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Abstract

This paper examines the importance of contract enforcement as a source of comparative advantage across Chinese provinces. We find that industries differ in their reliance on relationship-specific investments. Provinces with better contract enforcement specialize in industries where relationship-specific investments are more important. Following LLSV(1998), we separate our proxies for contract enforcement into two groups: those measuring the legal rules and those measuring the quality of contract enforcement. Our results indicate that contract enforcement based on official legal rules plays a modest role in shaping the patterns of industrial specialization. In contrast, the ease and reliability of law enforcement, which to a large extent, explains the patterns of industrial production in China.

JEL Classification: E22; K12

Keywords: Contract enforcement, Industrial specialization, China

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1. Introduction

The benefits of industrial specialization are well known, though the determinants of patterns of industry specialization have yet to be fully understood. Beginning with Adam Smith's theory on the division of labor, numerous studies have been conducted to explain the under-specialization of industrial production. David Ricardo asserted that the primary source of industrial distribution across regions, which resulted in trade, was differences of production in industries between countries. Marshall (1920), on the other hand, argue that natural conditions and rewards from governments and courts had been the main reason. Heckscher and Ohlin (1933) suggest that the differences between countries' factor endowments determine the patterns of commerce and production, under the assumption that countries will export products whose production demands the locally abundant factors (hereafter referred to as the H-O model).

Recent studies (Nunn, 2007, 2013; Levchenko, 2007, 2013) on industry specialization have focused on the effect of law and institutional factors. This line of literature suggests that, as relation-specific investments, under-investment occurs when contracts cannot be fully enforced, and that the scale and efficiency of investment is to some extent dependent on the contract enforcement. Thus, contracting institutions can also be regarded as one production factor, like physical capital, human capital or technology, whose endowment and difference across regions are able to shape the patterns of trade and industrial distribution in accordance with the H-O model (Klein et al, 1978; Grossman and Hart 1986; Hart and Moore 1990). Industries dependent more on contract enforcement will concentrate in regions with better contracting institutions. Empirical studies based on this argument have been conducted, using international trade and production data (Nunn, 2007; Levchenko, 2007; Ma, Qu and Zhang, 2010).

Theoretically, contract enforcement relies on both good legal rules and strong enforcement of these laws (LLSV, 1998). The legal rules are potentially important determinant of what rights contract holders have, while the quality of law enforcement will determine how well these rights are protected. Despite its importance, there are few studies investigating the relative importance of formal legal rules and the enforcement quality on industrial specialization. This issue is particular important in emerging market economies because of their weak law and legal systems (Acemoglu and Johnson, 2005). Inspired by western countries, most emerging market economies, such as China, has enacted constitutional amendment protecting property rights. Nevertheless, their enforcements remain low and varies from country to country (Gold and Guthrie, 2002). Whether and how official regal rules or the quality of contract enforcement influence the pattern of industrial specialization is an important issue yet to be fully understood.

This paper evaluates the role of formal and informal contracting institutions on the patterns of China's industrial specialization. China has experienced a radical and successful transition away from a planned economy, in which there were almost no institutions for contract enforcement in the market. Both formal contracting institutions and their enforcement have not been complete. Firms with different ownership in China do not have equal status. State-owned enterprises have the privilege to utilize institutional resources monopolized by the government – for example, they have the privilege to obtain cheap credit from state-owned banks. In this paper, we will examine whether institutional quality shapes the ownership structures of industries across provinces, and whether it shapes patterns of regional industrial distribution.

Using data from manufacturing industries in China between 1998 and 2009, we find that contract-intensive industries tend to cluster in provinces with better contract enforcement, which shows that the quality of contracting institutions can be a source of

comparative advantage among provinces in China. Meanwhile, in provinces with better formal institutions, contract-intensive industries have a higher share of the state-owned economy, while in provinces with better quality of enforcement, contract-intensive industries have a lower share.

The paper is organized as follows: Section 2 theoretically analyzes the possible influences of contracting institutions in China. Section 3 describes the data and the model. Section 4 presents the estimation results. Section 5 tests the robustness and addresses the issue of endogeneity. We conclude in Section 6.

2. Literature review and hypothesis development

Under the H-O model, industries can achieve higher growth in regions rich in factors they depends on, but will have lower growth in regions that lack these factors. When generalized to contracting institutions, the implication is that contract-intensive industries, whose investment is assured by contracts, grow more quickly and concentrate in provinces with better contracting institutions. This argument has been substantiated by some empirical studies (Nunn, 2007; Levchenko, 2007, 2013; Feenstra et al, 2012). As Acemoglu et al (2005) show, the quality of contracting institutions is determined and reflected not only by formal institutions, such as judicial institutions, public prosecution services and other official institutions dominated by the government, but also by informal institutions that are mostly led by social norms, such as guilds, self-enforced rules, and dispute resolution services that do not involve government intervention. Since these two types of institutions can be substituted for each other, either formal or informal institutions can serve society efficiently. But for China, whose economy is transitioning away from a planned system, neither formal nor informal contract enforcement are perfect. Its market economy system, which demands contract enforcement, does not enable the government to develop good formal institutions. Therefore, the supply of both types of contracting institutions is deficient. We have the following hypothesis:

Hypothesis 1: Contract-intensive industries in China concentrate in provinces with better formal contracting institutions, which are dominated by government, and better informal contracting institutions, which are dominated by social norms.

In China, the ownership status of firms is very important. State-owned firms obtain favorable treatment from the central as well as local governments, such as protectionist policies, favorable loans from state-owned banks, and the privilege to obtain contract enforcement from judicial agents. Thus, private firms are disadvantaged in regions that have bad contract enforcement, or where formal contracting institutions have deficient resources. The improvement of formal contracting institutions primarily benefits non-state-owned firms. Such effects increase with the contract intensity of industries. We expect that the concentration of contract-intensive industries mostly occurs through the growth of the non-state-owned economy.

Hypothesis 2: As formal contracting institutions improve, the proportion of the state-owned economy decreases in contract-intensive industries, while the proportion of the non-state-owned economy increases.

Formal institutions primarily serve the state-owned economy. In contrast, informal institutions, which compensate for the undersupply of formal institutions, naturally tend to serve the non-state-owned economy, which is less likely to obtain benefits from the government. Thus, the advantages of the non-state-owned economy in utilizing informal institutions are more significant with a deficient supply of informal institutions. Correspondingly, the improvement of informal institutions will reduce the advantages of the non-state-owned economy over the state-owned economy, which leads to the increase of the proportion of state-owned economy in contract-intensive industries.

Hypothesis 3: If the concentration of contract-intensive industries is driven by informal contracting institutions, the proportion of the state-owned economy increases in contract-intensive industries while the proportion of the non-state-owned economy decreases.

3. Data and Methodology

3.1 Research Design

The econometric model is given as:

$$I_{ikt} = \alpha_i + \gamma_k + \sigma_t + \beta_0 CONTR_i \cdot contr_{kt} + \beta_1 Z_i \cdot Z_{kt} + c + \varepsilon_{ikt}$$
(1)

I is the agglomeration (*Agg*) or relative share of state-owned economy (*State*) of industry *i* in province *k* in year *t*. α_i, γ_k and σ_t are respectively the industry, region and year fixed effects. *CONTR* is the measure of contract intensity of each industry, or the industry's dependence on contract enforcement. *contr* denotes the quality of contract enforcement, formal or informal, in region *k*, in year *t*. *Z* represents other endowment intensities, including physical capital, human capital, agricultural inputs and mineral inputs, in industry *i*, while *z* represents corresponding endowments in region *k*, in year *t*. ε is the residual error and *c* is the constant term.

When I is Agg, the agglomeration, a significantly positive β_0 can attest that the region with better contract enforcement is more likely to concentrate on contract-intensive industries, while a significantly negative β_0 means that region is less likely to concentrate on contract-intensive industries. When I is *State*, the share of state-owned economy, a significantly positive β_0 means that the relative share of state-owned enterprises in industries with higher contract intensities will be higher in regions with better contracting institutions, while a significantly negative one means otherwise.

3.2 Variables and data sources

The dependent variable Agg has been set as the agglomeration of industry *i* in region k, in year *t*. According to Kalemli-Ozcan et al. (2003), the agglomeration of mining industries are mostly determined by natural conditions, and cannot be greatly shaped by the quality of institutions that this paper is concerned with. Thus, 28 manufacturing industries, from the *Industrial Classification for National Economic Activities* (GB/T4754-2002), have been chosen from all provinces of China between the years 1998 – 2009. The sample excludes Tibet, whose manufacturing is too small. The calculation of Agg, according to the Hoover Index of industries by Bai et al (2004, 2008), is

$$Agg_{ikt} = ln \left(\frac{Output_{ikt}/Output_{it}}{Output_{kt}/Output_{total,t}} \right)$$
(2)

 $Output_{ikt}$ is the gross operation income of industry *i* in province *k*, at year *t*. $Output_{it}$ is the operation income of industry *i* across the whole nation, at year *t*, and $Output_{kt}$ denotes the operation income of all the manufacturing industries in province *k*, at year *t*. $Output_{total,t}$ is the operation income of all the manufacturing industries in the whole nation, at year *t*.

State represents the relative share of the state-owned economy of one industry in one province:

$$State_{ikt} = ln\left(\frac{State_Output_{ikt}/Output_{ikt}}{State_Output_{it}/Output_{it}}\right)$$
(3)

 $State_Output_{ikt}$ is the operation income of state-owned and state holding enterprises of industry *i* in province *k*, at year *t*. $State_Output_{it}$ is the nationwide operation income of state-owned and state-holding enterprises of industry *i*. $Output_{ikt}$ and $Output_{it}$ are the same as above. *State* reflects the degree of nationalization of each industry in each province, compared with the nationwide degree. All the data above are from *China Industry Business Performance Data*, from 1998 to 2009.

The contract intensity of industry *i*, *CONTR*, is defined according to Nunn (2007). The formula is given as:

$$CONTR_i = \sum_{i=1}^{40} \theta_{ii} \cdot R_i \tag{4}$$

In the formula, θ_{ij} stands for the proportion of inputs from industry *j* to the total intermediate inputs of industry *j*, and R_j is the ratio of the product sold neither by wholesale nor by retail in industry *j*. If an input is sold on an organized exchange or reference priced then the market for this input is thick, and the scope for hold-up problems is limited. Thus, if similar principles can apply to China, the share of inputs sold by wholesale and retail have similar implications for domestic trade. The higher *CONTR* is, the less the dependent inputs of this industry are on contract enforcement. We consider all the material inputs, including products from all manufacturing industries as well as agriculture and mining, which sum to a total of 40 categories. These are also drawn from the *Industrial Classification for National Economic Activities* (GB/T4754-2002).

Since these intensities are based on cases in China, they may be influenced by the quality of its contracting institutions. For robustness, we test our conclusions by two industrial contract intensities, based on American data, from Nunn (2007) to remove the possible influence of idiosyncratic factors in China.

Data for calculating *CONTR* are taken from the 2004 and 2008 editions of the *China Economic Census Yearbook*, in which data on sales, as inputs, of wholesale and retail of each industry category are available. The proportions of intermediate inputs from each industry are drawn from the 2002 and 2007 editions of the *Input-Output Table of China*. We calculate two indexes, one of which uses the data from 2004 and 2002, the other using data from 2008 and 2007. The average is taken as the final *CONTR*.

The quality of formal and informal contract enforcement is also measured. With regards to formal contracting institutions, we use the ratio of expenditure for public security, procuratorial agencies, and courts of justice to the total budgetary expenditure of provincial governments (*GJF_Exp*). This shows the efforts made by governments to enhance the judicial system, which is crucial for contract enforcement. In addition, we take the index "Governmental protection over the legal rights and interests of producers" (*Right*, of each province from *Marketization Index for China* (Fan and Wang, 2011). In this index, provinces are graded according to firm evaluations of the local government and the legal environment. Since items of fiscal expenditure in China were adjusted in 2007, the variable *GJF_Exp* only has data points from 1998 to 2006, but *Right* has data points from 1998 to 2009.

In informal contracting institutions, contract enforcement is provided through social norms, and can be measured by the number of attorneys and certified accountants per 10,000 residents (*Attorney, Accountant*). Their services are important in settling

contract disputes between firms or other relevant entities. The numbers of attorneys and accountants are determined by how many people are able to pass professional examinations, which are administered by professional organizations. These two variables are taken from provincial statistical yearbooks and provincial reports of qualification examinations for attorneys and certified accountants.

Control variables $Z_i \cdot z_{kt}$, encompass four interactions. The first interaction is the product of three variables: physical capital intensity of each industry (*CAP*), the ratio of fixed assets to added value, and per capita value of physical capital as the proxy of physical capital endowment in each province (*cap*). This industrial intensity is drawn from the *China Statistical Yearbook* and the *China Industry Economy Statistical Yearbook*. Physical capital measurements of each province are drawn from Li (2003) and updated using the perpetual inventory approach.

The second interaction is the product of three variables: human capital intensity (*SKL*), the ratio of employees with secondary school education or above to the total number of employees in an industry, and human capital endowments in each province (*skl*). Human capital intensity is drawn from the 2004 and 2008 editions of the *China Economic Census Yearbook*, while human capital endowments are from the *China Population Statistics Yearbook* and *China Statistical Yearbook*.

The third interaction is the product of two variables: industrial dependence on agricultural inputs (AGR), measured by the share of inputs from agricultural departments, including farming, forestry, animal husbandry and fishery; and agricultural production endowments, measured by the per capita output value of agriculture in each province.

The fourth interaction is the product of the three variables industrial dependence on mineral production, the share of mineral inputs to the total intermediate inputs, and per capita output value of mining. Data on industrial dependence on agriculture and mining are taken from *Input-Output Table of China* in 2002 and 2007. Detailed definitions of variables and data resources are listed in the Appendix.

3.3 Summary Statistics

The contract intensities of all the industries that we study are listed in Table 1. Large variations exist in the dependence on contract enforcement across the listed industries, among which the highest is 0.7692 for Electronic & Telecommunications. The lowest one is only 0.0107, for Petroleum Processing, Coking Products & Gas Production & Supply. Among contract intensities in Nunn (2007), though the classification of industries differs, electricity & signal testing instruments (0.872), telephone apparatus (0.880) and other electronic component (0.826), industries could be classified under Electronic & Telecommunications, and are among the 20 most contract-intensive industries. Petroleum refineries, included in Petroleum Processing, also is among the 20 least contract-intensive industries.

Industry	Industry	Contract Industry		Industry	Contract
code	Industry	Intensity	code	mausuy	Intensity
				Medical &	
13	Food Processing	0.7403	27	Pharmaceutical	0.2030
				Products	
14	Food Production	0.4302	28	Chemical Fibers	0.2237
15	Beverage Production	0.3342	29	Rubber Products	0.3134
16	Tobacco Processing	0.1679	30	Plastic Products	0.4053
17	Textile Industry	0.6892	31	Nonmetal Mineral Products	0.2541
18	Garments & Other Fiber Products	0.4812	32	Smelting & Pressing of Ferrous Metals	0.0492
19	Leather, Furs, Down & Related Products	0.4699	33	Smelting & Pressing of Non-ferrous Metals	0.0422
20	Timber Processing, Bamboo, Cane, Palm Fiber & Straw Products	0.4400	34	Metal Products	0.2613
21	Furniture Manufacturing	0.3969	35	Machinery & Equipment Manufacturing	0.3658
22	Papermaking & Paper Products	0.2092	36	Special Equipment Manufacturing	0.3143
23	Printing & Record Pressing	0.4182	37	Transportation Equipment Manufacturing	0.4147
24	Stationery, Educational & Sports Goods	0.3369	39	Electric Equipment & Machinery	0.3902
25	Petroleum Processing, Coking Products & Gas Production & Supply	0.0107	40	Electronic & Telecommunications	0.7692
26	Raw Chemical Materials & Chemical Products	0.3059	41	Instruments, Meters, Cultural& Official Machinery	0.3244

Table 1. Industrial contract intensities

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Notes: This table shows the average contract intensity of 28 manufacturing industries in China from 1998 through 2009. Industry code and industry name is drawn from Industrial Classification for National Economic Activities (GB/T4754-2002). Contract intensity is measured as the share of inputs that can be obtained through retail and wholesale, without a specific relationship enforced by contracts, in each industry.

Table 2 reports the summary statistics of contract enforcement and other control variables.

Variable	Observations	Mean	Median	Std.Dev.	Min	Max
GJF_Exp	270	0.0659	0.0660	0.0110	0.0388	0.103
Right	360	3.885	3.830	1.929	-0.460	10
Attorney	336	1.137	0.805	1.325	0.212	11.82
Account	348	0.655	0.428	0.994	0.0794	7.552
Mine	360	0.126	0.0583	0.180	0.0000342	1.060
Agr	360	0.277	0.246	0.132	0.0921	0.816
Cap	360	1.522	0.966	1.511	0.0984	9.335
Skl	360	0.195	0.179	0.0867	0.0614	0.563
IV_fire	270	194.878	162	145.397	2	825
IV_secedu	360	0.578	1	0.506	0	1
IV_seclaw	360	0.169	0	0.376	0	1
IV_econedu	360	2.184	1.200	3.036	0	17.447
IV_lawedu	360	0.503	0.135	1.167	0	8.907

Table 2. Summary statistics of contracting institutions and control variables

Notes: This table shows the descriptive statistics of independent variables, whose definitions and data sources are presented in the Appendix.

4. Estimation Results

4.1 Contracting Institutions and Concentration of Manufacturing Industries

After controlling for several endowment variables and fixed effects, we test whether contracting institutions have shaped industrial concentration across regions in China. Table 3 shows the results of our estimation.

From Table 3, both formal contracting institutions and informal contracting institutions significantly shape and concentrate manufacturing. Regions with better contract enforcement agglomerate contract-intensive industries more significantly, corroborating the notion that the quality of contract enforcement can be a source of comparative advantage across regions in China. However, in column (5) and (7) of Table 3, the significance of the effects of two informal contract enforcement variables decreases when the regressions account for formal contracting institutions, showing that the influence of formal institutions should be greater. The results are in general consistent with Hypothesis 1.

Among the control variables, the effect of human capital is notably negative, while that of physical capital is very volatile. A possible explanation is that excessive expansion of education, especially higher education, leads to serious redundancy and decreasing returns to human capital. Moreover, large-scale immigration between provinces further undermines provincial comparative advantages obtained from human capital. Likewise, excessive capital may also account for the ambiguous effects on industrial distribution. Comparatively, the endowments of agriculture and mining have significantly and consistently shaped industrial agglomeration, which matches the findings of Lu and Tao (2009), who show that the transportation costs of agricultural and mineral materials are high, making the ability of these two inputs to concentrate industries sturdy and consistent.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$GJF_Exp \times CONTR$	10.16***					9.582***	10.44***
	(1.106)					(1.153)	(1.149)
Right imes CONTR		0.0792***			0.0748***		
		(0.00546)			(0.00568)		
Attorney $\times CONTR$			0.0462***		0.0224**	0.0536***	
			(0.0110)		(0.0109)	(0.0165)	
Account $\times CONTR$				0.0339**			0.0142
				(0.0133)			(0.0170)
mine $\times MINE$	2.538***	1.466***	1.429***	1.414***	1.475***	2.562***	2.541***
	(0.419)	(0.197)	(0.201)	(0.202)	(0.197)	(0.415)	(0.418)
agr ×AGR	2.738***	1.965***	2.153***	2.079***	2.049***	2.787***	2.917***
	(0.266)	(0.171)	(0.179)	(0.174)	(0.184)	(0.271)	(0.269)
$cap \times CAP$	-0.00396	-	-	-	-	-0.00535	-0.00541
		0.0166***	0.0139***	0.0126***	0.0174***		
	(0.00357)	(0.00255)	(0.00254)	(0.00255)	(0.00256)	(0.00358)	(0.00361)
skl imes SKL	-0.738	-0.184	-1.301	-0.688	-0.821	-2.444**	-0.835
	(0.969)	(0.767)	(0.842)	(0.855)	(0.839)	(1.095)	(1.097)
Constant	-0.224***	0.154***	0.296***	0.326***	0.130***	-0.241***	-0.281***
	(0.0679)	(0.0405)	(0.0414)	(0.0411)	(0.0428)	(0.0712)	(0.0707)
Observations	7,560	10,080	9,408	9,744	9,408	7,168	7,224
R-squared	0.174	0.180	0.164	0.167	0.177	0.176	0.176

Table 3. Industria	concentration and	d contracting	institutions
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Notes: This table reports the relationship between industrial concentration and contracting institutions. The dependent variable is industrial specialization (Int_{ikt}) referring to Hoover (1936). The independent variables are interaction terms, and are products of four respective proxies for formal or informal contracting institutions and industrial contract intensities. The detailed definitions of explanatory variables are shown in the appendix. Other control variables include the interaction between industrial agricultural dependence and provincial agriculture endowment, the interaction between natural resource dependence and provincial natural resource endowment, the interaction between physical capital dependence and provincial stock, and the interaction between human capital dependence and provincial stock. Year dummies, industry dummies and region dummies are accounted for. The regressions utilize the ordinary least squares method. Robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

4.2 Contracting Institutions and Ownership Structures of Industries

To see whether improving contract enforcement will affect the ownership structure of industries, we first calculate the overall level of nationalization of manufacturing (*State_share*) in 28 industries. We take this as the dependent variable, and use the quality of contracting institutions as independent variables. *State_share* is the ratio of operation revenues in state-owned or state holding enterprises to total operation revenues in 28 industries. If good formal contract enforcement primarily enhances the growth of state-owned firms, the overall degree of industrial nationalization must be higher in regions with bad informal institutions. An opposite conclusion applies to the

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
GJF_Exp	-3.460***				-3.094***	-3.628***	
	(0.634)				(0.651)	(0.624)	
Right		-0.0128***					-0.0187***
		(0.00454)					(0.00437)
Attorney			0.0337***		0.0399***		
			(0.00437)		(0.00661)		
Account				0.0461***		0.0533***	0.0501***
				(0.00610)		(0.00833)	(0.00652)
Constant	0.955***	0.772***	0.711***	0.719***	0.906***	0.962***	0.782***
	(0.0470)	(0.0321)	(0.0245)	(0.0286)	(0.0480)	(0.0512)	(0.0330)
Observations	270	360	336	348	256	258	348
R-squared	0.669	0.647	0.687	0.672	0.706	0.710	0.691

case of informal institutions. Table 4. Nationalization of all industries and contracting institutions

Notes: This table reports the relationship between the overall level of nationalization and contracting institutions. The dependent variable is ratio of the share of the state-owned economy, by operation revenues, of all manufacturing industries in one province to its share in the whole country. The independent variables are four proxies for the quality of formal and informal contract enforcement. The detailed definitions of these explanatory variables can be found in the appendix. The regressions utilize the ordinary least squares method. White's robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

The results are shown in Table 4, which are consistent with our hypotheses that improving formal contracting institutions, which are dominated by the government, markedly lowers the level of industrial nationalization. However, improving informal institutions notably increases the percentage of state-owned economy. When we include both formal and informal institution variables in the regression, the coefficients of both variables become less significant. This suggests that there is less interplay between the two types of contract enforcement. Further evidence is needed in the interaction regressions, as reported in Table 5.

Consistent with Hypotheses 2 and 3, Table 5 shows that industrial nationalization will decrease as the quality of formal contract enforcement improves, while nationalization increases with the rise of informal contract enforcement. The effect of contracting institutions will strengthen as industrial contract intensity increases. In other words, the more dependent an industry is on contract enforcement, the more significant are the effects, both beneficial and detrimental, of contracting institutions are able to concentrate industries, we suppose that the concentration of contract-intensive industries through formal institutions is mostly achieved through the growth of private firms. The share of the state-owned economy in an industry declines when the improvement of contract enforcement enhances the agglomeration of the industry. Likewise, the industrial concentration facilitated by informal institutions is mainly achieved through the growth of state-owned or state holding firms.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$GJF_Exp \times$	-7.677***					-8.782***	-10.78***
CONTR							
	(1.505)					(1.561)	(1.548)
Right imes CONTR		-			-0.0975***		
		0.0861***					
		(0.00835)			(0.00861)		
Attorney $\times CONTR$			0.112***			0.127***	
			(0.0148)			(0.0228)	
Account $\times CONTR$				0.185***	0.208***		0.210***
				(0.0188)	(0.0189)		(0.0249)
mine $\times MINE$	-0.134	-0.0640	0.171	0.117	0.0448	0.0145	0.0391
	(0.205)	(0.105)	(0.123)	(0.121)	(0.112)	(0.221)	(0.222)
agr ×AGR	0.230	-0.521**	-0.429**	-0.262	-0.236	0.250	0.604*
	(0.313)	(0.203)	(0.210)	(0.205)	(0.204)	(0.324)	(0.318)
$cap \times CAP$	-0.00973***	0.00645**	0.000675	0.00120	0.00703***	-0.0138***	-0.0123***
	(0.00325)	(0.00263)	(0.00264)	(0.00263)	(0.00268)	(0.00341)	(0.00340)
skl imes SKL	10.98***	9.200***	5.134***	3.409***	3.025***	7.389***	5.185***
	(0.724)	(0.586)	(0.620)	(0.649)	(0.643)	(0.771)	(0.788)
Constant	1.062***	1.039***	0.741***	0.725***	0.980***	1.047***	1.113***
	(0.0929)	(0.0503)	(0.0465)	(0.0466)	(0.0510)	(0.0968)	(0.0964)
Observations	7,454	9,920	9,266	9,589	9,266	7,068	7,123
R-squared	0.210	0.200	0.198	0.196	0.215	0.218	0.217

Table 5. Industrial Ownership structure and contracting institutions

Notes: This table reports the relationhip between patterns of ownership and contracting institutions. The dependent variable is the relative share of the state-owned economy of one industry in one province $(State_{ikt})$. The independent variables are interaction terms, and are products of four respective proxies for formal and informal contracting institutions and industrial contract intensities. The detailed definitions of explanatory variables are shown in the appendix. Other control variables include four interaction terms, as in Table 3. Year dummies, industry dummies and region dummies are included. The regressions utilize the ordinary least squares method. Robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

The influence from agriculture and mining interactions are negligible, while influence from physical capital is too volatile to measure the exact effect. Human capital, whose coefficients are significantly positive in most cases, suggests notable impacts on the state-owned economy. It indicates that increases of human capital will be utilized by state-owned firms, accounting for a high level of industrialization.

4.3 Robustness Check

Our industrial contract intensities are calculated according to evidence in China, where the poor quality of contract enforcement is generally accepted. In light of this, contract intensities of Chinese industries are likely to be negatively influenced by the quality of contract enforcement. To address this issue, we need alternative indexes to ensure the robustness of our regressions.

Table 6. Correlation between Contact Enforcement Dependences in China and the US

	CONTR	CONTR_US1
CONTR_US1	0.4437	1
CONTR_US2	0.1358	0.5723

Notes: This table shows the correlation matrix of three contract intensities, according to data from different countries. *CONTR* is the intensity based on evidence in China. *CONTR_US1* and *CONTR_US2* are drawn from Nunn (2007) and have been adjusted by weight of output of detailed industrial categories of China in 2004 and 2008.

The contract intensities developed by Nunn (2007) are based on the I-O tables of the U.S. in 1997. He considers the intensities of two groups of industries, which will be adjusted by the output value of sub-industries in the *China Economic Census Yearbook* in 2004 and 2008 in our study. The results are denoted as *CONTR_US1* and *CONTR_US2*, and comprise just 28 industries. The correlations of *CONTR_US1*, *CONTR_US2* and *CONTR* are reported by Table 6. As shown in Table 6, these two measures of contract intensity from Nunn (2007), transferred to our 28 industries, are still highly correlated (0.5723). The correlation between *CONTR_US1* and *CONTR*, 0.4437, is not low. However, there is a low correlation between *CONTR* and *CONTR_US2*, at just 0.1358. We replace *CONTR* by the interaction variable, *CONTR_US1* and *CONTR_US1* and

As shown in Tables 7 and 8, changing the measures of contract intensities does not affect the estimation results. The improvement of both kinds of contracting institutions still prompts concentration of contract-intensive industries and changes the relevant ownership structures. Meanwhile, impacts from contracting institutions on manufacturing industries, measured by diverse contract intensities, are convincingly significant. The possible interplay between informal and formal enforcement still exists, in column (8), where the estimation coefficient of $CONTR \times Account$ shows little significance compared to those in column (7) of Table 3. Column (4) in Table 7 does not show a similar result.

	CONTR_USI				CONTR_US2			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\textit{GJF_Exp} \times \textit{CONTR_US}$		20.87***		21.82***		12.67***		13.89***
		(1.896)		(1.892)		(1.294)		(1.282)
$Right imes CONTR_US$	0.0545***		0.0631***		0.0310***		0.0349***	
	(0.00433)		(0.00432)		(0.00281)		(0.00285)	
$\textit{Attorney} \times \textit{CONTR_US}$	0.0655***	0.0966***			0.0373***	0.0434***		
	(0.00906)	(0.0136)			(0.00584)	(0.00928)		
Account × CONTR_US			0.0698***	0.0613***			0.0326***	0.0102
			(0.0109)	(0.0139)			(0.00660)	(0.00855)
mine $\times MINE$	1.475***	2.608***	1.461***	2.562***	1.468***	2.568***	1.452***	2.532***
	(0.201)	(0.413)	(0.201)	(0.416)	(0.204)	(0.418)	(0.205)	(0.421)
agr imes AGR	2.176***	2.879***	2.157***	3.044***	2.139***	2.803***	2.114***	2.982***
	(0.178)	(0.267)	(0.171)	(0.266)	(0.179)	(0.268)	(0.171)	(0.267)
$cap \times CAP$	-0.0215***	-0.00576	-0.0195***	-0.00358	-0.0287***	-0.00949**	-0.0249***	-0.00354
	(0.00291)	(0.00404)	(0.00288)	(0.00407)	(0.00311)	(0.00431)	(0.00300)	(0.00418)
skl×SKL	-3.563***	-5.468***	-3.317***	-3.313***	-2.663***	-4.018***	-2.027**	-1.423
	(0.902)	(1.207)	(0.903)	(1.177)	(0.914)	(1.244)	(0.924)	(1.209)
Constant	0.255***	-0.0447	0.251***	-0.0891	0.235***	-0.147**	0.234***	-0.211***
	(0.0396)	(0.0541)	(0.0395)	(0.0552)	(0.0399)	(0.0602)	(0.0399)	(0.0610)
Observations	9,408	7,168	9,744	7,224	9,408	7,168	9,744	7,224
R-squared	0.181	0.186	0.185	0.183	0.176	0.180	0.179	0.180

Table 7. Sensitivity tests with alternative contract intensities I

Notes: This table reports the relationship between industrial concentration and contracting institutions. The dependent variable is industrial specialization (Int_{ikt}) referring to Hoover (1936). The independent variables are interaction terms, and are products of four respective proxies for formal or informal contracting institutions, and industrial contract intensities. Detailed definitions of the explanatory variables are shown in the appendix. Other control variables include four interaction terms, as in Table 3. Year dummies, industry dummies and region dummies are included. The regressions utilize the ordinary least squares method. Robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

		CON	TR_US1		CONTR_US2			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$GJF_Exp \times CONTR_US$		-19.70***		-23.39***		-12.20***		-14.52***
		(2.906)		(2.893)		(1.833)		(1.816)
Right ×CONTR_US	-0.0908***		-0.0822***		-0.0459***		-0.0402***	
	(0.00654)		(0.00661)		(0.00399)		(0.00411)	
Attorney × CONTR_US	0.105***	0.0960***			0.0761***	0.0983***		
	(0.0119)	(0.0199)			(0.00700)	(0.0129)		
Account × CONTR_US			0.157***	0.170***			0.112***	0.136***
			(0.0151)	(0.0211)			(0.00868)	(0.0123)
mine $\times MINE$	0.0588	0.0379	0.00503	0.0830	0.0599	0.0967	-0.0123	0.0873
	(0.112)	(0.219)	(0.111)	(0.222)	(0.117)	(0.225)	(0.116)	(0.226)
agr imes AGR	-0.541***	0.0560	-0.458**	0.349	-0.496**	0.121	-0.423**	0.391
	(0.206)	(0.322)	(0.201)	(0.317)	(0.205)	(0.321)	(0.201)	(0.316)
$cap \times CAP$	0.00740***	-0.0125***	0.00921***	-0.00973***	0.00531*	-0.0213***	0.00734***	-0.0166***
	(0.00262)	(0.00324)	(0.00265)	(0.00332)	(0.00278)	(0.00355)	(0.00275)	(0.00338)
skl×SKL	4.060***	6.366***	2.175***	3.196***	2.333***	3.535***	0.215	0.931
	(0.770)	(1.056)	(0.820)	(1.063)	(0.783)	(1.083)	(0.843)	(1.067)
Constant	0.901***	0.989***	0.892***	1.017***	0.905***	1.087***	0.892***	1.135***
	(0.0452)	(0.0715)	(0.0461)	(0.0722)	(0.0452)	(0.0820)	(0.0462)	(0.0826)
Observations	9,266	7,068	9,589	7,123	9,266	7,068	9,589	7,123
R-squared	0.216	0.220	0.210	0.218	0.214	0.223	0.209	0.222

Table 8. Sensitivity tests with alternative contract intensities II

Notes: This table reports the relationship between industrial patterns of ownership and contracting institutions. The dependent variable is the relative share of the state-owned economy of one industry in one province ($State_{ikt}$). The independent variables are interaction terms and are products of four respective proxies for formal or informal contracting institutions and alternative contract intensities from Nunn (2007). The detailed definitions of the explanatory variables are shown in the appendix. Other control variables include four interaction terms, as in Table 3. Year dummies, industry dummies and region dummies are included. The regressions utilize the ordinary least squares method. Robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level,

5. Endogeneity

The OLS estimations cannot assure that causality only runs from contract enforcement quality to industrial concentration and ownership structures. Regions where contract-intensive industries concentrate tend to generate stronger demand for good contracting institutions. There is possible endogeneity between industrial concentration and contract enforcement, which has to be removed using IV estimations.

For international empirical analysis, differences in contract enforcement between countries largely derives from history, such as the development of differing legal systems (Nunn, 2007), whose determinants on economic institutions and financial development are broadly recognized. However, in our analysis, historical differences in regions across China are not only limited but also time-invariant, and are unsuitable for panel data.

The IV we used to instrument GJF_Exp is the number of casualties in fires in each province (IV_fire). The more casualties occur in fires, the greater effort public agents and judicial institutions should make to tackle possible crimes. If crimes or accidents with casualties cannot be clearly investigated, the careers of responsible officials are likely to be unfavorably affected, which necessarily creates incentives that urge judicial institutions to improve their efficiency as well as local fiscal expenditures.

Two dummies are used to instrument *Right*, the score of governmental protection over legal rights in each province. One is whether the secretary of the provincial

Politics and Law Committee (*Zhengfa Weiyuanhui*, PLC hereafter), a subordinate institution of the local Communist Party Committee, received an undergraduate degree or above before they began their political careers (IV_secedu). The second is that whether the secretary of the provincial PLC has undertaken any long-term education in law (IV_seclaw) – not necessarily a degree in law, but perhaps courses in colleges or Party schools. In China, the operation of public security agents, including the police and judicial institutions, is in the charge of the local PLC, in which the secretary necessarily influences the quality of formal contract enforcement. Thus, we assume that highly educated secretaries are more likely to enhance contract enforcement. Likewise, secretaries of PLCs that have undertaken long-term legal education are more likely to hold principles of the law in higher esteem, making them less likely to misuse their authority, and correspondingly more likely to facilitate contract enforcement. These two IVs are not highly correlated, with a correlation of only -0.1062. The data on PLC secretaries are drawn from public information online and from the *Law Yearbook of China*.

For informal contracting institutions, we use the number of students in law colleges and students in economic or financial colleges per 10,000 local residents (IV_lawedu , $IV_econedu$), both lagging 10 years, as the IVs of *Attorney* and *Account* respectively. Undoubtedly, professional education is significant for contract enforcement. However, in China government policy has made science and engineering the focus of higher education from the 1950s to the late 1990s. The scale of education in law and economics was limited, but crucial, for early professionals in law, economics and finance. Therefore, we believe that early relevant education can be an exogenous factor shaping informal contract enforcement. The data are taken from the *Educational Statistical Yearbook of China*.

We use the Two-Stage-Least-Square method (TSLS) to estimate the results and the IVs in regressions are set as interactions, using the products of the IVs introduced above and corresponsive contract intensities (*CONTR*). Table 9 reports the estimations of industrial concentration.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$GJF_Exp \times CONTR$	19.01***					18.61***	19.21***
	(2.326)					(2.253)	(2.306)
Right ×CONTR		0.165***			0.216***		
		(0.0536)			(0.0676)		
Attorney ×CONTR			0.0433***		0.00336	0.0190	
			(0.0123)		(0.0188)	(0.0200)	
Account ×CONTR				0.0550***			0.0268
				(0.0173)			(0.0227)
mine ×MINE	2.543***	1.546***	1.426***	1.427***	1.588***	2.527***	2.555***
	(0.417)	(0.199)	(0.201)	(0.201)	(0.197)	(0.417)	(0.415)
agr imes AGR	2.756***	1.954***	2.146***	2.110***	1.911***	2.747***	2.951***
	(0.270)	(0.179)	(0.179)	(0.175)	(0.218)	(0.277)	(0.275)
$cap \times CAP$	0.000809	-0.0216***	-0.0139***	-0.0126***	-0.0245***	0.000747	-0.000917
	(0.00369)	(0.00418)	(0.00253)	(0.00253)	(0.00439)	(0.00375)	(0.00371)
$skl \times SKL$	-0.825	-0.539	-1.198	-1.301	-0.809	-1.577	-1.275
	(0.955)	(0.784)	(0.886)	(0.907)	(0.926)	(1.160)	(1.165)
Constant	-0.655***	-0.0710	0.299***	0.314***	-0.208	-0.654***	-0.720***
	(0.118)	(0.149)	(0.0417)	(0.0418)	(0.166)	(0.114)	(0.117)
Observations	7,560	10,080	9,408	9,744	9,408	7,168	7,224
R-squared	0.167	0.163	0.164	0.167	0.130	0.169	0.169
Hansen-Test		0.963			0.823		
DWH-Test	696.34	36.63	767.74	446.61			
Hausman Test	0.000	0.095	0.631	0.058	0.017	0.000	0.000

Table 9. 2SLS IV regression I

Notes: This table reports the relationship between industrial concentration and contracting institutions. The dependent variable is industrial specialization (Int_{ikt}) referring to Hoover (1936). The independent variables are interaction terms and are products of four respective proxies for formal or informal contracting institutions and industrial contract intensities. All the IVs in regressions are also interaction terms, and are products of contract intensities (*CONTR*) and IVs of endogenous variables. The IVs of *GJF_Exp, Attorney* and *Account* are respectively *IV_fire, IV_lawedu* and *IV_econedu* while IVs of *Right* are two, *IV_seclaw* and *IV_secdeu*. The detailed definitions of explanatory variables are shown in the appendix. Other control variables are included, as in Table 3. Year dummies, industry dummies and region dummies are accounted for. The regressions utilize the ordinary least squares method. Robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

For column (2) and (5), where IVs are more than endogenous variables, the p-values of the Hansen Test are very high, substantiating that there is almost no over-identification. All F values of the DWH Test are higher than 10, suggesting no weak IVs. The results from column (1) to (4) change very little, as compared to Table 3. However, the regressions accounting for both informal and formal contracting institutions, from column (5) to (7), suggest different conclusions, in that the effects of informal enforcement are consistently offset by the impacts of formal enforcement. This suggests that, without endogeneity, the effects of formal contracting institutions on industrial concentration are significantly primary, while the improvement of informal institutions is only able to shape the agglomeration of contract-intensive industries when the quality of formal institutions also improves. The influence of informal institutions shows little statistical significance. This explains why the significance of informal enforcement was not stable in prior estimations above.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
GJF_Exp	-13.26***				-10.46***	-11.67***	
	(2.209)				(1.893)	(2.115)	
Right		-0.0928**					-0.0999**
		(0.0382)					(0.0403)
Attorney			0.0452***		0.0331***		
			(0.00793)		(0.00782)		
Account				0.0613***		0.0435***	0.0978***
				(0.00979)		(0.0128)	(0.0227)
Constant	1.570***	1.054***	0.704***	0.712***	1.371***	1.488***	1.044***
	(0.143)	(0.141)	(0.0236)	(0.0279)	(0.126)	(0.143)	(0.138)
Observations	270	360	336	348	256	258	348
R-squared	0.441	0.275	0.683	0.667	0.580	0.557	0.304
Hansen-Test		0.075					0.315
DWH-Test	51.95	8.72	108.72	54.86			
Hausman Test	0.000	0.006	0.008	0.007	0.000	0.000	0.000

Table	10.	2SLS	IV	regression II
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Notes: This table reports the relationhip between industrial patterns of ownership and quality of contracting institutions. The dependent variable is ratio of the share of state-owned economy, by operation revenues, of all manufacturing industries in one province to that share in the whole country. The independent variables are four proxies for the quality of formal and informal contract enforcement. The IVs of *GJF_Exp*, *Attorney* and *Account* are respectively *IV_fire*, *IV_lawedu* and *IV_econedu* while IVs of *Right* are two, *IV_seclaw* and *IV_secdeu*. The detailed definitions of these explanatory variables can be found in the appendix. The regressions utilize the ordinary least squares method. White's robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

In comparison, there is no change in the conclusions on the effects of patterns of ownership in manufacturing industries. The p value of the Hansen-Test in column (4) of Table 11 is 0.044, slightly below 0.05, which is insignificant. This implies that the enhancement of informal contract enforcement is capable of improving the share of the state-owned economy in contract-intensive industries, though its capacity to concentrate these industries is relevantly weak as compared to formal contract enforcement.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$GJF_Exp \times CONTR$	-44.34***					-38.86***	-42.21***
	(3.296)					(3.129)	(3.268)
Right × CONTR		-0.473***			-0.412***		
		(0.103)			(0.0925)		
Attorney×CONTR			0.164***			0.286***	
			(0.0181)			(0.0281)	
Account ×CONTR				0.237***	0.426***		0.279***
				(0.0253)	(0.0570)		(0.0312)
$mine \times MINE$	-0.167	-0.425***	0.227*	0.148	0.00367	0.181	0.0876
	(0.200)	(0.141)	(0.128)	(0.124)	(0.116)	(0.238)	(0.225)
$agr \times AGR$	0.146	-0.466*	-0.307	-0.185	0.0796	0.458	0.660*
	(0.345)	(0.281)	(0.210)	(0.205)	(0.264)	(0.348)	(0.347)
$cap \times CAP$	-	0.0294***	-0.000272	0.00123	0.0376***	-	-
	0.0293***					0.0351***	0.0286***
	(0.00372)	(0.00723)	(0.00273)	(0.00267)	(0.00706)	(0.00412)	(0.00383)
skl×SKL	11.32***	10.64***	3.309***	1.886**	3.880***	3.261***	3.601***
	(0.761)	(0.830)	(0.723)	(0.833)	(1.501)	(0.974)	(0.975)
Constant	2.847***	2.052***	0.692***	0.693***	1.728***	2.389***	2.619***
	(0.172)	(0.288)	(0.0472)	(0.0472)	(0.245)	(0.164)	(0.172)
Observations	7,454	9,920	9,266	9,589	9,589	7,068	7,123
R-squared	0.137		0.196	0.195	0.066	0.166	0.164
Hansen-Test		0.095			0.044		
DWH-Test	674.28	31.55	770.08	446.17			
Hausman Test	0.000	0.000	0.000	0.002	0.000	0.000	0.000

Table 11. 2SLS IV regression III

Notes: This table reports the relationship between industrial patterns of ownership and contracting institutions. The dependent variable is the relative share of state-owned economy of one industry in one province (*State_{ikt}*). The independent variables are interaction terms, and are products of four respective proxies for formal or informal contracting institutions and industrial contract intensities. All the IVs in regressions are also interactions, and are the products of contract intensities (*CONTR*) and IVs of endogenous variables. The IVs of *GJF_Exp, Attorney* and *Account* are respectively *IV_fire, IV_lawedu* and *IV_econedu* while IVs of *Right* are two, *IV_seclaw* and *IV_secdeu*. The detailed definitions of explanatory variables are shown in the appendix. Other control variables are included as Table 3. Year dummies, industry dummies and region dummies are accounted for. The regressions utilize the ordinary least squares method. Robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

6. Conclusions

In this study, we examined whether the quality of regional formal and informal contract enforcement can shape industrial distribution and patterns of ownership across regions in China. The evidence has significantly shown that contract-intensive industries agglomerate in provinces with good contracting institutions, especially with good formal institutions, as measured through the efficiency and efforts of judicial agents. Moreover, contract enforcement is also able to shape the pattern of industrial ownership. The share of the state-owned economy in manufacturing industries is higher in regions with better informal contracting institutions, but is lower in regions with better formal contracting institutions. Such impacts from contracting institutions have been notably enhanced with the rise of industrial contract intensity. To check the robustness and correct the latent endogeneity of contracting institutions, we have used alternative contract intensities of industries in the U.S., and conduct TSLS estimations using suitable IVs, acquiring further evidence that maintains our conclusions.

This study provides evidence that both formal and informal institutional resource of contract enforcement can be an important determinant for domestic industrial distribution. It also suggests that the two types of institutions have shaped patterns of industrial ownership in different directions, by affecting industrial distribution. For developing countries, whether private sectors can develop initially depends on the improvement of formal contracting institutions, which are dominated by the government. Without efficient judicial institutions, private sectors cannot rely on informal, civilian institutions to make breakthroughs in the economy.

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	Variable	Definition	Source
	GJF_Exp	The ratio of expenditure for public security,	Finance Yearbook of China,
		procuratorial agency and court of justice to the total	various years
		budgetary expenditure of provincial governments	
	Right	The score of governmental protection over the legal	Marketization Index of China
		rights and interests of producers	(Fan and Wang, 2011)
	Attorney	The number of attorneys per 10,000 residents	Statistical yearbooks of each
			province and provincial yearly
			reports of certified accountants
	Account	The number of certified accountants per 10,000	Statistical yearbooks of each
		residents	province and provincial yearly
			reports of certified accountants
	Other Contro	ol Variables	
	MINE	Average ratio of mineral inputs to intermediate inputs	Input-Output Table of China
		in industry	1997, 2002 and 2007
	mine	Per capita mineral output	China Statistical Yearbook,
			various years
	AGR	Average ratio of agricultural inputs to intermediate	Input-Output Table of China
		inputs in industry	1997, 2002 and 2007
	agr	Per capita agricultural output	China Statistical Yearbook,
			various years
	CAP	Ratio of net value of fixed asset to value added in	China Statistical Yearbook
industry		industry	and China Industry Economy
			Statistical Yearbook, various years
	cap	Per capita physical capital	Li (2003) and authors'

Appendix: Variable definition and data sources

			calculation
	SKL	Average ratio of workers with above secondary	China Economic Census
		schooling to the total number of employees in each	Yearbook 2004 and 2008
		industry	
	Skl	The ratio of the population with at least secondary	China Statistical Yearbook,
		schooling to the total population	various years
	Instrument	al Variables	
	IV_fire	Total casualties caused by fires in a year	China Statistical Yearbook,
			various years
	IV_secedu	A dummy denoting whether the secretary of the local	Law Yearbook of China,
		PLC received an undergraduate degree or above before	various years; Wikipedia
		they began their political careers. If yes, it takes the value	
		1. If not, it takes the value 0.	
	IV_seclaw	A dummy denoting whether the secretary of local	Law Yearbook of China,
		PLC has undertaken any long-term education in the law. If	various years; Wikipedia
		yes, it takes the value 1. If no, it takes the value 0.	
	IV_econed	The number of students in economic or financial	China Education Statistical
и		schools, per 10,000 residents	Yearbook, various years
	IV_lawedu	The number of students in law schools, per 10,000	China Education Statistical
		residents	Yearbook, various years