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Regional distribution of college enrollment in China under a multiple-principal framework

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ABSTRACT

What factors affect the regional distribution of college enrollment in China? This paper establishes a simple theoretical model under a multiple-principal framework and verifies that local college enrollment is affected by factors such as the principals involved, the educational quality, the availability and type of incentives, and policy constraints. The results show that principals adopt different incentive strategies, including "performance purchase" and "cost support". In addition, local government fiscal incentives can increase local enrollment. Among affiliated colleges, those with higher educational quality have higher local enrollment; among local colleges, those with higher educational quality have lower local enrollment.

1. Introduction

The distribution of enrollment resources for Chinese higher education institutions differs across regions. In some areas, there are large disparities between the planned enrollment and the number of local students. This has led to wide gaps in the ratio of college enrollment between local and non-local students in various provinces. In 2014, for example, enrollment in the first tier of higher education institutions in Beijing, Tianjin, and Shanghai exceeded 20%, while enrollment in Shanxi, Liaoning, and Sichuan was less than 6.5%.[1] This phenomenon has led to a series of social problems, such as "Gaokao migration" (migration for the college entrance examination)[2] and "long-distance Gaokao" (taking the college entrance examination somewhere other than one's own hometown)".[3] These strategies have further intensified the inequalities in the Chinese higher education system. In 2014, the Ministry of Education announced that, for the first time, the number of applicants taking the college entrance examination in places other than their own hometown had reached 56 thousand. Unlike the systems in the West, most higher education institutions in China are public institutions established by the government and are institutionally affiliated with government departments. The government not only provides funding and appoints university presidents but also prescribes planned enrollment numbers every year. Higher education institutions are responsible for preparing for these planned enrollment numbers in different provinces. The planned enrollment in various provinces

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[1] Source of data: the website of the Ministry of Education of the People's Republic of China.

[2] To increase their opportunities for college enrollment, examinees use various means to migrate to provinces with higher enrollment ratios to participate in the *Gaokao* (National College Entrance Examination).

[3] Examinees' parents move their entire families so that their children can participate in the local Gaokao. This strategy is employed because the Gaokao scores required for college enrollment vary by region.

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reflects the distribution of educational resources in these regions and is, therefore, an important index for evaluating the supply of educational resources. In May 2016, a mass disturbance occurred in Hubei Province when the parents of examinees besieged the Education Department because they were dissatisfied with the adjustment of the provincial enrollment plan. However, this practice has become so established that the enrollment plans of Chinese higher education institutions favor local placements. As early as 2008, the Ministry of Education required affiliated higher education institutions to gradually lower their local enrollment ratios. In 2009, a public proclamation was issued to maintain that ratio to 30%. From 2010 to 2015, "promoting the regional enrollment fairness of higher education" was set as an objective for which local policies were implemented. However, there is still a large gap between reality and the intended results of these policies. The inequality in enrollment resources of higher education institutions across different regions still exists, and social problems such as Gaokao migration are becoming increasingly serious.

The regional allocation of enrollment in Chinese universities has attracted the attention of scholars and involves two main debates. The first concerns the presence of educational injustice through the regional allocation of enrollment. Some scholars suggest that the regional differences in university attendance are reasonable because of the systemic differences among regions (e.g., Chen, 2004; Qiao et al., 2014). Researchers concerned with the history of education believe it is necessary for national political balance to survey the trends in regional allocation of the imperial examination system (Elman, 2001). Most scholars, however, argue that the unequal educational opportunities associated with the differences in planned enrollment between provinces amounts to educational injustice (e.g., Li, Wang, & Guo, 2012; Miao & Bu, 2013). This idea is supported by research into educational ethics (e.g., Coleman, 1989; Liu, 2005). There is some evidence to support this, but empirical research is lacking. The second debate involves the reasons for these differences. Research examining the geography of education has analyzed the regional differences in educational opportunity based on the structure, placement and sustainable development of regional education (e.g., Luo, 2004; Ma, 2005). In the field of pedagogical economics, various tools have been used to examine the regional differences between educational opportunities for universities in different provinces, including a representative index and a concentration curve (e.g., Yang, 2005). Additionally, studies have analyzed the number of examinees in each province, local per capita GDP, distances between universities and provinces, local economic development level, adjacency of provinces, population flow and other factors under the Gravity Model framework (e.g., Pan, Xu, Chen, Kang, & Lan, 2010; Pan & Ma, 2013; Cui & Pan, 2016). However, research in this area lacks a theoretical analysis of the phenomenon and formal model inference and experiential data verification using a theoretical framework (e.g., Peng, 2008; He, Shen, & Huang, 2012; Fan, 2013). In summary, previous studies have not considered the institutional factors involved in regional allocation. Given the current situation of universities, it is necessary to use the regional allocation of enrollment in an institutional structure as a starting point to determine the truth. In Chinese universities, the institutional structure is an important factor and refers to the existence of multiple principals.

Thus, using a multiple-principal framework, this paper analyzes the relationships between universities and governments, as well as their behavior models, and explains the regional allocation of enrollment at Chinese universities using a theoretical model and an experimental study. In particular, this paper emphasizes principal characteristics, agent characteristics, incentive strengths and policy constraints in forming research hypotheses and establishing a regression model. In total, 614 cross-sectional data points were tested in 2014. The results show that different principals adopt various incentive strategies, either "performance purchase" or "cost support" for universities. Thus, the university attribution, education quality, financial incentive strength, policy control and other factors influence the regional allocation of enrollment of the universities. The policy implications of these results are that when central and regional governments motivate universities, they should consider the externalities associated with incentives based on other principals and incentive effects. Improving the quality of education in universities will help balance the regional allocation of enrollment resources. The major contributions of this paper include establishing a theoretical model for university enrollment using the multiple-principal framework, quantitatively determining the relationship between incentive strategies and university enrollment, and verifying the factors that influence university enrollment through empirical research. The results of this empirical study can help governments design more effective incentives.

The structure of this paper is as follows: Part II establishes a simple theoretical model using the multiple-principal framework. Part III describes the methodology and results of the empirical research. Part IV discusses the research results and the current situation in China, and Part V presents the paper's conclusions.

2. Theoretical framework

In the public sector, the presence of multiple principals affects incentives in several ways. First, the number of principals determines the overall effects of incentives (Bernheim & Whinston, 1986; Dixit, Grossman, & Helpman, 1997; Bergemann & Valimaki, 2003). The presence of multiple principals results in a problem of "separation of powers" in the public sector. The degree of decentralization and the clarity in the division of power and responsibility directly affect how each principal designs his incentive contract (Cao, 2011). In addition, the degree of cooperation among principals influences the overall effects of incentives (e.g., Calzolari & Scarpa, 2000; Laussel & Breton, 2001; Martimort & Stole, 2001). With multiple principals, the incentive contract between each principal and agent does not function independently. The externalities associated with each incentive contract are known to the agents but not the principals (Calzolari & Pavon, 2006). Third, the characteristics of tasks also determine the overall effects of incentives (e.g., Holmstrom & Milgrom, 1991; Laffont & Pouyet, 2004; Liu & Qin, 2015). Finally, the decision order of principals is also important (e.g., Páez-Pérez & Sánchez-Silva, 2016; Whitford, 2005). Under China's centralized political system, there is often a natural power hierarchy in the public

sector. Although principals may be theoretically independent, their decision-making order in the power hierarchy is different. Often, higher-ranking principals are allowed to act first, while lower-ranking principals must wait.

The description of the multiple-principal phenomenon in the public sector is similar to the framework for the private sector, except that the principal or the agent is the government and the tasks are public sector tasks. However, the governmental sector behaves differently than the private sector. In particular, because of different social systems and cultural backgrounds, various governmental departments also behave very differently. As a result, applying the "economic man" assumption and private sector decision-making methods to the governmental sector often cannot explain the governmental decision-making process. For example, in the private sector, the objective function of principals is often relatively clear, and principals seek the optimal incentive strategy under a certain objective function. In the public sector, however, a clear property environment as in the private sector is lacking. Unlike the private sector, a governmental department acting as the principal does not have profit or output as its core objective. In addition, measuring the output of a governmental department is very difficult, and objective functions may not be helpful in describing this output. Additionally, the principal-agent relationship is often more complicated in the public sector than in the private sector. For example, the work relationship between upper and lower governmental departments develops naturally, and cannot be changed by signing a contract. An upper-level department often cannot select its preferred "lower department", nor can a lower-level department reject any task or refuse to cooperate with its upper department.

In the context of China's specific institutional and cultural background, the characteristics of public sector agents are related to the political system. In contrast to the West, China's political department is not elected. Multiple-principal-based studies of the governmental sector have mainly examined the Western system; studies of the Chinese political system are lacking. Because China's higher education institutions belong to the governmental sector, assessing the enrollment behavior of higher education institutions should consider the multiple principals present in the governmental sector, as well as their influence in the Chinese political system.

According to Article 68 of the Higher Education Law of the People's Republic of China, higher education institutions in China include postgraduate training institutions, undergraduate institutions, and specialized institutions.[4] Because the enrollment behavior of these three types of institutions varies widely in terms of policy basis, legal constraints, and approval procedures, this paper focuses on enrollment in undergraduate institutions. Hereafter, the term "higher education institutions" refers to regular higher education institutions at the undergraduate level. In December 2014, there were 2491 regular higher education institutions in China, including 1170 undergraduate institutions (including independent colleges).[5] These institutions offered instruction in many fields, including teacher training, engineering, agriculture, medicine, forestry, language, finance and economics, politics and law, physical education, art, and nationality. China's planned enrollment in colleges is determined jointly by the Ministry of Education (MOE), the National Development and Reform Commission (NDRC) and the higher education institutions. The MOE and the NDRC make the macro-level policies for the enrollment plan based on the development of the national economy and the educational strength of the higher education institutions. Next, each higher education institution is responsible for its own specific enrollment plan, including the number of students to be enrolled and the enrollment plan for each province and each major. The enrollment plan, which determines the number of higher education opportunities in each region, is an important reflection of the equalization of higher education resources in China. Even though the total number of students to be enrolled in higher education institutions is based on national-level policies, higher education institutions control the regional allocation of enrollment, and there is a tradeoff between local and non-local planned enrollment. How should higher education institutions balance the regional distribution of enrollment resources? What factors affect the regional distribution of college enrollment? These questions merit further discussion.

Under a basic framework of multiple principals, one agent accepts an allocation from several principals. With respect to the problems of this study, it is assumed that higher education institutions should entrust the enrollment task to both the central government and the local government. The central government aims to compel higher education institutions to fairly enroll the most qualified students from across the country, while the local government aims to compel higher education institutions to favor local examinees and enroll a greater number of local students. Higher education institutions in China mainly include affiliated higher education institutions (therefore, without a loss of generality, the model uses higher education institutions affiliated with the MOE as examples) and local higher education institutions.[6] The immediate superior of the former is the MOE, while the immediate superior of the latter is the local government. The following points are important for understanding the principal-agent relationship faced by higher education institutions in the context of China's institutional environment.

First, the relationship between higher education institutions and the government has important implications. The majority of higher education institutions in China are public schools, so private higher education institutions have few effects on the number of students and the educational quality.[7] Additionally, public higher education institutions are "public institutions" in China and are dominated by their governmental departments in terms of staffing, funding, and appointments. Compared with public universities in the West, Chinese higher education institutions act similarly to a governmental department, and their acquisition of education resources relies heavily on the government. For higher education institutions affiliated with the MOE, their staffing, number of students and funding are all controlled by the MOE. However, because these institutions are distributed in different provinces and municipalities, they must rely on the local government for daily operation, including campus construction and logistics. Local higher education institutions, in contrast,

[4] Higher education institutions include postgraduate training institutes, undergraduate universities and colleges and independent colleges, and specialized schools and adult higher education schools.

[5] Source of data: statistical data from the official website of the Ministry of Education of the People's Republic of China.

[6] See Table 1 of section 3.2 for details.

[7] Therefore, the analysis in this paper excludes private higher education institutions in China.

receive most of their resources from the local government, but they must rely on the MOE for many professional resources and tasks, such as the approval of master's and doctoral programs and key laboratories. Therefore, both affiliated and local higher education institutions must manage their relationship with the MOE and the local government. This results in a classic problem of multiple principals.

Second, the status of the government as a principal should be examined. China's governmental departments treat their immediate subordinates with an administrative affiliation differently from those without an affiliation. For a principal and an agent without a superior and subordinate administrative affiliation relationship, the work relationship is based on voluntary cooperation and exchange, which approaches free negotiation in the market; if a deal is not clinched, those involved may seek others that are better qualified. In this situation, a principal will attach more importance to incentive mechanisms when dealing with its non-subordinate department agent, and offer incentives to the agent based on its actual contributions. We refer to this mechanism as the "performance purchase" strategy. For a principal's immediate subordinate, because the superior department has direct authoritarian power over the employees and property of the subordinate department, the superior department often uses administrative orders and approvals to manage the subordinate department. The superior department devotes greater attention to encouragement and direct management of the agent's investment of resources, as in the widely adopted "cost support" method. However, because administrative affiliations cannot be changed freely, more importance is attached to the establishment of a mutually supportive relationship between superior and subordinate, to social capital, and to the fair distribution of resources to prevent conflict arising from a sense of inequality. Therefore, the principal's incentives for subordinate departments with an administrative affiliation tend to be less associated with the agent's performance and more related to the agent's actual input. We refer to this incentive strategy as the "cost support" strategy.

Using these basic ideas, we establish a simple model to analyze the characteristics of these kinds of dual principal-agent actions. We assume that an agent has two different principals, the first being its administratively affiliated superior and the second being a non-affiliated superior. If the resource boundary constraint of the agent is E, one part of the input, e_1, is required to produce output in the fields that the first principal expects, while the other part of the input, e_2, is required to produce output in the fields that the second principal expects. The total output is then $Alne_2$. Based on the above analysis, the incentive strategy of the first principal for the agent is a strategy similar to "cost support", in which a subsidy or reward is given based on the amount of resources e_1 that the agent invests in the expected field. In contrast, the second principal adopts a "performance purchase" incentive strategy, which involves purchasing or rewarding based on the output $Alne_2$ that the agent produces in the expected field. If both principals adopt a linear incentive strategy, then the payments that the first and the second principals make to the agent are g_1e_1 and g_2Alne_2, respectively. The problems that the agent faces can be expressed as follows:

$$\text{Max } U(e_1, e_2) = g_1e_1 + g_2Alne_2 \tag{1}$$

$$\text{s.t. } e_1 + e_2 = E$$

Using a first order condition, the following results can be obtained:

$$e_2 = \frac{g_2A}{g_1} \tag{2}$$

$$e_1 = E - \frac{g_2A}{g_1} \tag{3}$$

The resources of the agent are divided between the two types of activities and have the following characteristics:

(1) e_1 has a positive correlation with g_1 and a negative correlation with g_2; e_2 has a positive correlation with g_2 and a negative correlation with g_1. This difference shows that the relative ratio of resources between the two types of activities depends on the relative intensity of the two principals' incentives. In practice, g_1 and g_2 may include both encouragement measures and punitive measures. They may also be related to the efficiency of the incentive measures implemented by a principal. When $g_2/g_1 < E/(2A)$, $e_1 > e_2$. Obviously, when g_1 is large enough compared to g_2, the above formula always has the characteristics $e_1 > 0$, $e_2 > 0$. We assume that the first principal has greater control over the agent's actions, and so g_1 is always large compared to g_2.
(2) e_1 has a negative correlation with A and e_2 has a positive correlation with A. This shows that an agent with a higher technical level will invest more resources to serve the second principal. The reason is that the incentives offered by the second principal attach more importance to the actual output. For an agent with a higher technical level, the invested resources have higher marginal output when serving the second principal and therefore yield higher returns.

This simple framework can be used to analyze the enrollment actions of higher education institutions. The MOE and the local government are the dual principals, the higher education institutions are the agents, the enrollment plan that higher education institutions control is E, and A can be measured based on the educational quality of the higher education institutions.

First, a direct conclusion is that the affiliation of the principals affects the enrollment actions of higher education institutions.

Table 1
Types of regular higher education institutions for undergraduates in China.

Types		Sub-types	Main principals
Affiliated	Affiliated	Affiliated with the MOE	The MOE
		Affiliated with other ministries or commissions	Ministries or commissions
	Jointly developed by provinces	Affiliated with the MOE and jointly developed by the MOE and provinces	The MOE and provincial governments
Provincial	and ministries	Affiliated with other ministries or commissions and jointly developed by ministries or commissions and provinces	Ministries or commissions, and provincial governments
	Provincial	Provincial (no joint development)	Provincial governments

Source: drawn by the author.

Because the first principal has more control over the educational resources of their affiliated higher education institutions, they can exert more control over their agents' actions. That is, in the above formula, g_1 is much larger than g_2, and the agents will invest most of their resources in the field that the first principal expects. Therefore, overall, affiliated higher education institutions will allocate a higher ratio of planned enrollments to places distant from the institutions, while local higher education institutions will allocate a higher ratio of planned enrollments to places close to the institutions.

Another interesting conclusion from the above model regards the relationship between the allocation of planned enrollment and the educational quality of the higher education institutions. For higher education institutions directly affiliated with the MOE, the first principal is the MOE. The above analysis shows that the MOE will not use educational quality to differentiate between institutions under its jurisdiction in terms of the allocation of planned enrollments; its policies are often only linked with the planned enrollments and it prioritizes treating institutions equally regardless of their educational quality. The local government, as the second principal, also aims to compel affiliated higher education institutions to render more services for local development, including the recruitment of more local students. However, because the local government is not an administrative superior of the affiliated higher education institutions, it cannot directly control them. The local government will not worry about the sense of inequality caused by its incentive policies, instead emphasizing the actual contributions to the area made by higher education institutions; therefore, it gives more consideration to their education quality. Even with respect to the recruitment of local students, more importance is attached to institutions with higher educational quality. For local higher education institutions, the opposite is true. The local government, as the first principal, often adopts relatively even administrative plans and cost support policies, while the MOE, as the second principal, attaches more importance to the quality of local higher education institutions in incentive measures. Therefore, the above model predicts that for affiliated higher education institutions with higher educational quality will allocate a higher ratio of their planned enrollment to local students; the opposite is true for local higher education institutions with higher educational quality, which will allocate a higher ratio of their planned enrollment to non-local students. In addition, the model shows that the incentive intensity will affect the actions of the agents, predicting that for both affiliated and local higher education institutions, greater local government incentive intensity will compel them to recruit more local students.

Based on the above discussion, we conduct a preliminary analysis of the recruitment actions of two different types of higher education institutions based on a simple dual principal framework. In the following section, we discuss the detailed assumptions of the empirical study and analyze the results.

3. Empirical analysis

3.1. Hypotheses of the econometric model

Based on the above model description, this paper analyzes the relationship between the principal's characteristics, agent's characteristics, incentive intensity, administrative control and the ratio of local enrollment in higher education institutions. First, as agents of the public sector, higher education institutions in China are entrusted by several principals to complete the tasks of educating students, conducting scientific research, and serving society. Higher education institutions in China can be roughly classified into affiliated and local institutions. Affiliated higher education institutions include institutions affiliated with the MOE and institutions affiliated with other ministries and commissions; local higher education institutions include provincial higher education institutions and municipal vocational higher schools. Since 2004, the state has promoted the construction of a number of higher education institutions jointly built by provinces and ministries.[8] Thus, the local government's support for affiliated higher education institutions has increased; in addition, the relationship between various ministries and commissions and some local higher education institutions has strengthened, promoting the construction and development of higher education institutions in China via joint development by provinces and ministries. Therefore, based on the characteristics of the principals, higher education institutions in China can be classified into higher education

[8] There are four types of higher education institutions jointly developed by provinces and ministries. First, the MOE and the local government jointly developed universities through the 985 Project, and ministries and commissions pushed local governments to support planning for the development of higher education institutions. Second, some key universities in the 211 Projects focusing on special industries were jointly developed by the MOE and various industrial sectors. Third, some provincial universities were jointly developed by the local government, the MOE and other ministries and commissions, and their funding and resources were expanded. Fourth, provincial key universities jointly developed by the local government and a state ministry or commission other than the MOE could strengthens the support of such institutions by signing an agreement on province-ministry joint development with the local province or municipality. This actively develops strong disciplines and improves comprehensive strength with the purpose of constructing a number of high-level universities with significant influence in their respective industries.

institutions affiliated with ministries, higher education institutions jointly developed by provinces and ministries, and higher education institutions affiliated with provinces (Table 1). The various principals have different expectations for the enrollment actions of higher education institutions. The MOE and other ministries and commissions are inclined to expect that higher education institutions offer fair educational opportunities nationwide,[9] while provincial governments are inclined to expect them to provide more education opportunities within their own region.

Assumption 1. The characteristics of the principals associated with higher education institutions are related to the local enrollment ratio of these institutions.

Second, the agent's characteristics are reflected by the educational quality of higher education institutions and are indicated by factors such as research ability, educational quality, and overall reputation. Greater educational quality and reputation means that a higher education institution can attract an adequate number of students and does not have to consider whether non-local students will register for the examination. Additionally, higher education institutions with greater education quality can better attract resources; thus, they rely less on the principals' resources and have more power over their enrollment actions. The agent's characteristics are also reflected in the total college enrollment capacity relative to the number of local students. If the total college enrollment capacity is small relative to the number of local senior middle school graduates, higher education institutions experience less pressure to favor local students. However, if the total college enrollment capacity is large compared to the number of local senior middle school graduates, higher education institutions face more pressure to favor local students.

Assumption 2. The educational quality and the total enrollment capacity of higher education institutions are related to the local enrollment ratio.

In terms of incentive intensity, both the central and the local government invest public funds in higher education institutions. Affiliated higher education institutions are mainly funded by the central government, provincial higher education institutions are mainly funded by the local government, and higher education institutions jointly developed by provinces and ministries receive additional financial support from the other party. The local government expects a higher local college enrollment ratio, which can increase college education opportunities for local senior middle school graduates and increase the local talent supply, given that local college graduates tend to work in the local area. Conversely, the central government expects higher education institutions to fairly allocate their enrollment quotas nationwide. Therefore, funds from the local government are positively associated with the local college enrollment ratio, while funds from the central government are negatively associated with the local college enrollment ratio. Incentive intensity is also reflected in the government's support for the development and expansion of higher education institutions. In particular, the support from the local government in terms of land, taxation, and financing provides a strong incentive for higher education institutions that plan to build new campuses. Higher education institutions may give greater consideration to local demands regarding their enrollment actions due to their reliance on these resources.

Assumption 3. Funding from the central and local government is associated with the local enrollment ratio, as is a higher education institution's decision to build a new campus.

Finally, in terms of administrative control, the NDRC and the MOE stipulate the total nationwide college enrollment each year and the enrollment amount for each higher education institution, although they allow a certain amount of fluctuation in the actual enrollment of each institution. This policy constraint reflects the college enrollment index, which affects the local enrollment ratio of higher education institutions.

Assumption 4. The policy constraints on college enrollment are associated with the local enrollment ratios of higher education institutions.

This paper considers the following control variables for the local enrollment ratio of a higher education institution: the economic development level, the abundance of higher education resources, and the scarcity in total enrollment capacity in the area where a higher education institution is located. First, the educational resources of economically developed regions may have positive externalities. More economically developed regions tend to have greater higher education resources, with an overflow effect on other regions. Additionally, the greater the level of economic development in a higher education institution's region, the more non-local students are willing to study there and the higher the demand of the non-local market on the higher education institution's resources. Therefore, the more developed the regional economy of a higher education institution, the lower the local enrollment ratio of that institution, and the higher the enrollment ratio of non-local students. Additionally, scarcity in total enrollment capacity in the area of a higher education institution is negatively associated with the local enrollment ratio. The greater the scarcity in total enrollment, the stronger the local government's expectation for local college enrollment will be, and the higher the local enrollment ratio of the higher education institution; the opposite is also true.

Assumption 5. The level of local economic development will be negatively associated with the local college enrollment ratio.

Assumption 6. The scarcity in the total local enrollment capacity will be negatively associated with the local college enrollment ratio.

[9] The Circular on Assigning Regular Higher Education Planned Enrollment of Higher Education Institutions Affiliated to the MOE in 2015 issued by the General Office of the MOE.

3.2. Data collection and descriptive statistics

College enrollment in China mainly reflects the regional allocation of planned enrollment. This paper uses the local college enrollment ratio in 2014[10], which is the ratio of the planned local enrollment of a higher education institution versus its total enrollment capacity[11]Stratified sampling was used for the data samples. Simple random sampling was conducted in 31 provinces and regions (excluding Hong Kong, Macao and Taiwan). In total, 614 undergraduate higher education institutions (excluding independent colleges) were sampled, including 80 affiliated higher education institutions, as shown in Table 2. These institutions account for 70.2% of the total number of affiliated higher education institutions (114). In addition, 534 provincial higher education institutions were sampled, which account for 69.9% of the total number of local higher education institutions (764).

Notes: The east of regional distribution includes Shandong, Jiangsu, Anhui, Zhejiang, Fujian, Jiangxi and Shanghai; the south includes Guangdong, Guangxi and Hainan; the west includes Ningxia, Xinjiang, Qinghai, Shaanxi, Gansu, Sichuan, Yunnan, Guizhou, Tibet and Chongqing; the central includes Hubei, Hunan, and Henan; and the north includes Beijing, Tianjin, Hebei, Shanxi, Inner Mongolia, Liaoning, Jilin and Heilongjiang.

Using a framework that considers different principals, this paper introduces a virtual variable, the higher education institution attribute, to differentiate between the principal characteristics of higher education institutions. Two methods were used to assign values to this higher education institution attribute. In the first method, the institutions were classified into two types, affiliated and provincial higher education institutions, which were respectively assigned values of 0 and 1. In the second method, the institutions were classified into five types: institutions affiliated with the MOE, institutions affiliated with other ministries or commissions, institutions jointly developed by the MOE and provinces, institutions jointly developed by other ministries or commissions and provinces, and provincial institutions (except for those that were jointly developed). These two classification methods were used to verify the stability of the principal characteristics' influence on the enrollment actions of higher education institutions using a parallel model. The educational quality of higher education institutions was determined based on their ranking[12]; the scarcity associated with the total college enrollment capacity was determined by dividing the total enrollment capacity of the region by the number of local senior middle school graduates[13]; the fiscal incentives from the central and local governments were measured by the average education fund investment per student[14]; a higher education institution was considered to be establishing a new campus if it had a campus under construction in the last five years[15]; the policy constraints on college enrollment were measured based on the enrollment plan indices that the MOE issues to each institution[16]; local per capita GDP was used to measure the local economic development level[17]; the scarcity in total local enrollment capacity was calculated by dividing the total local enrollment by the number of local senior middle school graduates.[18]

This paper uses a university's ranking as a proxy for its educational quality. The data was taken from the Chinese Alumni Network,

Table 2
Description of Sample's structure.

Distribution	Number	Mean	Min.	Max.	Percent	Cumulative (%)
Regional Distribution Eastern	172	0.622	0.186	0.986	28	28
Southern	54	0.784	0.200	0.950	8.8	36.8
Western	121	0.694	0.083	1	19.7	56.5
Central	82	0.624	0.058	0.984	13.4	69.9
Northern	185	0.513	0.005	1	30.1	100
Types Teaching	356	0.909	0.083	1	58	58
Research	80	0.242	0.005	0.856	13	71
Teaching and Research	178	0.605	0.029	0.944	29	100
Profession Special Comprehensive	129	0.650	0.075	0.916	21	21
Science and Engineering	274	0.580	0.005	0.959	44.6	65.6
Arts	85	0.540	0.029	1	13.8	79.5
Ethnic	10	0.396	0.083	0.886	1.6	81.1
Normal	116	0.746	0.176	1	18.9	100

[10] Data from 2010-2016 was collected, but China delayed publishing data on educational funding for the central and local governments in 2015 and 2016. Thus, the data were not used. In addition, while there are data available for 2010-2013, the proportion of local enrollment at universities, university rankings and other data differ slightly relative to 2014. These differences can induce collinearity problems and hamper the regression model analysis. Thus, this paper only uses the best quality data (from 2014).

[11] The local area refers to the province, municipality or autonomous region in which a higher education institution is located; the enrollment capacity means the amount of regular planned enrollment in a higher education institution, excluding the amount of autonomous enrollment.

[12] Source of data: Assessment of Chinese Universities 2014: A Research Report, and the website of the CUAA. The research team behind this website has released rankings of Chinese universities for 13 consecutive years based on scientific research, education and reputation.

[13] Source of data: official websites of various higher education institutions.

[14] Education fund investment per capita = the government's education fund investment divided by the total number of students. Source of data: China's Statistical Yearbook on Education Funds 2014, in which the government education investment of some provinces and regions was 0 yuan.

[15] Source of data: official websites of various higher education institutions.

[16] Source of data: the website of the Ministry of Education of the People's Republic of China.

[17] Source of data: China's Statistical Yearbook 2014.

[18] Source of data: official websites of various higher education institutions.

Table 3
Descriptive statistics of variables (614).

Letter referred Variable	Mean	Standard deviation	Maximum	Minimum
Y college's local enrollment ratio	0.618	0.239	1.000	0.005
X1 local per capita GDP	50382.80	20552.326	99607	22922
X2 local enrollment indexes/the Number of high school graduates	0.630	0.464	2.157	0.267
X3 central governments' average Education fund investment per student	11.153	19.678	87.547	0
X4 local governments' average Education fund investment per student	137.894	47.276	542.059	69.510
X5 policy constraint of college enrollment	1.067	0.386	5	67 0.07
X6 the scarcity of total amount of college enrollments	0.167	0.016	0.148	0.001
X7 College's ranking	61.030	3.018	100.00	60.00
X8 college's attribute	0.87	0.337	1	0
X9 new campus or not	0.55	0.498	1	0

a widely praised professional third-party evaluation authority, whose research team ranks national universities based on scientific research, education and comprehensive reputation over 13 years. This paper uses these published university rankings to measure the educational quality of universities and selects other variables according to the current enrollment situation at Chinese universities. For example, enrollment at each university differs based on its size. Thus, the scarcity of enrollment for a university can be measured based on its total enrollment capacity and the number of local high school graduates; the planned enrollment amount of Chinese universities is determined by the Ministry of Education (MOE), which dictates the planned enrollment for each university. Because of differences in the enrollment numbers for each province, comparing the total local enrollment and the number of local high school graduates reflects the degree of scarcity of the local enrollment.

3.3. Regression results

Based on the above assumptions, this paper establishes the following regression model.

$$Y = \alpha + \sum_{i=1}^{9} \beta_i x_i + \beta_{10} x_1 x_8 + \beta_{11} x_6 x_8 + \beta_{12} x_7 x_8 + \varepsilon \quad (4)$$

Table 3 defines the terms in formula (4); α is the intercept, ε is the residual error, and β_i is the coefficient of the explanatory variable. The model includes three interaction terms to further explore how the interaction between a principal's characteristics and other explanatory variables affects a higher education institution's enrollment. We focus on the particular interaction terms of X_8 with other terms because we are mostly concerned with the different behavior of two types of education institutions, the ones affiliated with MOE and the provincial ones.[19]

This paper uses ordinary least squares (OLS) regression and SPSS 20.0 software for data analysis. To test the explanatory strength of the variables for each assumption, the variables were batched and regressed stepwise against the local enrollment ratio. Table 4 displays the results of the stepwise regression. A parallel model is used for the two classification strategies, including interaction items and institution attributes, to test the stability of the model. Table 5 displays the regression results for the parallel model.

Model 1 includes two control variables, the level of local economic development and the scarcity in total enrollment capacity. The model's overall goodness of fit is 0.274. Overall, the model is significant. The local per capita GDP coefficient is insignificant. The coefficient of the total local enrollment divided by the amount of senior middle school graduates is significant; thus, greater scarcity in local enrollment resources results in a higher local enrollment ratio. The explanatory power of this variable can be verified; as the variable coefficient is added successively from Model 2 to Model 6, it remains significant. After adjustment, the R^2 value increases, the model's overall goodness of fit improves, and the model is significant. Following the addition of variables in Models 5 and 6, the rankings of higher education institutions become insignificant.

For Models 7, 8 and 9, Table 5 shows the interaction terms for institution attributes and institution rankings, institution attributes and local per capita GDP, institution attributes and total college enrollment divided by the amount of senior middle school graduates. There is little difference between the goodness of fit for the three parallel models; the values are 0.719, 0.716 and 0.718, respectively, which show improvement over Model 5, verifying the stability of these models. Model 11 replaces the institution attribute for two-type classification in Model 5 with the institution attribute for five-type classification. There is little difference between the model coefficients and overall significance, which further verifies the stability of the model.

[19] We have also tried to include all the interaction terms of X8 with each other variable and found that other coefficients not in equation (4) and their combinations are not significant.

Table 4
Stepwise regression analysis of college's local enrollment ratio.

Variable	Model 1	Model2	Model 3	Model 4	Model 5	Model 6
Constant	0.803***	0.716***	0.822***	1.862***	0.021	0.088
	(0.023)	(0.034)	(0.042)	(0.160)	(0.139)	(0.109)
X1	0.043	0.005	0.047	0.015	0.046	0.004
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
X2	−0.493***	0.793***	0.911***	0.569***	0.645***	0.458***
	(0.027)	(0.053)	(0.052)	(0.052)	(0.038)	(0.033)
X3		0.299***	0.342***	0.258***	0.450***	0.328***
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
X4		0.166***	0.149***	0.232***	0.228***	0.171***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
X5			0.182***	0.037	0.105***	0.031
			(0.021)	(0.000)	(0.014)	(0.000)
X6				−0.188***	−0.211***	−0.172***
				(0.633)	(0.410)	(0.358)
X7				−0.272***	0.031	0.022
				(0.003)	(0.002)	(0.002)
X8 (two-type classification)					0.635***	
					(0.019)	
X9 institutions affiliated with provinces, new campus						1.223***
						(0.021)
institutions affiliated with provinces, without new campus						0.824***
						(0.021)
institutions affiliated with ministries, new campus						0.065**
						(0.024)
Adjusted R^2	0.274	0.315	0.344	0.447	0.711	0.819
F statistic	116.939***	19.270***	65.428***	65.776***	556.008***	277.993***

Notes: "***" denotes $p < 0.01$,"**"denotes $p < 0.05$,"*"denotes $p < 0.1$, the standard errors in parentheses. College's attribute (two-type classification)'s reference group is institutions affiliated with ministries. The cross item's reference group is institution s affiliated with ministries, without new campus.

4. Further analysis

The regression analysis results above data are consistent with the hypotheses and confirm the theoretical model established earlier. We perform the following additional analyses.

(1) Characteristics of the principal and college enrollment

The tables show that after the institution attribute is added to the model (see Model 5), the R^2 value increases from 0.447 to 0.711. The institution attribute uses the affiliated higher education institutions as the reference group. The coefficient of the institution attribute (0.635) is significant, which means that compared to affiliated institutions and due to different principal structures, the local enrollment ratio of provincial higher education institutions is significantly different. Additionally, the local enrollment of provincial higher education institutions is significantly higher than for affiliated higher education institutions. When the data are grouped by the institution attribute and whether a new campus is under construction (see Model 6), the coefficients of provincial higher education institutions both with and without a new campus under construction are significant, again demonstrating the influence of the institution attribute on the local enrollment ratio. This influence is also apparent when further groupings are made based on the institution attribute (see Model 11). Thus, the influence of the institution attribute on higher education institution enrollment is robust.

(2) The agent's characteristics and higher education institutions enrollment

Adding the institutional rankings and size to Model 4 changes its overall explanatory power of the model (the R^2 values increases from 0.329 to 0.447). The coefficient of total college enrollment divided by the amount of senior middle school graduates (-0.229) is significant, which indicates that the greater the enrollment of an institution, the lower its local enrollment ratio will be. The coefficient for the institutional ranking (-0.268) is significant, which shows a higher institutional ranking decreases the local enrollment ratio. Thus, a higher education institution with greater educational quality and a better reputation will be more likely to enroll excellent students from all over the country. When the institution attribute is added to Model 5, the coefficient for institutional ranking is insignificant. However, when the interaction item for the institution attribute and ranking is added to Model 10, the coefficient of the interaction term (-3.005) becomes significant. This indicates higher ranking provincial higher education institutions have lower local enrollment ratios, again suggesting that higher education institutions with greater educational quality can better follow market demands via their enrollment, ignore the constraints from local government, and reduce local enrollment.

(3) Incentive intensity and college enrollment

When the education funding per student from the central and local government is added to Model 2, the goodness of fit of the model

Table 5
Regression analysis of the parallel models of college's local enrollment ratio.

Variable	Model5	Model7	Model 8	Model 9	Model 10	Model 11
Constant	0.021	−0.090	−0.036	0.042	−0.099	0.604***
	(0.139)	(0.140)	(0.140)	(0.138)	(0.140)	(0.135)
X1	0.046	0.060*	0.225***	0.045	0.175**	0.042
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
X2	−0.645***	−0.674***	−0.679***	−0.631***	−0.683***	−0.649***
	(0.038)	(0.037)	(0.038)	(0.037)	(0.037)	(0.037)
X3	0.450***	0.463***	0.440***	0.430***	0.442***	0.442***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
X4	0.228***	0.226***	0.219***	0.236***	0.226***	0.221***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
X5	0.105***	0.096***	0.099***	0.089***	0.081***	0.094***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
X6	−0.211***	−0.191***	−0.203***	−0.072	−0.091**	−0.191***
	(0.410)	(0.410)	(0.409)	(0.666)	(0.673)	(0.413)
X7	0.031	0.052**	0.022	0.018	0.035	0.009
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
X8 (two-type classification)	0.635***	4.052***	0.814***	0.718***	3.827***	
	(0.019)	(0.578)	(0.045)	(0.024)	(0.576)	
X8×X7		−3.403***			−3.005***	
		(0.010)			(0.010)	
X8×X1			−0.222***		−0.144*	
			(0.000)		(0.000)	
X8×X6				−0.173***	−0.121**	
				(0.742)	(0.784)	
college's attribute (five-type classification) institutions affiliated with the MOE -						0.485***
						(0.025)
institutions affiliated with ministries -						0.460***
						(0.024)
institutions jointly developed by the MOE and provinces						−0.036
						(0.022)
institutions jointly developed by ministries and provinces						−0.114***
						(0.016)
Adjusted R^2	0.711	0.719	0.716	0.718	0.725	0.727

Notes: "***" denotes p < 0.01,"**"denotes p < 0.05,"*"denotes p < 0.1, the standard errors in parentheses. College's attribute (two-type classification)'s reference group is institutions affiliated with ministries. College's attribute (five-type classification)'s reference group is institutions affiliated with provinces.

improves. In Model 6, the coefficients for education funding per student by the central and local government (0.322 and 0.169) are both significant, indicating that the greater education funding per student from the central and local government result in a higher local enrollment ratio for an institution. Thus, fiscal incentives from the central government, rather than inducing higher education institutions to fairly allocate their enrollment opportunities, encourages them to enroll more local students. For both affiliated and local higher education institutions, fiscal incentives from the local government also make them favor local enrollment. Thus, the predictions in section 3.1 are verified.

Whether a higher education institution is building a new campus also has a significant impact on its enrollment actions. During the construction of a new campus, the higher education institution will rely more on the local government for land, funding and taxation. The coefficient for provincial higher education institutions (1.212) is significantly different from those of other groups; the coefficient of provincial higher education institutions without new campuses (0.821) is significantly positive, as is the coefficient of affiliated higher education institutions with new campuses (0.068). The gradual decrease in the coefficients for the three groups further indicates that different types of higher education institutions rely on local government resources differently.

(4) Policy constraints and higher education institution enrollment

When the policy constraint variable is added to Model 3, the coefficient of the indices issued by the MOE (-0.182) is significant, improving the model's goodness of fit. In Model 6, the coefficient of the policy constraint variable is insignificant, and the influence of the enrollment index issued by the MOE on local college enrollments does not pass verification. This may occur because the enrollment indices issued by the MOE serve as the basis for the enrollment plans of higher education institutions. Thus, most information is included in the college enrollment size variable, which is significant when the MOE-issued enrollment index is added to the model during stepwise regression. However, its explanatory power is reduced in the complete model.

The above analysis indicates that regional differences in enrollment at Chinese universities are explained well using a multiple principal framework. The theory of multiple principals suggests that agent activity is influenced by the characteristics of various principals, including incentive strength and constraint conditions. First, the different principal characteristics strongly affect the regional allocation of planned enrollment at universities. The enrollment at Chinese universities is entrusted to the central and local governments, and local governments favor local enrollment more than central governments. The central government gives greater weight to the balanced allocation of national education resources, and the universities affiliated with the MOE and affiliated with the

central government aim to balance their enrollment among different regions. The local government gives greater weight to local needs and aims to increase the enrollment quota, which is limited by the central authority each year. Thus, provincial universities affiliated with local governments tend to favor local high school graduates.

Second, the regional allocation of enrollment is related to the educational quality of universities. For the universities affiliated with the MOE, those with high educational quality have more opportunities to win performance rewards from local governments; thus, they have a greater incentive to favor local enrollment. One example is Zhejiang University, a university affiliated directly with the MOE. In total, 48.53% of its enrollment came from Zhejiang Province in 2016 [20], a number that is much higher than other MOE-affiliated universities with lower rankings. Among provincial universities, the higher a university's educational quality, the more incentives it will receive from the central government. Therefore, it will enroll a higher number of non-local students. For example, Suzhou University enrolled 52.61% of its students from Suzhou in 2017,[21] a number lower than other provincial universities.

Third, the planned enrollment amount at universities is related to the incentive strength of the principals. The financial incentives for universities directly affiliated with the MOE involve the "cost supporting" strategy, which means the central government allocates funds according to its budget. No matter how a university performs, the central government will provide equal support. Thus, this incentive does not promote a balanced regional allocation of enrollment at universities. However, local governments use a "performance purchase" strategy as the financial incentive for universities affiliated with the MOE, which means that universities with better performance will obtain more financial support. This strategy promotes the enrollment of local graduates. During the construction of a new campus, universities must rely on support from the local government, such as land, tax revenue, financing, and safety. Thus, the university will favor local enrollment if the local government provides greater financial incentives. Finally, the regional allocation of enrollment is restrained by policy. The yearly enrollment amount at Chinese universities is controlled at the macro level by the central government. Universities must plan their enrollment based on the dictates of the central government, and the planned enrollment amount reflects the scarcity of enrollment at the universities. If the enrollment capacity is smaller, a university will favor local high school graduates. In conclusion, the regional allocation of enrollment at Chinese universities is consistent with the multiple-principal theory.

From a policy perspective, this analysis of the factors affecting the regional distribution of college enrollment suggests the following recommendations for decision-making in the public sector. First, improving the education quality of higher education institutions is basic to realizing an equal distribution of enrollment resources. Otherwise, the reliance of these institutions on resources from local governments may cause them to favor local students. In addition, higher education institutions with poor educational quality are not attractive to non-local students, which force them to recruit more local students. Higher education institutions should improve their educational quality in terms of scientific research, education, and social services; this will help them attract students from around the country and promote an equal distribution of higher education resources. Second, the multiple-principal framework indicates that an incentive from one principal will be affected by externalities associated with incentives from other principals. Therefore, when formulating incentives, a principal must consider whether an incentive measure strengthens or weakens the incentive for other principals. For college enrollment, the "performance purchase" and "cost support" incentive strategies of the central and local government, respectively, will affect each other. The resulting college enrollment may thus contradict the wishes of the principals. Finally, when principals in the public sector constrain the working style of an agent through administrative control, they can restrict the agent's competitive activities and effectively control the agent's actions in the direction they desire. However, this result is affected by the basic demands of other principals. The agent may strive to meet the minimum requirements of each principal given the expectations of multiple principals; they may then respond according to the degree of constraint. Therefore, tighter administrative controls may result in actions by the agent that deviate from expectations; in contrast, looser administrative controls may allow the agent may to strive for the realization of the principal's expectations after autonomously balancing the requests from various parties.

5. Conclusion

Using a multiple-principal framework, this study showed that a principal's characteristics, an agent's characteristics, incentive intensity and administrative control affect enrollment in higher education institutions in China. Through the analysis of 614 data points, this paper verified the relationship between the regional distribution of China's college enrollment and institutional affiliation, education funding, institutional ranking and policy constraints. We draw the following main conclusions.

(1) Institution affiliation, educational quality and enrollment

Among affiliated higher education institutions, those with higher educational quality have higher local enrollment ratios. Among local higher education institutions, those with higher educational quality have lower local enrollment ratios. These results verify the "performance purchase" and the "cost support" incentive strategies of different principals for higher education institutions. In other words, the first principal of affiliated higher education institutions uses the "cost support" incentive and does not discriminate between institutions with different educational quality; in contrast, the second principal, the local government, adopts the "performance purchase" incentive in the hopes that affiliated higher education institutions will recruit more local students. The first principal of local higher education institutions, the local government, tends to adopt a relatively even "cost support" incentive, while the second principal, the MOE, attaches more importance to the educational quality of local higher education institutions.

[20] Source of data: enrollment information from the website of Zhejiang University. http://zdzsc.zju.edu.cn/index.php?c=Index&a=detail&catid=15&id=1448.
[21] Source of data: enrollment information from the website of Suzhou University. http://www.suda.edu.cn/enroll_job/?id=1#bk.

(2) Institutional affiliation, education funding and enrollment

Higher education funding from the central government and the local government directly reflects the intensity of their incentives for higher education institutions. The result of an incentive from the central government may deviate from its expectations, though, because for each additional unit of education funding per student from the central government, the local enrollment of the higher education institution increases by 0.322. This value is higher than the increase resulting from the educational costs of the local government (0.169). A likely explanation is that after the central government increases the amount of funding, higher education institutions begin to add to or expand their campuses, thus increasing their reliance on the resources of the local government and causing the increase in local enrollment to meet the local government's expectations.

(3) Institutional affiliation, administrative control and enrollment

The central government exerts macro-scale control over the overall enrollment size. To some extent, it can prevent college enrollment from excessively favoring local students. The more enrollment indices are issued by the central government, the more willing higher education institutions are to recruit non-local students, thus more evenly allocating educational opportunities nationwide and attracting more excellent students. However, when the MOE issues fewer enrollment indices, higher education institutions must prioritize the demands of the local government to ensure an appropriate local enrollment ratio. In other words, greater administrative control results in higher education institutions being less able to allocate their enrollments according to market demands.

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