

Article

# Influencing Factors for the Promotion of International Vocational Qualification and Certification: Evidences from International Project Manager Professionals in China

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**Abstract:** Globalization has driven the promotion of international vocational qualification and certification (IVQC) to unify certification systems and standards. We explore IVQC promotion paths through the introduction and development of China's International Project Manager Professional (IPMP) certification and identify and analyse IVQC processes' influencing factors. Four factors (economic level, education level, employment level, sex ratio) are proposed; their impacts are hypothesized. Geographically weighted regression (GWR) is employed to identify factor impact relationships and validate assumptions. The results show that the four factors are positive for the promotion of IVQC. Economic level, employment level, and sex ratio contribute to the promotion of IVQC; employment level contributes most. Education level has relatively small impact. Therefore, IVQC is more likely to enter areas with developed economies, high employment rates, and more males. The promotion of IVQC can be facilitated by continuous social progress and international development. However, areas where salient factor levels are too low still present challenges.

**Keywords:** International Vocational Qualification and Certification; engineering education; International Project Manager Professional; geographically weighted regression; influencing factors

## 1. Introduction

Ongoing and expected changes in working life related to, among other factors, new product and process technologies, increasingly short product life cycles, changing production concepts, and strategies of rationalization are widely believed to be creating strong new demands for occupational competencies and qualifications among the work force [1]. Consequently, during the last two decades, both in systems and in policy, we have witnessed an increasing focus on human resource development and work-based education and training as instruments for enhancing productivity, competitiveness, and economic growth [2]. As early as 1853, the nationwide examination system of professional technical disciplines was established by the Ministry of Science, Technology and Innovation (MOSTI) in the UK. Later, the examination system of these disciplines was revised by the relevant department in Germany, and examinations were introduced in 1908 as a means to obtain relevant vocational qualifications. In subsequent years, vocational qualifications were applied to many industries such as architecture, accounting, and law in USA, Canada and other capitalist countries. Today, vocational qualifications are important for a person's job search and to incorporate qualification assessments [3–5].

The development of globalization has been powerful in promoting the integration of the international economy and culture. Accordingly, multinational corporations, cross-border education and cross-border work have all greatly increased [6]. For example, vocational education has embarked on the path of internationalization; a number of international vocational education and qualification certification systems have also emerged and are gradually being introduced by many countries. In 1994, the Sino-UK vocational qualification certificate was initiated. The British Council introduced many vocational qualification certificates focused on the internationalization of Chinese companies and formed a Sino-UK vocational qualification certificate system containing 46 certification courses [7,8]. The very popular US Project Management Professional (PMP) certification has now been introduced in more than 170 countries [9]. Clearly, the promotion of international qualifications in various countries has become a prominent issue. However, there are few studies of international vocational qualification and certification (IVQC) due to their large scope, and the studies of vocational qualification certificates (VQC) focus on the qualification system and the mentality of the applicants. The development of an IVQC when it is introduced into a new country has not been discussed.

To fill this research gap, this study discusses the development trend of an IVQC introduced into a new country by focusing on the case of the International Project Manager Professional (IPMP) certification in China. It preliminarily explores the factors influencing the promotion of an IVQC in different regions. Geographically weighted regression (GWR) is employed in this study as a local modelling technique for spatial data with some degree of spatial dependence. The aims of this paper are to propose a quantitative analysis method (a spatial metrology model) to analyse the factors influencing the development of IVQC in different regions, to provide information for the easy introduction and promotion of IVQC in various countries and support the government in formulating regional differentiation policies for talent management. At the same time, this research is also helpful for policy maker to unify the professional norms in project management related industries and for managers to formulate the balanced development strategies within companies across regions.

The rest of the paper is organized as follows: Section 2 describes related research on IVQC and GWR. Section 3 describes the methods used in this paper. Subsequently, a case of IPMP certification in China is described in Section 4, and results and discussion are also presented. Section 5 concludes the paper and points out the development prospects of IVQC.

## 2. Literature Review

Due to the accelerating pace of globalization, the research on Vocational Qualification Certificates (VQC) has increased in recent years. The initial research showed that vocational certification assessments are indeed beneficial in the employment of students and the teaching quality of schools. Fennell discussed the impact of professional and technical qualifications on the educational quality of engineering faculty [10]. Jakulevičienė analyzed some problems existing in establishing vocational qualification certification system in China's university libraries [11]. They all suggested that the teaching content and the expansion of reading materials of relevant vocational qualifications should be added to college education. Nevertheless, they did not conduct research and analysis on the development and impact of international professional qualifications.

More scholars are paying attention to the development characteristics and influence of IVQC, in addition to the integration of vocational education in college education. The authors, subjects, main conclusions, and research methods of the relevant studies are listed in Table 1. The studies in Table 1 are all conducted on a certain type of IVQC. Some of the research covers the whole world, and some only have one or a few countries. There is few studies conducted on Asian countries. It may be because the countries that initiate IVQC are always European countries or the United States and other developed countries. Although the scope of these studies is different, the main conclusions are: 1) International professional qualification certification can promote industry standardization and improve the professionalism of employees; 2) The development of international professional

qualification certification varies in different regions. In addition, the research methods of these studies focus on qualitative research.

**Table 1.** The research on the development characteristics and influence of IVQC [12–17].

Author	Research Object	Region	Conclusions about IVQC	Method
Castillo et al. (2016)	MRI qualification and certification frameworks	Around the world	Mandatory certification could lead to registration in an MRI specialist register Adequate staffing of safety personnel with the required educational and professional qualifications can enhance safety management in construction	Document analysis
Awolusi et al. (2017; 2018)	Safety professionals	The US	Establishing a specialized professional training framework with the goal of providing an useful example for other organizations and institutions.	Structured survey
Medeisis (2017)	Spectrum management training programme	Around the world		Case study
Honey et al. (2017)	First nursing qualification	New Zealand, US, England, Australia, Finland, Canada	It is important to find a way forward that fits with local drivers and initiatives to strengthen the professional trainong and education of nursing A unified welding professional qualification certification system is easier to be recognized. The number of countries willing to introduce a unified certification system has reached 60%, and the number of welding personnel professional qualification certifications is also increasing.	Document analysis
Quintino et al. (2008)	The International Education and Qualification System for Welding Personnel	Around the world		Document analysis and qualitative data analysis

The above examples notwithstanding, there are few in-depth studies of the promotion and influencing factors of IVQC, especially by quantitative methods. The development performance of an IVQC when entering a new region can provide for other countries as a reference for this certification. Analysis of the factors affecting the development performance of IVQC introduced in different regions is conducive to promoting the balanced development of the related industries. Therefore, this study uses a quantitative analysis method to study the influencing factors of the development performance of an international professional qualification certification introduced into a new country, taking into account the geographical differences between provinces and cities.

### 3. Research Methods

The research tools used are statistical analysis techniques and spatial econometrics. The characteristics of and differences in the development of IVQC can be found through cluster analysis of authenticator information. Accordingly, the possible influencing factors and their impact relationships are proposed. GWR is employed to test and analyse the impact of factors based on spatial differences; however, first, exploratory spatial data analysis (EDSA) technology is used to analyze the spatial correlation of IVQC population data, which laid the foundation for later analysis of influencing factors by GWR model. Finally, it is determined whether the influence of the factors matches the characteristics of the original data.

### 3.1. Hypothesis for Influencing Factors and Impact Relationship

Content analysis and literature research are employed in this study to propose the factors that may affect the entry of a vocational qualification. A large amount of certifiers' information (including age, birthplace, educational background, and gender) must be observed and analysed to identify the clustering and variation characteristics. Accordingly, the possible influencing factors and their impacts can be proposed.

### 3.2. ESDA Spatial Autocorrelation Analysis

According to Anselin, the spatial autocorrelation in the ESDA method includes global Moran's I and local Moran's I [18]. This paper introduces global Moran's I to detect the spatial variation characteristics of the number of certified individuals in a country. The global Moran's I index can be given as:

$$I = \frac{\sum_{i=1}^N \sum_{j=1}^N w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{\sum_{i=1}^N \sum_{j=1}^N w_{ij} \sum_{i=1}^N (x_i - \bar{x})^2} \quad (1)$$

In this formula,  $N$  is the number of provinces;  $x_i$  and  $x_j$  denote the population intensity of the certificates of provinces  $i$  and  $j$ , respectively;  $\bar{x}$  refers to the average value of  $x$ ;  $w_{ij}$  is the spatial weight matrix, which can be defined as the spatial neighbouring relationships between each geographic unit. This paper uses the binary contiguity matrix with queen contiguity. If the  $i$ th province is adjacent to the  $j$ th province, the matrix elements  $w_{ij}=1$ , otherwise for  $w_{ij}=0$ . The value of the global Moran's I index is between  $-1$  and  $1$ . Positive global Moran's I values mean positive spatial dependence, and the closer the value is to  $1$ , the greater the spatial clustering in the pattern. Negative Moran's I values indicate negative spatial dependence; the closer the value is to  $-1$ , the greater the spatial dispersion in the pattern. A zero value indicates that there is no spatial autocorrelation and that the number of certificates exhibits a random spatial distribution.

Positive autocorrelation shows that objects with similar geographical locations have greater similarity and vice versa [18,19], making it possible to use the GWR model to discuss the driving factors of the distribution.

#### 3.2.1. GWR

In regression models where the cases are geographical locations, regression coefficients do not always remain fixed over space [20]. Accordingly, GWR is introduced. GWR is a common method for exploring spatial relationship non-stationarity. In GWR, all coefficients vary over space, and the parameter estimates are made using an approach in which the contribution of a sample to the analysis is weighted based on its spatial proximity to the specific location under consideration [21,22]. The GWR model is considered to be a very effective spatial data analysis tool.

By adopting the GWR approach, the significant spatial non-stationarity of the object and its influencing factors are observed, and the performance is markedly better than in conventional (global) regression analysis [23]. The model has a considerably better fit with empirical data than the global model, which makes it possible to draw detailed conclusions [24,25]. For OLS (ordinary least squares), GWR is an improved and processed OLS model where the spatial position of the influencing factor variable is fully considered and the parameter estimation of local regression is allowed [26,27]. Therefore, in this paper, the GWR model is selected as the main method to analyse the influencing factors of IVQC. According to Anselin [18,28], the GWR model is specified as:

$$y_i = \beta_0(u_i, v_i) + \sum_k \beta_k(u_i, v_i)x_{ik} + \varepsilon_i \quad (2)$$

Where  $(u_i, v_i)$  represents the geographical coordinates of province  $i$  and  $\beta_k(u_i, v_i)$  denotes the regression coefficient related to the  $k$  explanatory variable for province  $i$ . The regression coefficient of province  $i$  can be estimated based on the spatial weighting function. Fotheringham et al. (1996) suggested that a weighting function can be used as a monotone decreasing and continuous function of spatial distance [29]. Gauss's function is used in this study:

$$w_{ij} = \exp[-(d_{ij}/b)]^2 \quad (3)$$

where  $b$  refers to the bandwidth,  $d_{ij}$  denotes the distance between province  $i$  and province  $j$ . Bowman (1998) proposed a cross-validation (CV) method [30], which can be used to determine the appropriate bandwidth  $b$ :

$$CV = \sum_{i=1}^n [y_i - \hat{y}_{\neq i}(b)]^2 \quad (4)$$

In this formula,  $\hat{y}_{\neq i}$  represents the estimated value for  $y_i$ , which is the  $i$ th observation value that is excluded in the regression process. When the CV value reaches the minimum, the corresponding  $b$  is the appropriate bandwidth. Determination of the optimal bandwidth was based on minimizing the corrected Akaike information criterion (AIC):

$$AIC = 2n \ln(\hat{\alpha}) + n \ln(2\pi) + \left[ \frac{n + tr(s)}{n - 2 - tr(s)} \right] \quad (5)$$

### 3.2.2. GWR Model Determination

The quantity of certificates is used as the dependent variable, and the influencing factors are used as the explanation variables. The OLS, as a global regression model, was used for parameter estimation. In contrast to the OLS models, the relationships among parameters and independent variables in the GWR models had complex local characteristics at the spatial scale. Consequently, the adoption of GWR models was necessary. The OLS and GWR analyses were performed using the tools in ArcGIS10.2 (Environmental Systems Research Institute, Inc. Redlands, California, USA).

The performance of the OLS and GWR models was compared using two statistics:  $R^2$  adjusted and AICc [31]. The higher the  $R^2$  adjusted is, the stronger the ability of the dependent variables will be interpreted by the independent variables to be. Similarly, the lower the AIC value is, the better the observed data will be described.

## 4. Case Study

### 4.1. IPMP and Data

The development of project management as a professional field originally arose in engineering construction. The Chartered Institute of Building (CIOB) in the UK and the Project Management Institute (PMI) in the US played important roles in the practice and promotion of project management (PM). The Lubuge power plant project in the mid-1980s effectively improved engagement in PM and propelled its professionalism in China, where the introduction of international certifications had begun to be taken seriously [32]. At present, professional PM qualifications have been introduced in various industries in China. There are three main evaluated professional PM certifications: IPMP, Project Management Professional (PMP) and CIOB. Each certification has a certain authority internationally; however, certification is not mandatory for entry into practice. The IPMP certification was introduced into China as early as 2001, and it has been an increasingly popular certification exam with approximately 30 thousand applicants annually in recent years. The certification system has been carried out in more than 30 countries worldwide. There are four grades in this system, from A to D. IPMP has become an international passport for project managers.

Due to its relatively mature institutional and public recognition, IPMP is chosen as the focus of this empirical study. In this case, the quantity of C-class certificates in the IPMP examination is used as the object of the study, which includes panel data from China's 31 provinces and municipalities from 2001 to 2017 (Hong Kong, Macao, and Taiwan are not included due to the absence of data).

#### 4.2. Hypothesis of Influencing Factors and Impact Relationship

A few factors that clearly contribute to data clustering are found by analysing the information on all IPMP certifiers from 2001 to 2017. First, the number of candidates is found to be different in various provinces. Based on spatial heterogeneity, GDP (gross domestic product), which is the most common factor used to distinguish provinces is proposed [33]. Moreover, it is found that the candidates have different vocations, and the main candidates are project managers and undergraduates. Therefore, employment level and education level are proposed to be two other positive factors. Employment level is denoted by unemployment rate because statistics on employment rate are absent and unemployment rate has a negative correlation with employment level. To quantify educational level, the quantity of higher education students per 10 million people in the province is selected as the indicator. Another notable feature in the data is that qualification certification is much more popular among males. The sex ratio, which equals the ratio of the number of males to females, is then proposed to be a positive influencing factor of IPMP promotion. Accordingly, the per capita GDP of the province, the unemployment rate of the urban registered population, the quantity of higher education students per 10 million people and the sex ratio are chosen as the four possible factors influencing the number of IPMP certificates in a region. The information on IPMP certificates was retrieved from the database of the IPMP headquarters in China. The data of the four factors were obtained from the China statistical yearbook. In summary, this study proposes the following hypothesis:

**Hypothesis 1.** *Economic level is an influencing factor for the distribution of IPMP certificates in China, with positive correlation.*

**Hypothesis 2.** *Educational level is an influencing factor for the distribution of IPMP certificates in China, with positive correlation.*

**Hypothesis 3.** *Employment level is an influencing factor for the distribution of IPMP certificates in China, with positive correlation.*

**Hypothesis 4.** *Sex ratio is an influencing factor for the distribution of IPMP certificates in China, with positive correlation.*

Accordingly, the regression model is initially established in Table 2 (To save space, the data from 2012 to 2015 is selected for research).

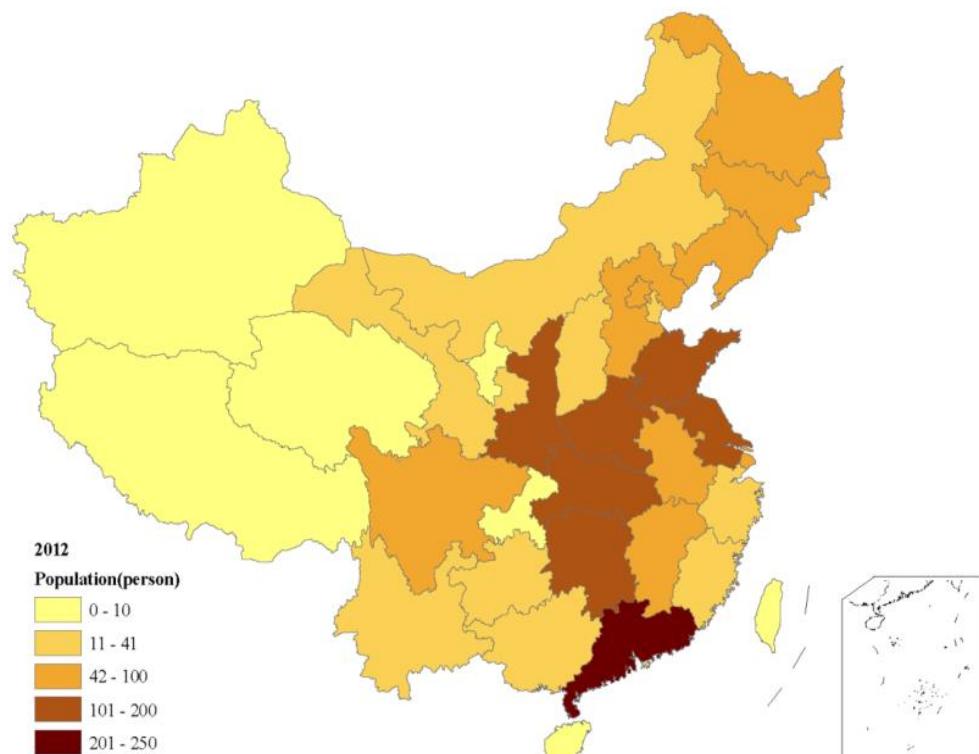
**Table 2.** Establishment of the regression model.

Time Span	Study Area	Dependent Variable	Explanatory Variables
From 2001 to 2017	China's 31 provinces and municipalities(Hong Kong, Macao and Taiwan excluded)	Quantity of C-class certificates in IPMP examination	per capita GDP of province unemployment rate quantity of higher education students per 10 million people sex ratio

#### 4.3. Results and Discussion

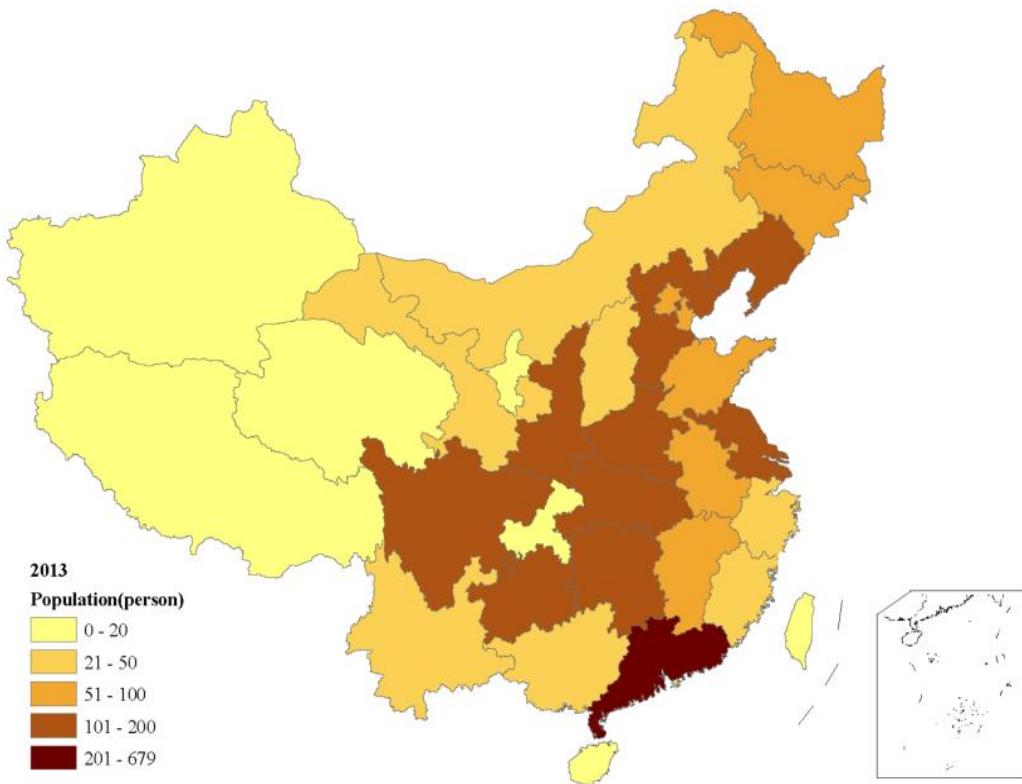
##### 4.3.1. Visual Data Analysis

The IPMP certificates of China's C-class in different provinces are clearly mapped by the quantile grading method (Figure 1). As shown in Figure 1, the distribution has changed over time, however, the intensive areas and sparse areas remain relatively fixed. According to the data from 2012, the most certificates are earned in Kwangtung, where the economy has grown rapidly in recent years. Hunan, Hubei, Shaanxi, Henan, Shandong and Jiangsu, which are always labelled as major education provinces, have the second-highest number of certificates. Sinkiang, Tibet, Qinghai, and Ningxia, whose economies, educational conditions and employment status are relatively undeveloped, are the provinces with the fewest certificates, and Chongqing is also included in this group. Similar to 2012, in 2013, the highest number of certificates is still held in Kwangtung. Hebei, Shanghai, Sichuan, Guizhou and Liaoning have become the provinces with the second-highest number of certificates; and there is no difference in the provinces with the lowest number of certificates. In 2014, Yunnan has the highest number of certificates along with Kwangtung; the group with the second-highest number has changed: Shanghai, Guizhou, and Liaoning are absent, and Beijing has been added; Guizhou, Gansu and Jiangsu join the group with the fewest certificates. Finally, in 2015, Kwangtung is still the province with the most certificates; 11 provinces, such as Hunan and Hubei, are listed in the second-highest group. There are no obvious changes in the lowest-ranked group.

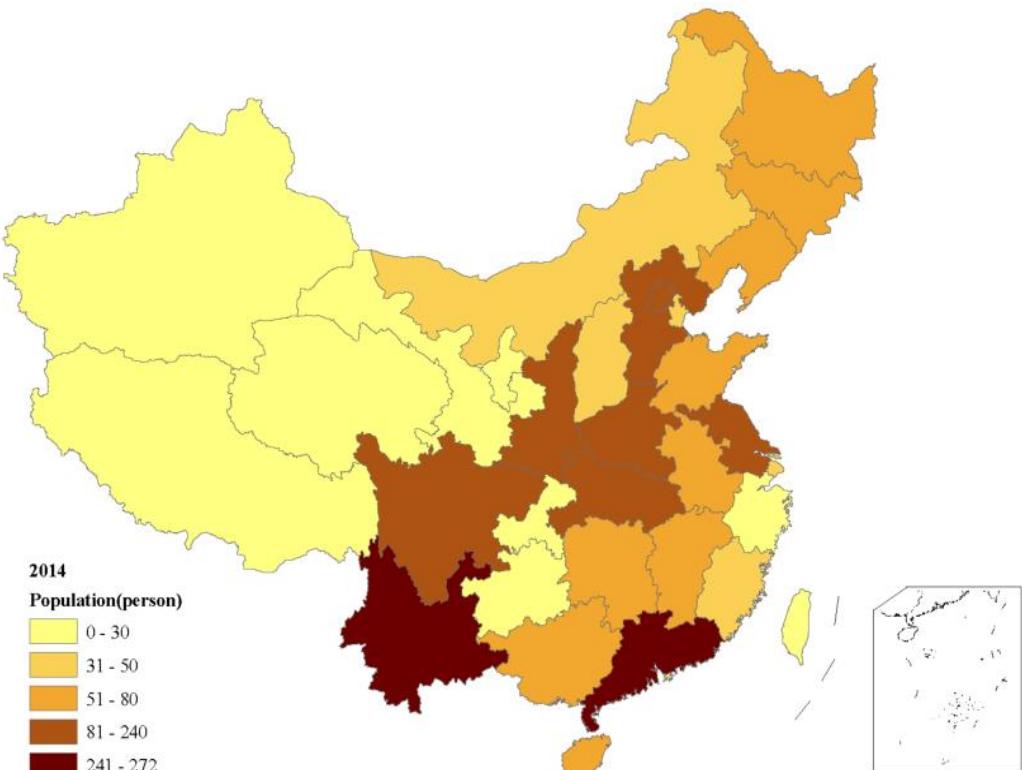


(a) Pattern of China's quantity of IPMP certificates in 2012.

**Figure 1. Cont.**

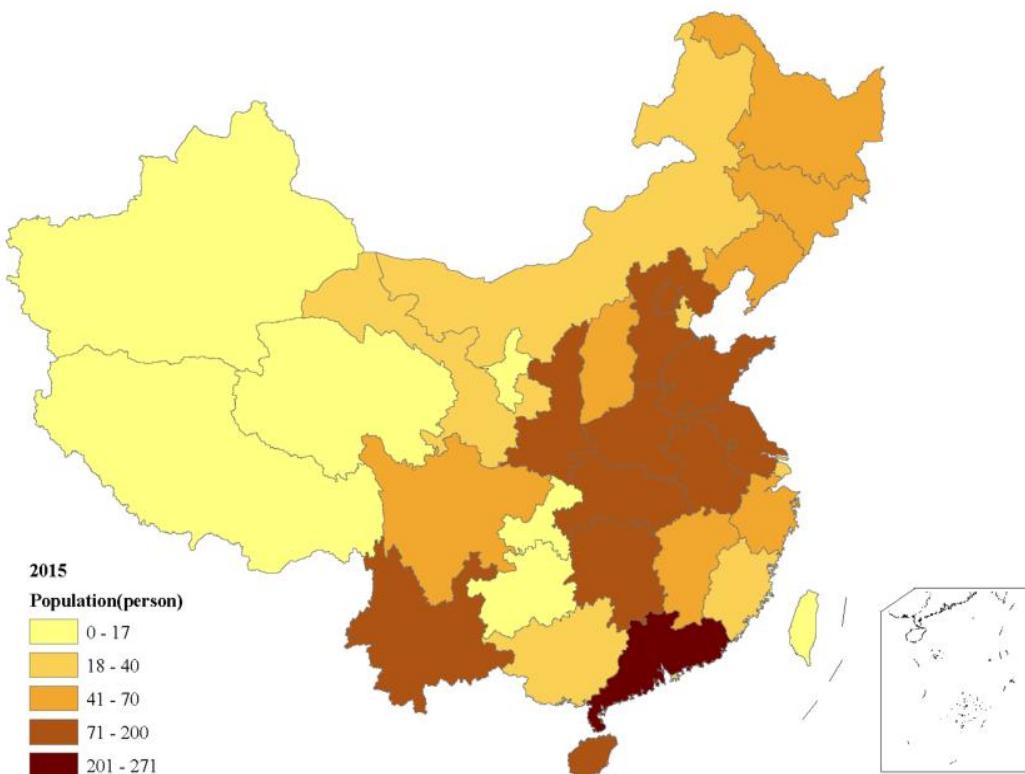


(b) Pattern of China's quantity of IPMP certificates in 2013.



(c) Pattern of China's quantity of IPMP certificates in 2014.

Figure 1. Cont.



(d) Pattern of China's quantity of IPMP certificates in 2015.

**Figure 1.** Patterns of China's quantity of IPMP certificates in 2012–2015.

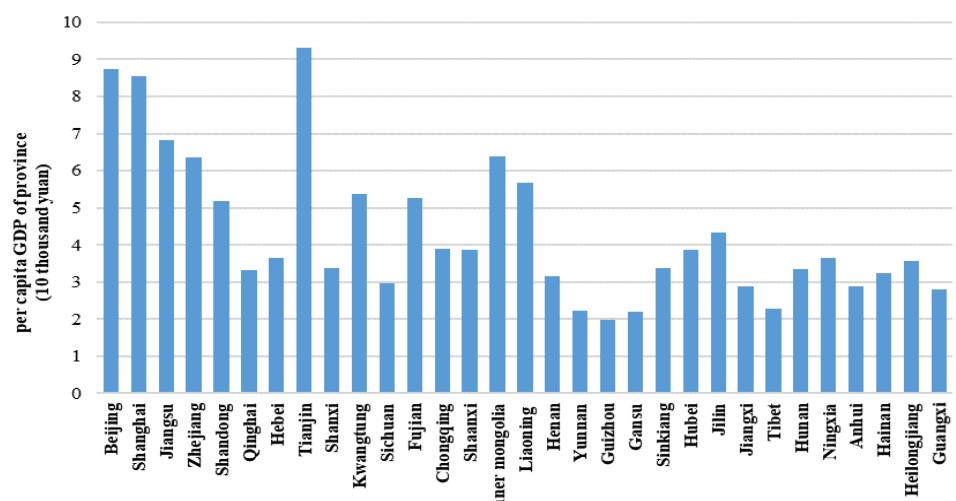
The provinces with more certificate classes (the highest and the second-highest grades) in the period from 2012 to 2015 and the provinces with fewer certificates are shown in Table 3 for easy analysis of the features and laws. In Table 2, when a province has a large or small number of certificates for two consecutive years, its area in the table will span two periods, and in the same way, the more years for which a province has a large or small number of certificates, the larger its area in the table. The levels of the four driving factors proposed in this study (Figure 2) are shown in the 31 provinces to preliminarily test the hypothesis according to the collected data.

As demonstrated in the four charts, the provinces with more certificates are proven to have high and middle economic levels, of which Beijing, Shanghai, Jiangsu and Kwangtung have rather high per capita GDPs. The provinces with fewer certificates, such as Qinghai and Guizhou, represent the most undeveloped economies of the four levels. The provinces with more certificates also generally have higher educational levels than those with fewer certificates. A similar situation arises for the sex ratio.

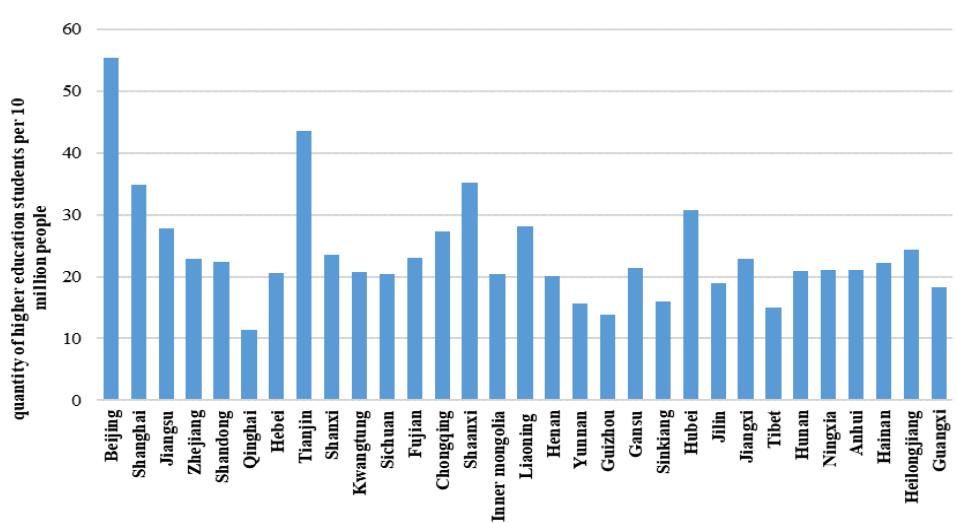
Conversely, for unemployment rate, provinces with more certificates present lower levels of unemployment than those with fewer certificates; that is, they have a higher employment level. These provinces have a lower unemployment rate due to their strong employment markets, as seen in Shanghai, Beijing and Kwangtung. Therefore, most of the provinces with more certificates score higher in the categories of economy, education, employment and sex ratio. These findings seem to provide preliminary support for the hypothesis of this study.

**Table 3.** Provinces of more certificates and fewer certificates in 2012–2015.

a) Provinces of more certificates.				
2012	2013	2014	2015	2012
Hunan	Shanghai; Liaoning; Guizhou	Sichuan	Anhui; Hainan	Hunan; Shandong
Kwangtung, Hubei, Shannxi, Henan, Jiangsu				
b) Provinces with fewer certificates.				
2012	2013	2014	2015	2012
Gansu, Zhejiang				
Guizhou				
Sinkiang, Tibet, Qinghai, Ningxia, Chongqing				

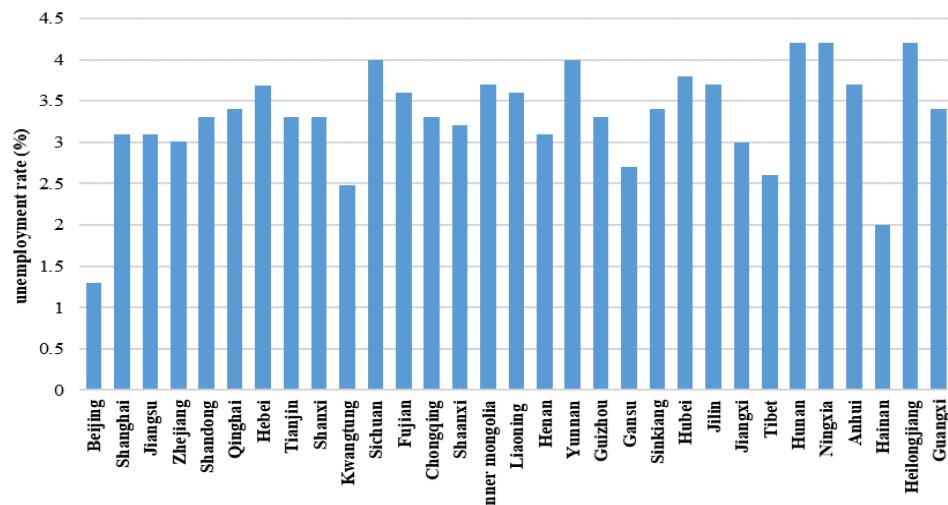


(a) The economic level of 31 provinces.

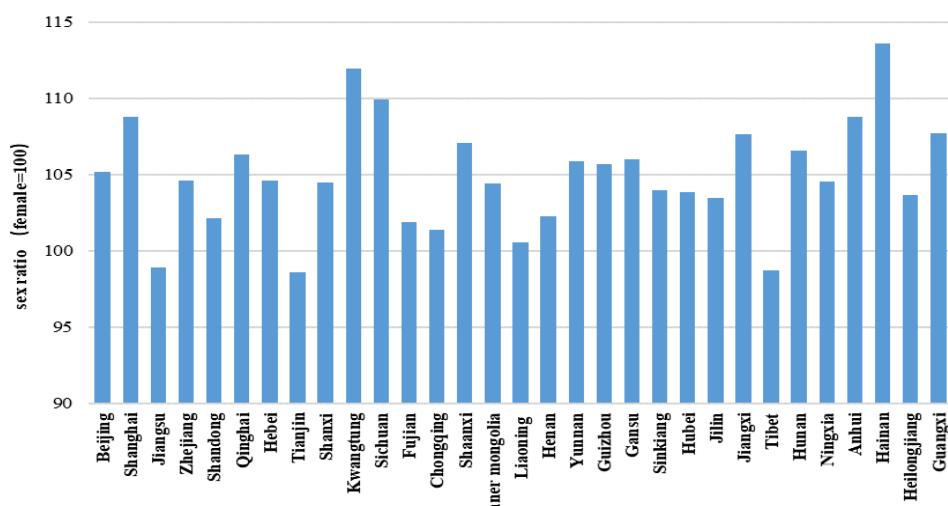


(b) The educational level of 31 provinces.

**Figure 2. Cont.**



(c) The unemployment level of 31 provinces.



(d) The sex ratio of 31 provinces.

**Figure 2.** The levels of four factors in each province.

#### 4.3.2. Global Spatial Autocorrelation

To test the spatial autocorrelation, the data of IPMP certificates in China were input to the spatial autocorrelation tool in ArcGIS10.2. The result shows that the Moran's I index of IPMP certificates in China is in the range of 0.3–0.4 and the P-value is close to 0.01 over the four years (Table 4), which indicates that there is clearly a positive spatial autocorrelation for IPMP certificates in China. Meanwhile, this result also provides the premise for the application of the GWR model.

**Table 4.** Global Morans' I of IPMP certificates in China.

Indicator	2012	2013	2014	2015
Moran's index	0.337547	0.367610	0.367802	0.328546
Expected index	-0.001129	-0.001129	-0.001129	-0.001129
Variance	0.000004	0.000004	0.000004	0.000004
Z-score	161.170143	175.55787	175.621292	156.915231
P-value	0.01	0.01	0.01	0.01

#### 4.3.3. Analysis on Geographically Weighted Regression

Based on the object of this case study and the influencing factors assumed in this study, the regression model was determined as Table 2. To identify the influencing force of the four factors proposed in this study, the coefficient of each factor was calculated by OLS and GWR. In the OLS model, the result is that adjusted  $R^2=0.053272$ ,  $AIC_C=379.566855$  and in the GWR model, adjusted  $R^2=0.053381$ ,  $AIC_C=66.415$ . By contrast, the adjusted  $R^2$  of GWR is greater than that of OLS. The  $AIC_C$  of GWR is less than that of OLS. Thus, the GWR model better describes the observed data according to the meaning of the two indicators, which takes into consideration not only the spatiotemporal heterogeneity of the study object but also the spatial property of the influencing factors. The whole estimation result of GWR including the value of local,  $R^2$  the appropriate bandwidth, and the corrected Akaike information criterion (AICc) in each year are reported in Table 5.

**Table 5.** The completed fitting result of GWR.

Indicator	2012	2013	2014	2015
$R^2$	0.168	0.241	0.190	0.308
$R^2$ Adjusted	0.053	0.0678	0.0359	0.129
Bandwidth	38124888.010	2674393.273	3576951.819	2314512.171
AICc	66.415	116.044	74.800	67.024

To elucidate the influencing relationships, the influencing coefficients of the per capita GDP of each province, the quantity of higher education students per 10 million people, the unemployment rate and the sex ratio are computed, and the influencing degree of the variables on IPMP qualification examinations is clearly identified. Additionally, GWR is also utilized to recognize the spatial relationship between the variables and IPMP certificates in China and to describe the aggregating feature of the influence coefficients. To save space, this paper lists only the results of GWR in 2012 (Table 6). To eliminate the effect of dimension, the data were processed with normalization.

When reviewing the sign of the influencing factors' coefficients (Table 6), the coefficients of the per capita GDP of the province, the quantity of higher education students per 10 million people and the sex ratio in different years are all positive values, indicating that a higher level of economic development, education and sex ratio can facilitate the entrance and development of the IPMP qualification examination. The coefficients of the unemployment rate are all negative values, which confirms that stronger employment pressure promotes the entrance and development of the IPMP qualification examination. The results are in accordance with the overall assumption of this paper.

Considering the absolute value of the influencing factors' coefficients, it is clear that the unemployment rate in a province has the strongest effect on IPMP certificates, and the value is approximately 0.42. The second highest value, approximately 0.38, is the per capita GDP in the province. The coefficient of the sex ratio is approximately 0.37, and that of the number of higher education students is less than 0.1. Thus, the quantity of higher education students in a province has a relatively weaker effect on IPMP certificates in the province. This result can be considered to be a reflection of the fact that as a mode of practising qualification, IPMP examination is directly related to the level of employment.

The results are consistent with the previous research, but there are also differences. According to Nijhof and Streumer [34] and Bush [35], key qualifications provide rapid and effective acquisition of the new knowledge and skills. First, qualifications enable workers to react to and exercise initiative in their work. Second, qualifications enable workers to shape their own 'employability'. Therefore, the higher the level of employment in a region, the higher the demand for qualifications of employees, and the employees themselves will be more actively qualified to improve their employability. Similar conclusion were reached in the research of Elhorst [36]. Similar to the findings of Klein, regions with higher education levels have more complete educational resources and management systems, so that students have a higher awareness of vocational qualifications and are closer to the learning content

of qualifications [37]. The difference is that the research results in this paper show that the impact of education level on the entry of IPMP is not very obvious. The reason is speculated that the weaker impact of education level on the IPMP examination may be due to the fact that this effect usually stimulates changes in employment circumstances from the perspective of talent, which always has very strong liquidity. The sex ratio is a positive influencing factor of IPMP promotion because gender difference has a certain impact on employment and income, which is in accordance with Pearlman [38]. At higher economic levels, a province's openness and internationalization can progress more easily (Du et al., [33]), so the effect of economic level on the IPMP examination is stronger.

**Table 6.** Results of GWR in 2012.

Province	Local $R^2$	Predicted	Per Capita GDP of Province	Quantity of Higher Education Students per 10 Million People	Unemployment Rate	Sex Ratio
Heilong Jiang	0.1679	0.5408	0.3758	0.0091	-0.4206	0.3749
Sinkiang	0.1679	0.4908	0.3763	0.0091	-0.4208	0.3750
Shanxi	0.1679	0.5654	0.3765	0.0091	-0.4192	0.3738
Tibet	0.1680	0.5162	0.3767	0.0091	-0.4155	0.3713
Ningxia	0.1680	0.4557	0.3767	0.0091	-0.4205	0.3747
Shandong	0.1679	0.6151	0.3770	0.0091	-0.4198	0.3742
Henan	0.1680	0.5269	0.3770	0.0091	-0.4198	0.3742
Jiangsu	0.1680	0.7236	0.3771	0.0091	-0.4200	0.3743
Anhui	0.1680	0.5240	0.3773	0.0091	-0.4178	0.3728
Hubei	0.1680	0.6265	0.3773	0.0091	-0.4194	0.3739
Zhejiang	0.1680	0.6856	0.3774	0.0091	-0.4185	0.3733
Jiangxi	0.1680	0.5667	0.3774	0.0090	-0.4203	0.3745
Hunan	0.1680	0.5111	0.3775	0.0091	-0.4171	0.3723
Yunnan	0.1680	0.4268	0.3777	0.0091	-0.4190	0.3736
Guizhou	0.1680	0.4303	0.3778	0.0091	-0.4198	0.3741
Fujian	0.1680	0.6112	0.3778	0.0090	-0.4207	0.3747
Guangxi	0.1680	0.5051	0.3779	0.0091	-0.4160	0.3714
Kwangtung	0.1680	0.6804	0.3780	0.0090	-0.4211	0.3750
Hainan	0.1681	0.6374	0.3780	0.0090	-0.4205	0.3745
Jilin	0.1679	0.5401	0.3782	0.0090	-0.4197	0.3740
Liaoning	0.1679	0.6666	0.3782	0.0091	-0.4183	0.3730
Tianjin	0.1679	0.9499	0.3783	0.0090	-0.4211	0.3749
Qinghai	0.1680	0.4556	0.3783	0.0091	-0.4191	0.3735
Gansu	0.1680	0.5335	0.3785	0.0090	-0.4205	0.3745
Shaanxi	0.1680	0.7044	0.3786	0.0090	-0.4198	0.3740
Inner Mongolia	0.1679	0.6345	0.3787	0.0090	-0.4210	0.3748
Chongqing	0.1680	0.6085	0.3787	0.0090	-0.4191	0.3735
Hebei	0.1679	0.5347	0.3789	0.0090	-0.4216	0.3752
Shanghai	0.1680	0.8878	0.3790	0.0091	-0.4182	0.3729
Beijing	0.1679	1.1435	0.3791	0.0090	-0.4195	0.3738
Sichuan	0.1680	0.5128	0.3797	0.0090	-0.4199	0.3740

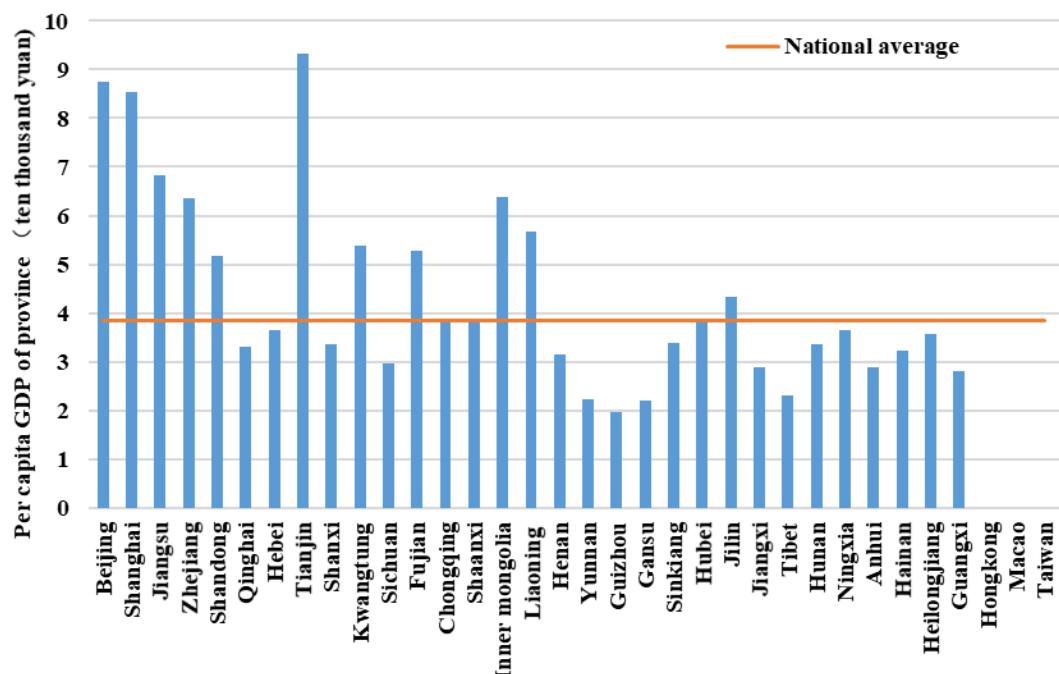
#### 4.3.4. Discussion

Levels of qualifications and approaches of using these competencies varied in each country [17]. What is anomalous is that some provinces with fewer IPMP certificates, such as Sinkiang, Ningxia and Qinghai, have a low or even high value for the four factors' influencing the coefficients. However, even with rising employment and economic levels, the numbers of certificates in these provinces have not increased. Regarding the mean level of each factor as a horizontal line, the 31 provinces can be classified into two types: one where the corresponding level is above the mean and another where it is below the mean (Figure 3). Most of the provinces with more certificates referenced above perform well. (For the purpose of regularity, the provinces that only account for the highest or lowest number of certificates once during the four years are ignored.) Jiangsu, Beijing and Shanghai all have four factors exceeding the mean level. Jiangsu and Shanghai are typical coastal cities where international economic exchange and the exchange of talent can develop rapidly. Beijing is the centre of politics, finance and culture in China, and every one of its indicators is high. Kwangtung, Shaanxi and Shandong have

three factors exceeding the mean level; the weakest factor in Kwangtung and Shandong is educational level, and the weakest factor in Shaanxi is economic level. Overall, these factors have weaker effects. In Hebei, educational level and sex ratio do not reach the mean level; however, the level of employment is high. Therefore, these provinces still have more IPMP certificates. Moreover, all provinces with fewer certificates have three or four factors below the mean level except Gansu, whose economy is far below the mean level. There are usually only one or two factors that reach the mean level in the provinces with a medium number of certificates (i.e., provinces are never ranked as having the most or fewest certificates). Thus, the influencing force of driving factors may depend not only on the influencing coefficient but also on the actual level of a province. When the levels of influencing factors reach the mean level, the influencing coefficients will take effect.

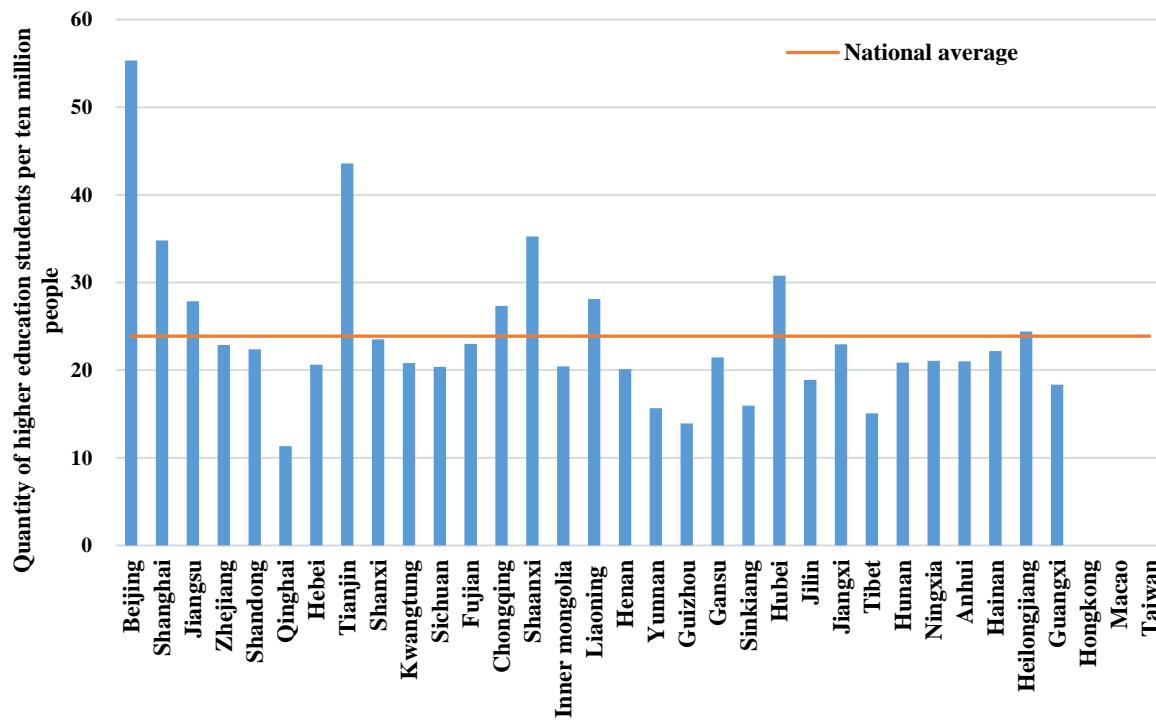
In the preceding part of this paper, the discussion is based on universality; however, there is also specificity that should be addressed. Although visual analysis and the GWR results have further supported the hypothesis of this paper, there are some exceptions. The two groups of provinces that are different from the universal law, and the possible reasons for these differences, are shown in Table 7.

One group's levels of the four factors are not particularly high, and that group has more certificates. There are four provinces in this category, including Sichuan, Henan, Hunan and Hubei. In Sichuan, many colleges have established an IPMP project department where people can apply to be trained, and these departments play an important role in the generalization of IPMP. In contrast to Sichuan, the generalization of IPMP in Henan can be attributed to the organization and support of enterprises. Moreover, since the IPMP qualification began in 2008, many transnational corporations have entered Henan, stimulating the need for international talent. As early as 2002, IPMP qualification had entered Hunan. With the development of industrialization in Hunan, the number of applicants for the IPMP qualification examination has increased since 2012, and many junior colleges now list international project management as a separate discipline. As a major province for education, Hubei has been closely following the international standards since 2012. It is important to recognize that in 2013, the fifteenth certificate of grade A in IPMP qualification examination was from Hubei.

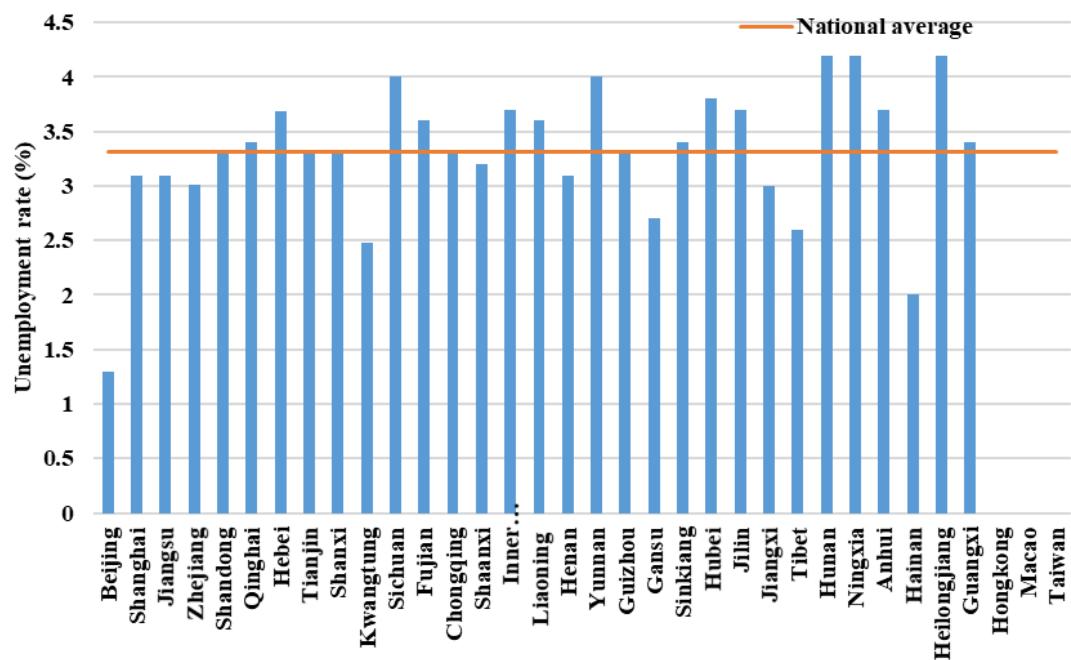


(a) The economic level of 31 provinces and the national average economic level.

Figure 3. Cont.

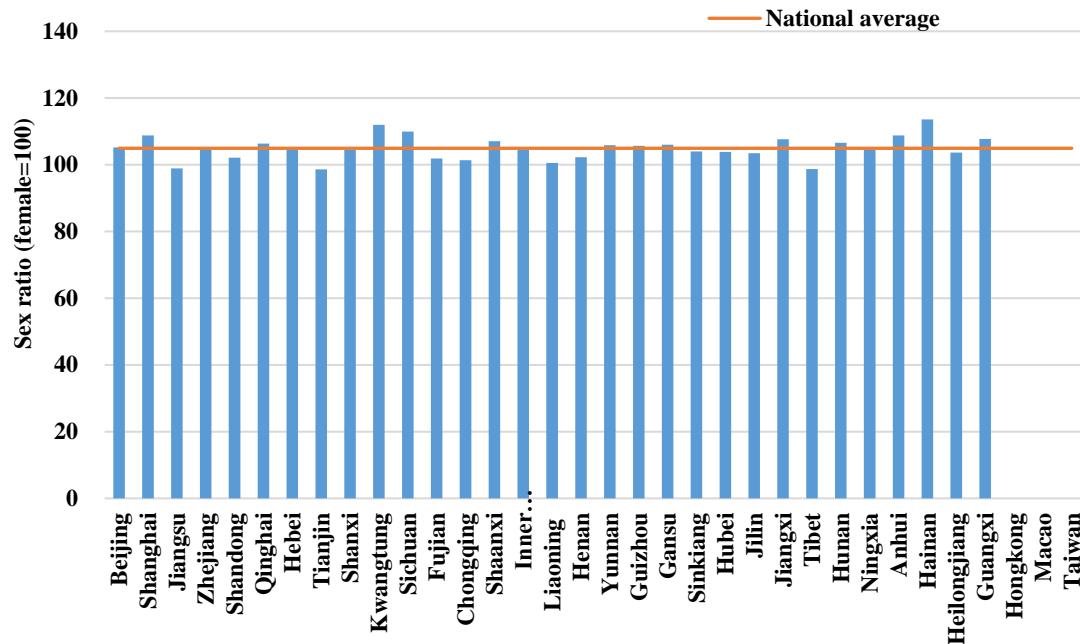


(b) The educational level of 31 provinces and the national average educational level.



(c) The unemployment level of 31 provinces and the national average educational unemployment level.

Figure 3. Cont.



(d) The sex ratio of 31 provinces and the national average sex ratio.

**Figure 3.** The levels of four factors in each province and the corresponding national averages.**Table 7.** The two groups of provinces that are different from the universal law and the possible reasons [39,40].

Case	Province	Reason (Zhao, [39]; Zhou and Zhao [40])		
The provinces whose levels of the 4 factors are not very high that have more certificates.	Sichuan	(1)	More Training and certification centres	
	Henan	(2)	Advance of further into line with international norms	
	Hunan	(3)	Longer time for entering the IPMP qualification examination	
	Hubei			
Tianjin		(1)	Fewer training and certification centres	
		(2)	High internationalization level makes grade C and D not sufficient.	
The provinces whose levels of the 4 factors are not low that have fewer certificates.	Zhejiang	(1)	Fewer training and certification centres	
		(2)	Primary focus is on business management	
		(3)	Fewer international projects	
Yunnan		(1)	Export for the external exchange of China Southern Power Grid	

Another group's levels of four factors are also not particularly low, and yet this group also has fewer certificates. Tianjin, Zhejiang and Yunnan are in this group. As is known, Tianjin has a high level of internationalization not only with regard to commercial exchange but also with regard to construction projects. In 2008, one-fourth of the Fortune Global 500 companies entered Tianjin.

IPMP qualification became available in Tianjin in 2001, and both the winner and runner-up of the grade B exams were from Tianjin the next year. Until 2012, grades C and D on the IPMP qualification did not offer high rewards. In contrast to Tianjin, the level of internationalization in Zhejiang was limited, and there was only one training and certification centre. During the period from 2012 to 2015, of the top seven practicing qualifications, there was only one international qualification, and most were qualifications for business management such as the China Market Accreditation Test (CMAT), one for Chinese logistics professional managers, and one for Chinese restaurant industry professional managers. To answer the question of why Yunnan has more certificates, it is necessary to consider the China Southern Power Grid. In 2004, due to a power surplus in China, the China Southern Power Grid became the first power company to transmit electricity abroad. As a result, this company's foreign trade exchange, international cooperation, foreign project contracting and foreign labour cooperation rapidly advanced, and IPMP was accredited and quickly promoted. The company's headquarters is in Kwangtung, which therefore always has the most IPMP certificates. However, as the main branch location, Yunnan, Guizhou and Hainan also have poor performance due to undeveloped levels of its economy, education and employment.

In addition, whether the faculty members in a local project management-related major (such as civil engineering management) obtains a professional licensure and program objectives mention professional licensure or registration, which also affects the number of professional qualifications according to Bielefeldt [41] and Zhang, et al. [42]. The further quantification of this impact will be considered in conducting our future work.

#### 4.3.5. Suggestions and Implications

Based on the research and discussion results, some policy recommendations and management implications are presented in this article. For policy makers, in the process of introducing IVQC, balanced development among regions should be paid attention to and inter-provincial linkages should be used. Different provinces should adopt a differentiated talent training system to promote industry standardization and sustainable development. For example, qualifications can first be introduced to economically and well-developed provinces, enabling them to drive surrounding provinces. Underdeveloped provinces need to be implemented with more encouraging policies.

For managers in enterprises, especially large inter-provincial companies, the balance of qualified employees within the enterprise should be noticed. Managers should determine the management methods for employees based on the development environment. For example, in underdeveloped areas, employees can be promoted to obtain qualification certification through unified training of enterprises.

For institutions intending to promote international professional qualifications, interregional linkages and balance should also be considered. Developed and international regions or large benchmarking companies should be preferred. According to the development characteristics of IPMP introduced into China, the difficulty lies in that it is slower to accept international qualification certification in some regions with lower economic and educational levels, and more active promotion is needed.

## 5. Conclusions

This study supports the hypotheses that economic level, employment level, educational level and sex ratio in a province all have an effect on the spatiotemporal distribution of certificates via practising qualification examinations. This study examines the impact of these factors by using IPMP as an example. A quantitative analysis method (a spatial metrology model) is proposed in this paper to analyse the factors influencing the development of IVQC in different regions. The results of this study provide information for the easy introduction and promotion of IVQC in various countries and support the government in formulating regional differentiation policies for talent management. The suggestions and implications are helpful for policy maker to unify the professional norms in project

management related industries and for managers to formulate the balanced development strategies within companies across regions. The main conclusions are as follows.

First, economic level, employment level, educational level and sex ratio in a province truly affect the spatiotemporal distribution of IPMP certificates. In general, provinces with a high economic level always have more certificates of practicing qualifications of level evaluation. When there are more practitioners in a province, it is easier for practicing qualifications of level evaluation to enter the province. If the average degree of education in a province is enhanced, the quantity of certificates will also increase. Under the circumstance that there are many more males in a province than females, the practicing qualifications of level evaluation will be more quickly accepted.

Second, in general, level of employment has the strongest effect on the distribution of certificates via practicing qualification examination of level evaluation. Economic level exerts a strong effect due to its importance for overall development, and sex ratio, as a characteristic of population structure, is the objective foundation for all social activities; thus, its impact is less than that of the economy. Education has the weakest effect stemming from the liquidity of talent. Accordingly, the hypotheses in this paper are true.

Third, the influencing degree of factors on the distribution of IPMP certificates depends not only on the influencing coefficient, but also on the actual level of four factors in a province. Only when the measurement of employment, economy, sex ratio and education reach a certain level can it be consistent with the final results.

In summary, recommendations and reflection are required to introduce and develop IVQCs in a new country. The IVQCs should first be introduced into relatively developed areas, for instance, coastal areas, major educational areas, and areas with fierce competition in employment. Next, through the flow of the economy and talent from developed areas to the surrounding regions, the degree of market recognition and generalization can quickly increase. Moreover, to promote market recognition, more training and certification organizations are needed to stimulate practitioners to apply. Audiences can be expanded and awareness can be increased by introducing certification organizations at colleges and universities.

The IVQCs carry increasing weight although, since 2013, the number of VQCs has declined. Many enterprises use certificates as the threshold for inviting employees to the first interview. In addition, there are quite a few corporations, such as China Southern Power Grid, IBM, and Microsoft, that encourage their staff to participate in training and obtain certificates as a means of promoting employee competency. Therefore, these qualifications are a crucial way to support general education and professional competency. This paper shows that with the rapid development of modern society, it will become easier for this type of competency examination to enter a province or country more quickly and easily.

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## References

1. Ellström, P.E. The many meanings of occupational competence and qualification. In *Key Qualifications in Work and Education*; Springer: Dordrecht, The Netherlands, 1998; pp. 266–273. [[CrossRef](#)]
2. Pfeffer, J. Competitive advantage through people. *Calif. Manag. Rev.* **1994**, *36*, 9–28. [[CrossRef](#)]

3. Kreuzer, C.; Weber, S. Modelling Opportunity Recognition Competence as a Foundation for Teaching and Learning in Vocational Education. *Vocat. Learn.* **2018**, *3*, 399–423. [[CrossRef](#)]
4. Astier, P.; Petit, L. Experiential learning assessment and competence development for a second career: The case of alternating training programmes for professional promotion. *Archit. Innov. Apprenticesh.* **2012**, *231*–240. [[CrossRef](#)]
5. Wang, S.; Wang, H. National teachers' qualification examinations: Necessity, guide and thinking—Statistical analysis based on two pilot provinces' first examination. *Teach. Educ. Res.* **2012**, *24*, 32–37. [[CrossRef](#)]
6. Centre for Educational Research and Innovation (CERI). *Guidelines for Quality Provision in Cross-Border Higher Education: Complete Edition*; Sourceoecd Education and Skills; The United Nations Educational, Scientific and Cultural Organization: Paris, France, 2005; Available online: <http://www.unesco.org/education/hed/guidelines> (accessed on 3 January 2020).
7. Huang, R.; Deng, Z. The introduction of the British national vocational qualification certificate system in China. *Chin. Vocat. Tech. Educ.* **2004**, *24*, 47–49. [[CrossRef](#)]
8. Liao, Y. British national vocational qualification certificate system and its Enlightenment to China. *Vocat. Educ. Mech. Ind.* **2008**, *5*, 56–58. [[CrossRef](#)]
9. Project Management Institute (PMI). *A Guide to the Project Management Body of Knowledge (PMBOK®Guide)*; Project Management Institute, Inc.: Newtown Square, PA, USA, 2008; p. 104. [[CrossRef](#)]
10. Fennell, B. Professional and technical qualifications for engineering faculty: An important decision. *J. Prof. Issues Eng. Pract.* **2018**, *144*, 02517006. [[CrossRef](#)]
11. Jakulevičienė, L. Probe into the establishment of vocational qualification certification system in university library. *Sci-Tech Inf. Dev. Econ.* **2011**, *30*, 263–265. [[CrossRef](#)]
12. Awolusi, L.; Eric, M.; Hallowell, M. Wearable technology for personalized construction safety monitoring and trending: Review of applicable devices. *Autom. Constr.* **2018**, *85*, 96–106. [[CrossRef](#)]
13. Awolusi, L.; Marks, E.; Vereen, S. Qualifications and staffing requirements of safety personnel in construction. *Pract. Period. Struct. Des. Constr.* **2017**, *22*, 04017009. [[CrossRef](#)]
14. Castillo, J.; Caruana, C.J.; Morgan, P.S.; Westbrook, C.; Mizzi, A. An international survey of mri qualification and certification frameworks with an emphasis on identifying elements of good practice. *Radiography* **2016**, *23*, e8–e13. [[CrossRef](#)] [[PubMed](#)]
15. Medeisis, A. ITU spectrum management training program: A comprehensive modular framework for formalized professional education. *IEEE Commun. Mag.* **2017**, *55*, 154–159. [[CrossRef](#)]
16. Quintino, L.; Ferraz, R.; Fernandes, I. International education, qualification and certification systems in welding. *Weld. World* **2008**, *52*, 71–79. [[CrossRef](#)]
17. Honey, M.L.; Skiba, D.J.; Paula, P.; Foster, J.; Kouri, P.; Nagle, L.M. *Nursing Informatics Competencies for Entry to Practice: The Perspective of Six Countries*; Forecasting informatics competencies for nurses in the future of connected health; IMIA and IOS Press: Amsterdam, The Netherlands, 2017; Volume 232, pp. 51–61. [[CrossRef](#)]
18. Anselin, L. *Spatial Econometrics: Methods and Models*; Studies in Operational Regional Science; Springer: Dordrecht, The Netherlands, 1988. [[CrossRef](#)]
19. Legendre, P. Spatial autocorrelation: Trouble or new paradigm? *Ecology* **1993**, *74*, 1659–1673. [[CrossRef](#)]
20. Brunsdon, C.; Fotheringham, S.; Charlton, M. Geographically weighted regression. *J. R. Stat. Soc. Ser. D (Stat.)* **1998**, *47*, 431–443. [[CrossRef](#)]
21. Fotheringham, A.S.; Brunsdon, C.; Charlton, M. Quantitative Geography Perspectives on Spatial Data Analysis. *Geogr. Anal.* **2010**, *33*, 370–372. [[CrossRef](#)]
22. Qin, W.; Wang, J. Exploring spatial relationship non-stationary based on GWR and GIS. In Geoinformatics 2006: Geospatial Information Science. *Int. Soc. Opt. Eng.* **2006**, *6420*. [[CrossRef](#)]
23. Fotheringham, A.; Brunsdon, C.; Charlton, M. *Geographically Weighted Regression: The Analysis of Spatially Varying Relationships*; John Wiley and Sons: Bognor, UK, 2002.
24. Barry, B. Developing local measures of spatial association for categorical data. *J. Geogr. Syst.* **2003**, *5*, 139–160. [[CrossRef](#)]
25. Lewandowska-Gwarda, K. Geographically weighted regression in the analysis of unemployment in Poland. *ISPRS Int. J. Geo-Inf.* **2018**, *7*, 17. [[CrossRef](#)]

26. Huang, J.; Huang, Y.; Pontius, R.G.; Zhang, Z. Geographically weighted regression to measure spatial variations in correlations between water pollution versus land use in a coastal watershed. *Ocean Coast. Manag.* **2015**, *103*, 14–24. [[CrossRef](#)]
27. Sheng, J.; Han, X.; Zhou, H. Spatially varying patterns of afforestation/reforestation and socio-economic factors in China: A geographically weighted regression approach. *J. Clean. Prod.* **2017**, *153*, 362–371. [[CrossRef](#)]
28. Anselin, L.; Griffith, D.A. Do spatial effects really matter in regression analysis? *Pap. Reg. Sci.* **2005**, *65*, 11–34. [[CrossRef](#)]
29. Fotheringham, A.S.; Charlton, M.; Brunsdon, C. The geography of parameter space: An investigation of spatial non-stationarity. *Int. J. Geogr. Inf. Syst.* **1996**, *10*, 605–627. [[CrossRef](#)]
30. Bowman, A. Bandwidth selection for the smoothing of distribution functions. *Biometrika* **1998**, *85*, 799–808. [[CrossRef](#)]
31. Akaike, H. A new look at the statistical model identification. In Selected Papers of Hirotugu Akaike. *IEEE Trans. Autom. Control* **1974**, *19*, 716–723. [[CrossRef](#)]
32. Ministry of Labor and Social Security (MLSS). Notice on Strengthening Management of Introducing Foreign Vocational Qualification Certificates. *China Train.* **1998**, *12*, 11–12.
33. Du, Q.; Wu, M.; Wang, N.; Bai, L. Spatiotemporal characteristics and influencing factors of China's construction industry carbon intensity. *Pol. J. Environ. Stud.* **2017**, *26*, 2507–2521. [[CrossRef](#)]
34. Nijhof, W.J.; Streumer, J.N. *Key Qualifications in Work and Education*; Springer: Dordrecht, The Netherlands, 1998. [[CrossRef](#)]
35. Bush, T. The national professional qualification for headship: The key to effective school leadership? *Sch. Leadersh. Manag.* **1998**, *18*, 321–333. [[CrossRef](#)]
36. Elhorst, J.P. The mystery of regional unemployment differentials: Theoretical and empirical explanations. *J. Econ. Surv.* **2003**, *17*, 709–748. [[CrossRef](#)]
37. Klein, M. The increasing unemployment gap between the low and high educated in West Germany: Structural or cyclical crowding-out? *Soc. Sci. Res.* **2015**, *50*, 110–125. [[CrossRef](#)]
38. Pearlman, J. Gender differences in the impact of job mobility on earnings: The role of occupational segregation. *Soc. Sci. Res.* **2018**, *74*, 30–44. [[CrossRef](#)]
39. Zhao, J. Research on the change mechanism and characteristics of regional distribution of vocational education in China. *Educ. Res.* **2017**, *38*, 76–92.
40. Zhou, J.; Zhao, W. Contributions of education to inequality of opportunity in income: A counterfactual estimation with data from China. *Res. Soc. Stratif. Mobil.* **2019**, *59*, 60–70. [[CrossRef](#)]
41. Bielefeldt, A.R. Professional Licensure among Civil Engineering Faculty and Related Educational Requirements. *J. Prof. Issues Eng. Educ. Pract.* **2019**, *145*, 04019004. [[CrossRef](#)]
42. Zhang, Y.; Zheng, L.; Liu, H. Developing Professional Integrity Indicators for Chief Supervision Engineers in China. *J. Prof. Issues Eng. Educ. Pract.* **2018**, *144*, 04018008. [[CrossRef](#)]



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