errors (Driscoll and Kraay, 1998) are generated in order to correct for heteroscedasticity, autocorrelation, and spatial dependence issues. Command *xtscc* is used to obtain Driscoll and Kraay standard errors in STATA (Hoechle D. 2007).

4.1 The existence of resource curse and the type effect

We estimate five different models that control for initial income, investment, human capital, R&D activities, and corruption (Table 2). The resource variable in these regressions pools both diffuse and point resources. The coefficient on the resource variable for the sample is significant and negative. It is consistently around -0.20, implying that a one percent increase in natural resource specialization lowers per capita real income growth by twenty hundredths of a percentage point on average, all else equal. In other words, an increase in the natural resource earnings share from the lowest 0.16% (Connecticut) to the highest 43.99% (Alaska) would reduce income per capita growth by 8.77%, which is a remarkable drop on an annual basis. The absolute magnitude of the resource coefficient is higher than Corey's -0.1573 (2009).

The estimates in Table 2 suggest conditional income convergence at the state level. The coefficient on the log of per capita income lagged one period is consistently negative and significant in regressions (3), (4), and (5). All growth-friendly factors present significant positive relationships with per capita income growth. As the institution proxy, corruption hinders growth and is statistically significant at the 0.1% level.

The results from testing the resource curse with respect to different resource types are consistent with literature. In Table 3, the coefficient of the diffuse resource variable is negative but not significant while the point resources suggest a significant negative effect on income growth. Holding others constant, a one percent increase in mining's earning share is associated with 0.22% decline in per capita income growth. This difference implies that the negative effect of the total resource abundance is mainly caused by point resources rather than diffuse resources. Thus, a high extractive mining industry share in GSP may impede income growth in some U.S. states.

The problem of endogeneity related to the resource abundance measure is challenging in the resource curse literature. Flow measures are used by Sachs and Warner (1995) and Mehlum et al. (2006), such as share of natural resources in export or GDP. Other studies employed stock measures such as the share of natural capital in total capital or the value of subsoil assets (Alexeev and Conrad, 2001, Brunnschweiler and Bulte, 2008, Gylfason, 2001, Hodler, 2006). Stock measures are suggested to suffer fewer problems with endogeneity. However, how well a stock measure fits the narrative remains a question. On one hand, unexploited resources may be only tenuously connected with economic performance. It is when resources come into the production process that they become a factor to influence growth. On the other hand, if resource reserve is employed as an instrumental variable, then whether it is highly correlated with resource exploitation remains as a question. For example, a national resource conservation strategy could disturb the relationship.

Monetary flow proxies, which we use in this study, could reverse the causality because the higher proportions of energy industry in total output may be due to bad economic performance. To address this endogeneity issue, we regressed the resource variables on growth variable lagged one, two, and three periods respectively. The *F* test could not reject the null hypotheses that all coefficients were equal to zero.

4.2 Crowding-out effect or institutions?

The point resource share over GSP is used to indicate resource abundance in the rest of the analysis. In order to test the crowding-out effect, we regress the growth-related factors, such as investment, human capital, R&D, and institution proxies on the resource variable and the initial income level. All else equal, higher point resource share is associate with lower investment level, higher human capital level, less R&D expenditure, and poorer liability system score (Table 3). Resource abundance hinders economic growth by crowding out investment, R&D, and liability. However, why these three factors rather than others? Most interestingly, why is human capital not another crowded-out factor but instead positively related with the point resource share?

To further investigate the resource influence on growth-related factors, we introduce interaction terms in our regressions. The marginal effect of growth-friendly factor x on growth is given by Equation (4), where γ is the coefficient on x and β_3 is the coefficient on interaction terms (*Resource*x*). For the growth-friendly factors of investment, human capital, R&D, and liability, the coefficients of the interaction terms are statistically significant (Table 5). However, the sign differs from each other, implying different resource influences on the respective marginal effects.

(4) $\partial G/\partial x = \gamma + \beta_3 \times Resource$

The negative sign shows on the interactions with investment, R&D, and liability, which are exactly the same factors that are crowded-out by the resource. On average and all else equal, the marginal effect of investment and R&D on growth are (0.00989-0.000526**Resource*) and (0.296-0.0697* *Resource*) respectively, and both decrease as the point resource share increases. In another word, the returns from an additional investment or R&D to the economy are dragged down by the mining development. As the primal sector, mining industry may possess some defects such as lack of innovation or knowledge accumulation. Higher point resource share in GSP crowds out investment and R&D due to their diminishing returns to the economic growth. In the same vein, the liability system tends to be corrupted in resource-rich regions. Since point resource rents are concentrated and more easily appropriable, rent-seeking and similar growth-reducing behaviors are encouraged.

The natural defects of the mining industry are the story that the crowding-out explanation tells. The policy implications deduced from it are pessimistic: one cannot simply compensate the crowded-out factors. According to the symmetric property of the interaction specification in the empirical model, the marginal effect of the point resource share also depends on the *X*. The results suggest that the resource abundance decreases growth and the negative effect increases with investment and R&D ($\partial G/\partial Resource = -0.223 - 0.000526 * investment$ and $\partial G/\partial Resource = -0.201 - 0.0697 * R\&D$; Table 5). The injected investment or R&D would be locked in the mining industry which further weakens the marginal returns from these two factors. Therefore, increasing investment or R&D via policy does not help to escape from the curse but rather may worsen the situation.

Is this then really a resource curse that nothing can help? The institutional explanation says "No". The marginal effect of resource abundance, which is given in equation (5), can become positive with a high level of x and a positive β_3. x is an index of institution quality in the institutional explanation. We expand the interaction term to other control *X*.

$$(5)\quad \partial G/\partial Resource = \beta_2 + \beta_3 \times x$$

The positive interaction coefficients show on *Resource*HC* and *Resource*EcoFree* (Table 5). However, the institutional explanation is not well supported in our U.S. state data. Even with the Economic Freedom Index, the index itself did not show a significant positive effect on growth. In regressions with other two institution proxies, corruption and state liability system, either the variable itself or the coefficient on the interaction is insignificant.

Human capital stands out here. The positive sign on *Resource*HC* proposes that the human capital is the condition for the resource curse. In regression (2) of table 5, the marginal effect of the resource on growth is given as (-0.480+0.0123**Human Capital*), which could be positive as long as the percentage of state population with a college degree is over 39.024% (0.480/0.0123=39.024; Figure 1). This suggests the logic of institutional explanation: the resource curse is conditional on certain factors and the resource abundance will not be harmful to growth when the factors are relatively strong. In the institutional explanation, the factor that could overwhelm the resource curse is institutions. However, we find human capital plays the role to counter the curse in the U.S. In our dataset, the maximum human capital index is 38.70% (Colorado in 1999), which is still lower than the predicted level to overcome resource curse.

Why is it human capital rather than the institutions? Glaeser et al. (2004) suggested that human capital is a more basic source of growth than are the institutions. In the context of the resource curse, the job choices available to highly educated labor could break the lock-in effect so that a resource rich economy could shift away from the mining industry and into more growth-friendly sectors. On the other hand, the institution quality measurement at the subnational level could be further discussed. In cross-country studies of the resource curse, political institution indices are widely applied such as degree of democracy. However, within one nation, the political system is constant while other indicators such as rule of law or government effectiveness may vary to some degree. Restricted by the availability of data, the three proxies we use in this study do not show strong evidence on the institutional explanation of the resource curse.

5. Conclusion

The relationship between resource abundance and economic growth has been tested by numerous studies. This study tested the so-called resource curse phenomenon with U.S. state data. The results show evidence that the resource curse is present at the state level, even after controlling for initial income, investment, human capital, R&D activities, and institution quality. In addition, evidence suggests that resource abundance crowds out the growth-friendly factors such as investment and R&D activities, thus hindering growth. Therefore, the crowding-out effect seems to explain this case of the resource curse better than does the institutional explanation.

The comparison between the crowding-out effect and institutional explanation at a subnational level offers a better understanding of the mechanism of recourse curse. According to our investigation, the resource curse is conditional on human capital level rather than institution quality. While what ultimately drives growth remains as an open question, the resource curse phenomenon provides a good opportunity to investigate the answer. Moreover, further discussion on subnational level institution and proper proxies for institution could explore the resource curse deeper.

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Table 1 Variable definitions and descriptive statistics

Variable	Definition	Mean	Std.Dev.	Min	Max
G	Annual growth in per capita personal income (%)	4.51	2.13	-2.00	12.89
Y	Per capita personal income lag one period ($)	30226.55	6159.25	18079.00	55859.00
Resource	Annual percent of earnings in agriculture, forestry, fishing, and mining (%)	4.51	6.60	0.16	43.99
Resource _diffuse	Annual percent of earnings in agriculture, forestry, and fishing (%)	1.50	1.55	0.14	9.64
Resource _point	Annual percent of earnings in mining (%)	3.01	6.48	0.01	43.24
Investment	Annual growth of the proportion of industrial machinery production to its GDP (%)	3.36	18.39	-57.14	133.33
Human Capital	Annual percentage of state population with a college degree (%)	25.57	4.75	14.60	38.70
R&D	Annual ratio of total R&D performed in a state to its GDP (%)	2.07	1.50	0.00	8.76
IQ_ecofree	Annual Economic Freedom of North America Index (scale from 0 to 10 where 10 is the most free)	7.17	0.61	5.35	8.39
IQ_corruption	Annual public official corruption conviction	18.53	22.82	0.00	134.00
IQ_liability	Annual score of state liability system (scale from 0 to 100)	58.59	8.70	24.80	78.60

Note: The Institution Quality proxy, IQ_liabililty, is from 2002 till 2008. So there are 350 observations for this variable, but 600 observation for all other variables.

Table 2 Fixed Effect Estimates

G	(1)		(2)		(3)		(4)		(5)	
$\ln Y_{t-1}$	-0.682	(0.890)	-0.747	(0.856)	-2.419^{**}	(0.852)	-2.579^{**}	(0.818)	-2.405^{**}	(0.805)
Resource	-0.139^{**}	(0.0509)	-0.147^{**}	(0.0452)	-0.227^{**}	(0.0652)	-0.221^{**}	(0.0650)	-0.216^{**}	(0.0638)
Investment			0.00994^{***}	(0.00218)	0.00617^{**}	(0.00211)	0.00632^{**}	(0.00209)	0.00635^{**}	(0.00214)
$HumanCapital_{t-2}$					0.196^{**}	(0.0720)	0.187^{**}	(0.0678)	0.179^{**}	(0.0658)
$R\&D_{t-1}$							0.227^{*}	(0.110)	0.243^{*}	(0.119)
$Corruption_{t-2}$									-0.0136^{***}	(0.00337)
Constant	12.16	(9.069)	12.84	(8.743)	25.50^{*}	(9.720)	26.87^{**}	(9.428)	25.47^{**}	(9.289)
N	600		600		500		500		500	
R^2	0.012		0.021		0.039		0.042		0.046	

Note: standard deviations are in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; The Driscoll and Kraay standard errors is applied; observation becomes 500 in regression (3) till (5) because Human Capital and Corruptions are lagged two periods.

Table 3 Estimation with different type of natural resource

	(1)		(2)		(3)	
$\ln Y_{t-1}$	-1.574^{*}	(0.778)	-2.469^{**}	(0.865)	-2.405^{**}	(0.805)
Resource_diffuse	-0.226	(0.180)				
Resource_point			-0.220^{*}	(0.0906)		
Resource					-0.216^{**}	(0.0638)
Investment	0.00728^{**}	(0.00209)	0.00611^{**}	(0.00213)	0.00635^{**}	(0.00214)
$HumanCap_{t-2}$	0.156	(0.0803)	0.174^{**}	(0.0638)	0.179^{**}	(0.0658)
$R\&D_{t-1}$	0.299^{*}	(0.123)	0.227	(0.116)	0.243^{*}	(0.119)
$Corruption_{t-2}$	-0.0152^{***}	(0.00371)	-0.0132^{***}	(0.00317)	-0.0136^{***}	(0.00337)
Constant	16.77	(8.929)	25.98^{*}	(9.996)	25.47^{**}	(9.289)
N	500		500		500	
R^2	0.032		0.045		0.046	

Note: standard deviations are in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; The Driscoll and Kraay standard errors is applied; observation is 500 because Human Capital and Corruptions are lagged two periods

Table 4 Test for *crowding-out effect*

	(1)	(2)	(3)	(4)	(5)	(6)
	Investment	Human Capital	R&D	Corruption	EcoFreedom	Liability
Resource_point	-0.0290^{***}	0.0777^{*}	-0.0192^{*}	-0.0203	-0.0105	-0.310^{*}
	(0.00733)	(0.0313)	(0.00860)	(0.220)	(0.00536)	(0.152)
$\ln Y_{t-1}$	-1.410^{*}	8.295^{***}	0.868^{***}	6.473^{***}	0.209^{***}	19.20^{***}
	(0.556)	(1.011)	(0.173)	(1.440)	(0.0368)	(2.458)
Constant	15.66^{**}	-60.07^{***}	-6.805^{***}	-48.06^{**}	5.058^{***}	-140.2^{***}
	(5.735)	(10.25)	(1.800)	(15.46)	(0.375)	(25.75)
N	600	600	600	600	600	350
R^2	0.166	0.449	0.088	0.010	0.058	0.349

Note: standard deviations are in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; The Driscoll and Kraay standard errors is applied; observation for regression (6) is 350 because the data of state liability system are from 2002 to 2008.

Table 5 Estimation with interaction terms

G	(1)	(2)	(3)	(4)	(5)	(6)
$\ln Y_{t-1}$	-2.393**	-2.393**	-2.563**	-2.421**	-2.365**	1.509
	(0.862)	(0.878)	(0.811)	(0.896)	(0.689)	(3.412)
Resource_point	-0.223*	-0.480***	-0.201*	-0.186	-0.962**	-0.0190
	(0.103)	(0.131)	(0.0886)	(0.103)	(0.309)	(0.178)
Investment	0.00989***	0.00585*	0.00639**	0.00602**	0.00664**	0.00860*
	(0.00246)	(0.00230)	(0.00206)	(0.00218)	(0.00233)	(0.00398)
$HumanCap_{t-2}$	0.166*	0.149*	0.172**	0.171*	0.181**	0.184**
	(0.0640)	(0.0598)	(0.0626)	(0.0651)	(0.0627)	(0.0600)
$R\&D_{t-1}$	0.232	0.241	0.296*	0.235*	0.158	0.497***
	(0.117)	(0.126)	(0.113)	(0.116)	(0.133)	(0.0911)
$Corruption_{t-2}$	-0.0134***	-0.0131***	-0.0131***	-0.0116*		
	(0.00314)	(0.00307)	(0.00335)	(0.00434)		
EcoFreedom					-1.198	
					(0.910)	
Liability System						0.0369
						(0.0477)
Resource*Inv.	- 0.000526***					
	(0.0000924)					
Resource*HC		0.0123*				
		(0.00522)				
Resource*R&D			-0.0697*			
			(0.0320)			
Resource* Cor.				-0.00128		
				(0.00145)		
Resource*EcoFree					0.103*	
					(0.0451)	
Resource*Liability						-0.00564*
						(0.00251)
Constant	25.41*	25.74*	27.10**	25.47*	33.31**	-18.57
	(10.07)	(10.12)	(9.367)	(10.30)	(12.00)	(32.31)
N	500	500	500	500	500	350
R^2	0.048	0.049	0.049	0.046	0.048	0.086

Note: standard deviations are in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; The Driscoll and Kraay standard errors is applied; observation is 500 because Human Capital and Corruptions are lagged two periods; observation for regression (6) is 350 because the data of state liability system are from 2002 to 2008.

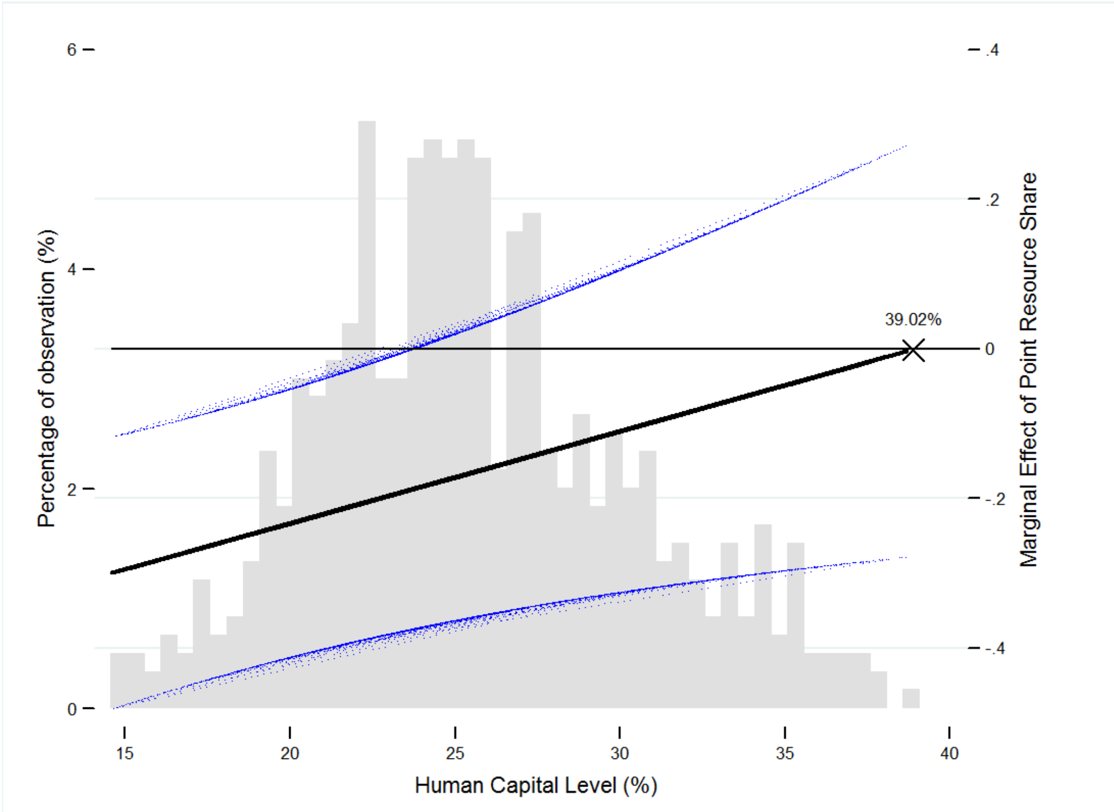

Figure 1 Marginal Effect of Point Resource Share conditional on Human Capital Level
Note: The vertical axes on the right indicate the magnitude of the marginal effect while those on the left are for the histogram, which depicts the distribution of human capital level in the sample. The blue dash lines indicate 95% confidence intervals.