The Role of Taiwan's Industrial Diversity In Regional Employment Growth - A Comparative Study on Digital Economy Industry and Cultural Innovation Industry

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Abstract: Urban-regional and national economies are more vulnerable to external events and turbulence, such as the impact of the 2008 financial crisis, resulting in a global economic downturn. Recently, understanding the regional (un)related variety is central to create new regional industrial structure, such as digital industry sector and cultural creative industry sector. This causality has been argued and emphasized in evolutionary economic geography, but empirical analysis in the causal influence of related variety on regional employment growth remain less examined in Asian cities.

This paper aims to examine the impact of related and non-related variety on employment growth of digital economy industry (DEI) and on cultural and creative industries (CCI) in Taiwan. This paper use spatial regression and spatial lag model analysis to examine this issue through comparing 350 samples of two different industries (DEI and CCI) under the level of towns and cities in Taiwan during 2001 to 2011. Main data comes from Industrial and Commercial Survey in Taiwan.

The empirical result shows that related diversity will increase employment growth, while non-related diversity will reduce unemployment growth. And this result will become more significant as the degree of urbanization increases. In addition, digital economy industry are more significant than cultural and creative industries. This research contribution can provide more accurate data analysis for regional economic planning or labor market policies.

Keyword: Diversity analysis, Digital Economy Industry, cultural and creative industries, Employment growth

Introdution

In the era of information and knowledge intensive, innovative and creative industries are dominated by digital economic industries and cultural and creative industries. According to the statistical information network of the Republic of China, the output value of Taiwan's digital economy industry grew by 1.1 (trillion yuan) from 2008 to 2015, and the proportion of GDP in the whole country grew from 17.3% to 20.3%, an increase of 3 percentage points. As shown in Figure 1, Taiwan's digital economy industry has always been a key industry and has grown rapidly, which is bound to drive the employment growth of Taiwan's digital economy industry in the future. However, the development of cultural and creative industries in Taiwan can be traced back to 2010. The proportion of GDP of cultural and creative industries has declined by 0.41 percentage points from 2010 to 2015. Because the change of employment ratio will be affected by the output value of cultural industries in the previous year, the employment growth rate has shown a reverse upward trend despite the decline of the proportion of GDP after 2013, as shown in Figure 2.

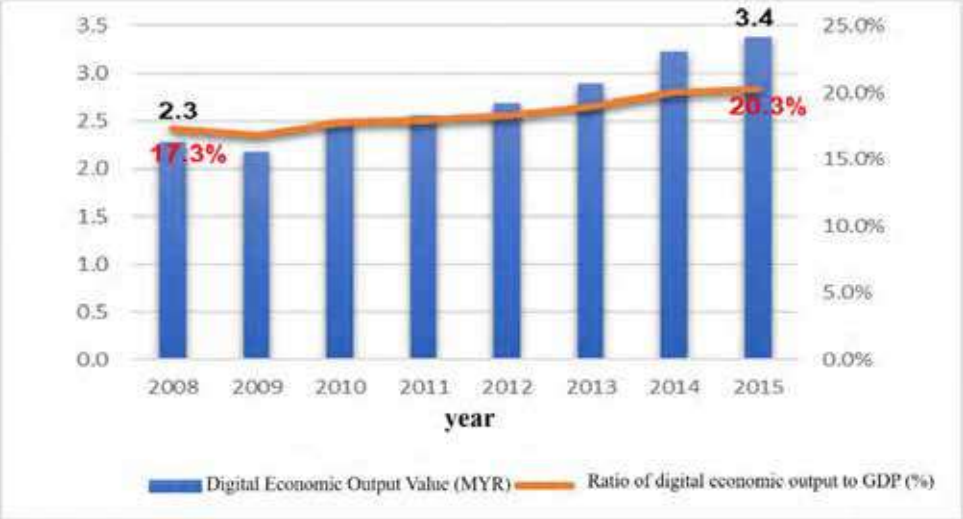

Figure 1-Digital economic industry business cycle: gdp and weight change

Reference：Statistics of the Republic of China

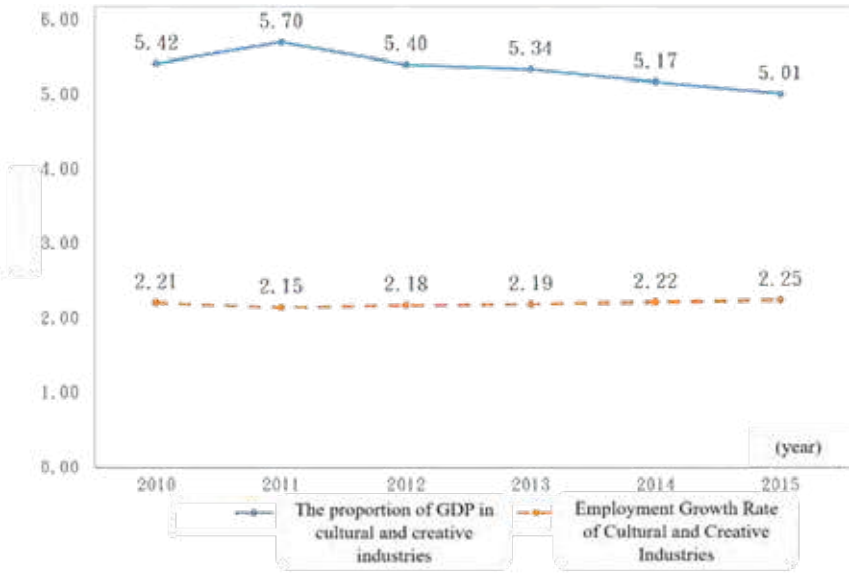

Figure 2-Business cycle of cultural and creative industries: gdp proportion and employment growth chart

Reference：World Bank Open Data: Cultural Bureau Cultural Statistics

In view of this, the above-mentioned causal relationship between industrial innovation and development for employment growth can be roughly divided into two types: the innovation and development of industrial economy and the orientation of urban space. The first is to explore the measurement index of innovation with the effect of agglomeration economy, with entropy index. The (entropy) indicator is a change in the index of computational diversity (Frenken, Oort, and Verburg, 2007; Frenken, van Oort, Verburg, and Boschma, 2005) and the spillover effect on the diversity between specific industries. empirical objects to explore the specific internal industry diversity whether it can drive industrial growth. The other is the urban type. Although the urban type variables have been adopted for specific developments in different townships, different urban types have different developments for the industry, such as the degree of urbanization in each township. The difference in the degree of human capital, in other words, due to different urban development conditions, the relationship between various industrial diversity factors and employment growth rate will form a spatial difference. Based on this, this study combines these two research perspectives and considers the relationship between the innovation and development of industries in the urban space and the growth of employment.

To investigate the effect of the industrial structure for the diversity of job growth through research design purpose of this study, using multiple regression model research tool. Based on the results of this study, the government will provide data support for the implementation of the human resources structure and industry's innovative development strategy in the space location.

Overview of related variety concepts

Agglomeration economy

In the theory of agglomeration economy, there have been many studies on the spillover effects of urbanization economy and localization economy(Glaeser, Kallal, Scheinkman, and Shleifer, 1992). Frenken, van Oort, Verburg, and Boschma (2005) put forward a new empirical framework to explain the spillover effect of agglomeration economy. Proposed the variety

index is divided into related variety and unrelated variety, however Lazzeretti, Innocenti, and Capone (2017) added regional variety variables in the analysis of a specific industry diversity, different from the unrelated variety and related variety is related to 4-digits level according to industry classification for data analysis, the regional variety of variable is 2-digit level Industrial variety classified by benchmarks. Before discussing the impact of the externalities of sector variety within a specific industry on regional economic development and employment growth, we must first understand the theoretical basis and context related to variety indicators.

Firstly, Frenken et al. (2005) points out that there are three kinds of relationship between variery and economic development, the first is in addition to a spillover effect between intra industry manufacturers, the industry also has spillover benefits, variery of a region, this region can bring additional economic growth (Glaeser et al., 1992; Jacobs, 1969; Van der Panne, 2004), this is not said Only input and output will affect the development of regional economy, when the region exists in the composition of a particular industry will also affect the quality of the regional economic growth, and the spillover effect is a geographical proximity (Jaffe, Trajtenberg, and Henderson, 1993; Porter, 1998), focused on the development of mutual complementary regional industry and the economic growth will focus on the development of complementary products to Industry is higher (Frenken et al., 2005).

The second is to consider variety as a risk-dispersing strategy in a portfolio to reduce the impact of external shocks on a region (Attaran, 1986). When there are diversified sectors in a region, external shocks will only have a slight negative impact on economic growth and employment. Conversely, if a region concentrates only on one area or sector with the same demand, the impact will lead to long-term economic recession and high unemployment risk.(Martin, 2011; Xiao, Boschma, and Andersson, 2018)

Finally, the variety and evolution of relationship between geography and economic development approach, if an economy is not increasing over time other industry variety, regional economic development will be affected by structural unemployment, and eventually fell into recession (Cantwell, Andersen, and Technology, 1996), Frenken, Oort, and (Verburg 2007) pointed out that an economy in the new Department issued Exhibition needs to absorb the surplus labor force in the original sector, which is the result of the product life cycle of the existing industries. This phenomenon is also reflected in the spatial development, because new industries usually appear in urban areas, while older industries are mainly in rural areas. This also shows that the surplus labor force is mainly produced in rural areas, while new employment opportunities arise in rural areas. In the highly urbanized areas.

And related variety is believed to stimulate employment growth, because new combinations will bring new products or services(Hidalgo, Klinger, Barabási, and Hausmann, 2007), thereby creating new employment opportunities. On the contrary, the localized economy where

specialized firms cluster will enhance process innovation, as expertise is used to improve production processes in existing industrial chains. These innovations stimulate labour productivity, but they do not necessarily lead to more jobs. Therefore, the concept of variety is consistent with the theory of product life cycle, which indicates that young industries with high product innovation rate create employment opportunities in different urban areas, while mature industries with high degree of specialization stimulate the productivity of surrounding areas.(Content and Frenken, 2016; Duranton and Puga, 2001)

Research design

Conceptual model

According to Figure 3, according to the data analysis method of diversity indicators, three main variables of diversity within two digital economic industries and cultural and creative industries are calculated. The control variables of population density and human capital with spatial differences are added into the multiple regression equation. The variances are tested by regression analysis at 350 Township scales and among different industries. Finally, the conclusions of this study are sorted out.

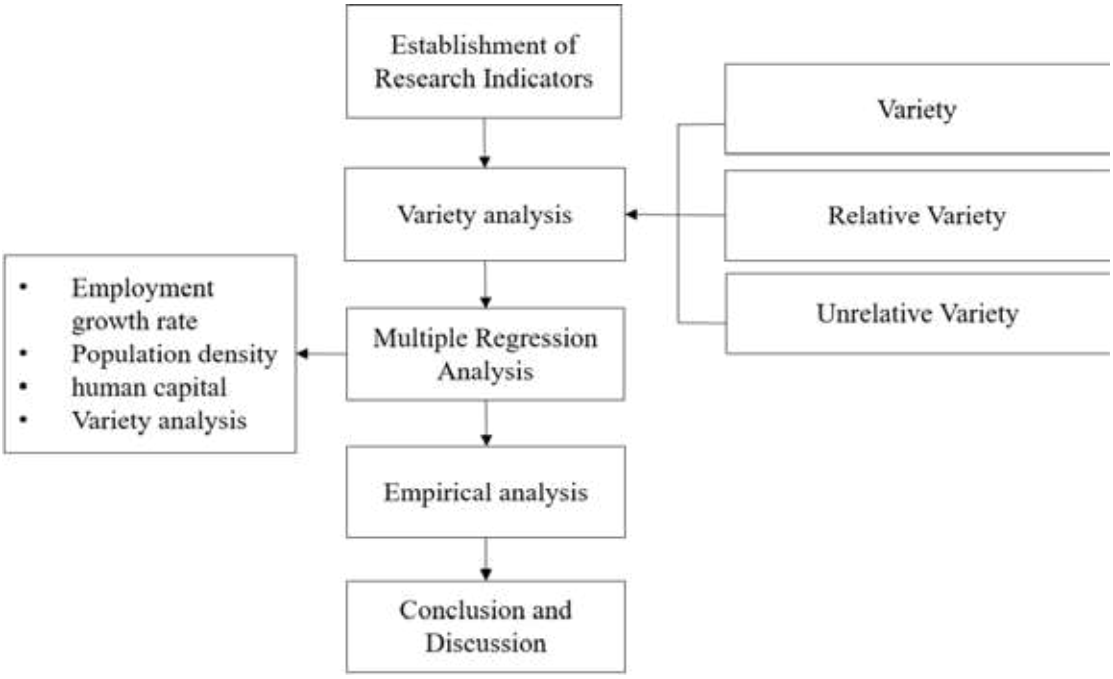

Figure 3 Research framework

Reference: Drawing by this study

Research methodology and variables

The purpose of this section is to establish a model to verify the relationship between the diversity of Taiwan's digital economy and employment growth. Commercial census categories of the General Accounting Office of the Executive Yuan is used 4-digit level for the data base. Based on this, the following formulas are listed to calculate the diversity. (Frenken et al., 2005; Hartog, Boschma, and Sotarauta, 2012; Lazzeretti et al., 2017)

Relative Variety, RV

Among them, the proportion of the total number of employees in each sub-industry in a certain regional economic scale is expressed as follows:

$$p_{ij} = \frac{\text{Population of the industry (region)}}{\text{Total Employed Population (Region)}} \qquad (1)$$

Among them,i: the number of employments in 4-digit level, j: town, 1,…,350

Assuming that there are g middle-class industries in a certain regional economic scale, the G middle-class industries are subdivided into n sub-industries. The employment proportion of the middle-class industries is the sum of the employment proportion of the sub-industries, that is:

$$P_{\mathrm{g}} = \sum_{i \in S_{\mathrm{g}}} p_{ij} \qquad (2)$$

Among them,P_{ij}: the ratio of employment in each township, S_{g}: the middle sector, g=1,...,G, P_g:p_{ij},g=1,...,G.

As mentioned above, the related diversity is composed of four-digit industrial codes classified in the same two-digit codes in the industry standard classification. In order to obtain the diversity of specific industries, the digital economic industries and the literary and creative industries identified in the industry standard classification are classified into a group of related industries: S_{g}. Finally, the I industry in the industry standard classification is calculated. (Subcategory) In regional economies: the ratio of the number of employed persons in the P_{ij} industry to the total number of employed persons and the proportion of each relevant diversity in the regional economy (P_g). Using these ratios, the degree of diversification of the sub-industries within the same industry can be expressed as the following entropy in the (H_{g}):

$$H_{\mathrm{g}} = \sum_{i \in S_{\mathrm{g}}} \frac{pij}{P\mathrm{g}} \log_2\left(\frac{1}{pij/P\mathrm{g}}\right)] \qquad (3)$$

In order to measure the degree of diversification of the fine industries with strong technological connections within the middle industry, it can be expressed as follows:

$$\mathrm{RV} = \sum_{\mathrm{g}=1}^{G} P_g H_g] \qquad (4)$$

Which type (4) as the target calculation formula, and the digital economy industry related diversity. Taiwan industry announced a total of four categories are categories, categories, categories and small categories, g value in industry categories, each industry is divided into several small classes industry. (1) calculated fine industry the area proportion of total employment, (2) belong to the same type of (3) Formula for calculating the diversification level of the fine industries in each medium industry.

Unrelative Variety, UV

Unrelated variety is to explore the correlation between different industries. The high level of unrelated variety means that the correlation between industries is not high, and they are not in the vertical or horizontal industrial chain.

$$\mathrm{UV} = \sum_{g=1}^{G} Pg \log_2\left(\frac{1}{Pg}\right)] \quad (5)$$

$$p_{ij} = \frac{\text{Population of the industry (region)}}{\text{Total Employed Population (Region)}} \quad (6)$$

$$P_g = \sum_{i \in S_g} p_{ij} \quad (7)$$

UV: unrelated variety

p_{ij}:The ratio of 4−digit level employment to 2−digit level employment in each township

P_g: The aggregation of the same 2-digit level category in the industrial category and the ratio of the employed population in the digital economic industry

Formula (5) is the objective formula to calculate the non-related diversity with the digital economy industry. (6) Formula (7) calculates the proportion of the fine industries in the region to the total employment population of the total industries. (7) Formula (7) is the sum of the ratio of the fine industries in the same middle class.

Employment growth

$$\text{Employment growth} = \frac{\text{Number of employed in that year} - \text{Number of employed in the previous year}}{\text{Number of employed persons in the previous year}} \quad (8)$$

Calculation of employment growth rate as shown in formula (8), base for a year before the employment population, this research of employment growth in 2006 and 2011, the annual employment population using data for the number of employment population in 2011, a year before the number of people in employment the number of employment population in 2006. Then we calculate the total industry employment growth rate, as well as digital the employment growth rate of economic industry is used to analyze the impact of related variety and unrelative variety on employment growth.

Empirical Research

Model and Hypothesis Verification

Based on the empirical process mentioned above, the section illustrates the establishment of the model, which is divided into two parts: confirming whether the diversity of digital economic industries in different townships affects the regional employment growth. Referring to the regression model (Lazzeretti et al., 2017), the relationship between industrial diversity and employment growth in different townships can be expressed as follows (9):

$$\Delta Y_t = \beta_0 + \beta_1 Rel]Val]_t + \beta_2 Un]Val]_t + \beta_3 Pop]Dens_{]t} + \beta_4 Human]Cap]_t + \varepsilon_t .(9)$$

Yt：Employment growth rate

X_1it：RV

X_2it：UV

X_3it：Human capital

X_4it：Population]density

Among them, the total employment growth rate of all industries is taken as the strain of the three models, and the independent variables are the diversity of digital economic industries, related diversity, non-related diversity, population density and human capital, which measure the degree of urbanization, and t is expressed as time. The sources of all independent variable and dependent variables are shown in Table 1.

Table 1 list of multiple regression variables.

Item	Variables	Statistical units	Expected symbols	Source
Dep. var.	Employment growth rate (average)	Unit		Employment in industry and Commerce census conducted by the Comptroller's Office of the Executive Yuan, from 2001 to 2015, is calculated from the statistical data every five years.
Variables	Variety of Digital Economy Industry (V)	Indicators of Industrial Innovation	?	Employment in industry and Commerce census conducted by the Comptroller's Office of the Executive Yuan, from 2001 to 2015, is calculated from the statistical data every five years.
	Related Variety of Digital Economy Industry (RV)	Indicators of Industrial Innovation	+	
	Unrelated Variety of Digital Economy Industry (RV)	Indicators of Industrial Innovation	×	
	Human capital	Population/km2	+	Social and Economic Data Service Platform of Statistics Department of Ministry of Interior
	Population density	人/km2	+	Social and Economic Data Service Platform of Statistics Department of Ministry of Interior

Symbol description: ＋：positive influence relationship; －: negative influence relationship; × : no significant influence; ？：Uncertainty of impact

Estimation of results and discussion

Table 2 lists the regression results of digital economic industry diversity and employment growth. In the first model (model 1), the overall diversity of digital economic industry is positive and significant, which shows that there is a positive relationship between the overall diversification of digital economic industry and employment growth. In model 3, the overall diversity of digital economic industry is used. In addition, The control variables of population density and human capital are also added. This model can find that population density is negative and human capital is not significant. The overall R2 increases slightly, and the overall diversity of digital economy industry is still positive and significant. Therefore, this model shows that various digital economy industries have a positive impact on employment growth.

In model 2, the variables of digital economic industry diversity are replaced by digital economic industry related diversity and non-related diversity. The model finds that both related diversity and non-related diversity are not significant, which means that companies engaged in digital economic industry can not generate employment growth in related or unrelated sectors. The spillover effect may be related to the industrial structure, or it may be because during the past decade, the industry has shown a saturated state, which slows down the growth of employment, resulting in a non-significant causal relationship between inter-departmental diversity and employment growth. However, after adding other control variables in Model 4, R2 has increased, and the related diversity of digital economic industries has also shown. Positive significant impact, while other variables show the same symbols and meanings, which indicates that a large number of technology companies are set up in interrelated departments, and the spillover effect has a positive impact on employment growth.

The regression results of cultural and creative industries and employment growth presented in Table 3 show that the regression methods are the same as those of digital economic industries, but the results are quite different. The results show that cultural and creative industries are not significant in the first six models. Only the irrelevant diversity in Model 7 has a positive and negative impact on regional employment growth and population density. This shows that the related industries within the cultural and creative industries can not promote the employment growth of the industries, but the non-related industries within the industries have a positive impact on the regional employment growth, which shows the concept of risk diversification, and the protected areas are not affected by external shocks leading to the regional total employment growth. It also shows that the unrelated departments within the cultural and creative industries can communicate with each other and produce spillover effects.

Table 2 Model Results Consolidation Comparison Table

Models	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Period	2001-2011				2001-2006	2006-2011	2001-2011
Dep. var.	Employment Growth in Digital Economy						Tot Emp. Growth
Rel Var DEIs		0.113 (1.315)		0.221* (2.237)	0.098 (0.228)	2.366 (0.311)	6.890 (1.386)
Unrel Var DEIs		0.018 (0.201)		0.053 (0.570)	0.156 (0.393)	3.089 (0.362)	-2.392 (-0.515)
Variety DEIs	0.849** (3.156)		1.498*** (4.139)				
InPop density			-0.202** (-2.743)	-0.166* (-1.71)	-0.130 (-0.360)	-1.863 (-1.054)	-23.090*** (-6.115)
Human cap^2			2.587 (0.429)	1.889 (0.305)	-0.847 (-0.118)	6.053 (0.283)	167.396 (0.535)
obs	350	350	350	350		350	350
R2	0.028	0.017	0.050	0.032	0.003	0.008	0.148
Adj. R2	0.025	0.012	0.041	0.021	-0.009	-0.004	0.138
F test	9.961**	3.068*	6.018***	2.829*	0.219	0.683	14.963**

Table 3 Model Results Consolidation Comparison Table

Models	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Period	2001-2011				2001-2006	2006-2011	2001-2011
Dep. var.	Employment Growth in Cultural and creative industries						Tot Emp. Growth
Rel Var CCIs		0.026		-0.045	-0.140	0.554	1.391
		(0.080)		(-0.101)	(-0.477)	(0.491)	(0.147)
Unrel Var CCIs		0.069		0.163	0.089	0.123	27.857*
		(0.133)		(0.312)	(0.260)	(0.814)	(2.526)
Variety CCIs	-0.535		-0.787				
	(-0.871)		(-0.887)				
InPop density			0.180	0.175	0.068	0.118	-14.432***
			(1.030)	(0.888)	(0.525)	(0.452)	(-3.486)
Human cap2			-12.334	-18.895	-5.609	1.633	272.414
			(-0.800)	(-1.293)	(-0.586)	(0.239)	(0.887)
obs	350	350	350	350	350	350	350
R2	0.002	0.000	0.006	0.005	0.002	0.003	0.093
Adj. R2	0.000	-0.006	-0.003	-0.006	-0.010	-0.009	0.082
F test	0.759	0.010	0.708	0.466	0.184	0.234	8.660***

Conclusion

In the past, the research on related diversity mainly focused on all industries in the region, such as service industry and manufacturing industry. This study takes township administrative divisions as the research scope, defines emerging industries with 4-digit level, and lists explanatory variables for urban spatial differences. Finally, the spillover effects of related diversity in different industries and regions are analyzed.

Limitation of the study

The area identified in this study is 350 townships in Taiwan. There is no data on unemployment, and it is not possible to verify the hypothesis that irrelevant diversity can reduce the unemployment rate.

The original data used to classify the digital economy industry are classified according to the relevance of the nature of the work in advance, without taking into account the correlation between the input and output of the company and the export commodities of the company. Such a classification may be underestimated.

Contribution of the study

Analysis of the results of the two industries shows that the spillover effects of diversity are different for different industries, and non-related diversity in cultural and creative industries can also lead to employment growth, which has not been found before, but the R2 of the general model is not high, which may be due to the lack of key variables, such as: company size, industrial returns, infrastructure. And so on, because of the relationship of product life cycle, for mature industries, on the contrary, because of the improvement of labor productivity, so as to reduce employment growth rate, which may lead to cultural and creative industries can not reflect the relationship between the spillover effect of diversity and employment growth.

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