An Empirical Analysis of the Tertiary Sector Growth and Residents' Employment and Income: Taking Sample Data from the 50 States in the U.S. from 2000 to 2020 as an Example

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Abstract. The tertiary sector has had a rapid growth in the U.S. This paper analyzes the relationship between the tertiary sector and residents' employment and the relationship between the tertiary sector and per capita income. The data are collected from all 50 states in the U.S from 2000 to 2020. Empirical analysis, robustness test and heterogeneity analysis are applied to study the issues. The findings are: (1) the tertiary sector growth and the employment are positively related; (2) the relationship between the tertiary sector growth and per capita income is also positive; (3) the results vary from state to state.

Keywords: the tertiary sector output value, the service sector, residents' employment, residents' income, intercontinental panel, fixed-effect model.

1. Introduction

To study the structural changes, a few economists classify the economy into the primary, secondary, and tertiary sectors. The tertiary sector (also known as the service sector) usually includes the industries related to transportation, communication and public utility [1]. The sector has experienced a rapid growth since World War II. It is still booming now. Many countries have shifted to a service-based economy, including the United States. Industry development may increase national economic growth by creating job opportunities and improving the quality of people's lives. Therefore, this paper will analyze the effect of tertiary sector growth on residents' employment and income.

The study focuses on the influence of service sector growth instead of the whole economic growth on employment and income. Furthermore, it is based on the whole sample from all states in the U.S. These may be different from previous research.

This paper will employ statistical methods and models like the FE model to analyze the relationship between the tertiary sector and residents' employment and income. Additionally, the OLS model and the OLS+ model will be used to test the robustness, and the FE model will be used to test the heterogeneity.

2. Literature review

2.1 The tertiary sector growth and employment

Employment is affected by multiple factors. From previous studies, the influence on employment can be divided into the influence on the overall employment and the influence on the employment of each industry. Pallares and Adkisson find that general employment is positively related to population growth [2]. Education can be another factor for local employment [3]. Moreover, from a single industry perspective, according to the conclusion given by Altonji and Ham, employment in one industry is affected by shocks caused by other industries [4].

Specifically, in the tertiary sector, many new jobs are created for people, which can help to promote employment growth. By comparing data like employment rates in E.U. countries, researchers find the service sector provides part-time jobs that allow many women who need to do unpaid housework to get paid jobs [5]. Johnston and Huggins employ the statistical technique to find that more productive service sectors like the financial area need more human capital [6].

2.2 The tertiary sector growth and income

The determinants of per capita income growth are also various. However, most of the studies mention education. For example, Bauer, Schweitzer, and Shane's study notes that the increase in per capita income is highly related to the policies that promote education levels [7].

The relationship between tertiary sector growth and income can be ambiguous. Through reviewing the literature, Eichengreen and Gupta find that different researchers give disparate conclusions about the relationship between services and per capita income [8]. The results can also be diverse in different regions. Clemes, Hu, and Li conclude that the service sector increases personal income and continues to drive economic growth in China through empirical analysis [9].

2.3 Literature comments

From the above studies, many researchers consider that the tertiary sector can influence residents' employment and income. However, there is not much previous empirical research on their relationship in the U.S. In order to study this issue, residents' employment and income in the U.S. are considered objects. Intercontinental panels and the tertiary industry growth are emphasized. The data collected are time-sensitive, and the research method is based on causal inference. Since population growth and education level can also affect employment and income, the study tries to eliminate the interference from them.

3. Sample and data

3.1 Sample selection and data source

This study applies all the 50 states in the United States as a representative sample. The data for the variables, industry's contribution to percent change in real GDP (IND1, IND2, IND3), which represents the sector growth, employment (Y1, EIND1, EIND2, EIND3), population (POP), and income which is measured by GDP per capita (Y2), between 2000 and 2020 were collected from U.S. Bureau of Economic Analysis. The data for the variable, education level (EDL) between 2000 and 2018, which is measured by total fall enrollment in degree-granting postsecondary institutions, was collected from the National Center for Education Statistics (NCES).

3.2 Research data and descriptive statistics

Based on Table 1, the contribution of the tertiary sector to percent change in real GDP (IND3) has the highest average value, standard deviation and range among the three sectors of industry. In general, the fluctuation of IND1, IND 2, and IND3 is low, while the fluctuation of other variables is high.

Table 1 Descriptive statistics results

Variable	Sample Size	Mean	Std. Dev.	Min	Max
IND1	1050	0.133	0.968	-5.930	12.020
IND2	1050	0.166	1.251	-5.830	8.000
IND3	1050	1.331	1.860	-10.650	7.920
Y1	1050	358.429	389.834	32.470	2422.760
EIND1	1050	9.388	11.617	0.080	88.700
EIND2	1050	49.185	49.772	0.000	298.720
EIND3	1050	299.774	333.331	22.040	2099.530
EDL	950	374114	433462	25692	2735579
POP	1050	6157478	6816323	494300	39547996
Y2	1050	49747.050	9599.553	30602.760	80434.260

4. Empirical analysis

4.1 Correlation analysis of each variable related to the tertiary sector growth

In this paper, the tertiary sector is intensively studied. In Table 2, Spearman correlation and Kendall correlation are used to analyze the correlation of variables related to the tertiary sector growth. The Spearman correlation shows that IND 1 is negatively related to EDL and POP, and the Kendall correlation shows that IND 1 is negatively related to IND 2, EDL and POP. The two correlations indicate that IND 1, IND 2 and IND 3 have a slight relationship with other variables listed, but POP and EDL are strongly related.

Table 2 Correlation test of each variable related to the tertiary sector growth

	IND1	IND2	IND3	EDL	POP
IND1		-0.008	0.047	-0.037	-0.039
IND2	0.035		0.363	0.019	0.020
IND3	0.016	0.316		0.040	0.057
EDL	-0.070	0.021	0.029		0.983
POP	-0.079	0.012	0.041	0.979	

4.2 Empirical analysis of the tertiary sector growth and residents' employment

According to Aarnio, in a few countries with the service sector shares growing, like the U.S., new employment opportunities have been generated swiftly [10]. It means people can expect a positive correlation between growth in the tertiary industry and employment. In this section, the fixed-effect (FE) model estimates the factors affecting residents' employment. Time (Year) and individual (State) are fixed to lower the biased errors. The impact caused by the tertiary sector of the economy is mainly focused. The method of the FE model is given below:

$$lnY1_{i,t} = \alpha_0 + \beta_1 lnIND1_{i,t} + \beta_2 lnIND2_{i,t} + \beta_3 lnIND3_{i,t} + \beta_4 lnEDL_{i,t} + \beta_5 lnPOP_{i,t} + \varepsilon_{i,t}$$

where α is the constant term, β_n is the regression coefficient, and ε is the stochastic error. Additionally, i represents the states, and t represents the years. Log transformation is applied to the variables to reduce the deviation factor and improve data stability. Table 3 exhibits the results as below.

Table 3 Empirical analysis of the tertiary sector growth and residents' employment

	(1)	(2)	(3)	(4)	(5)
lnIND1		0.001 (8.913×10^{-4})	3.110×10^{-5} (7.429×10^{-4})	3.370×10^{-4} (3.699×10^{-4})	1.233×10^{-4} (3.709×10^{-4})
lnIND2		-0.003** (0.002)	-9.888×10^{-4} (0.001)	-0.001** (6.539×10^{-4})	-3.966×10^{-4} (6.648×10^{-4})
lnIND3	-0.009*** (0.002)	-0.009*** (0.002)	3.078×10^{-4} (0.002)	0.005*** (9.431×10^{-4})	0.002** (9.660×10^{-4})
lnEDL			0.280*** (0.014)		-0.069*** (0.010)
lnPOP				1.032*** (0.015)	1.127*** (0.022)
Constant	5.422*** (0.002)	5.422*** (0.002)	1.955*** (0.172)	-10.210*** (0.226)	-10.795*** (0.260)
Sample Size	1050	1050	950	1050	950
R-squared	0.0029	0.0024	0.9627	0.9937	0.9932
Prob>F	0.0001	0.0001	0.0000	0.0000	0.0000

*, ** and *** respectively indicate significance level at 10%, 5% and 1%

Since this study focuses on the impact caused by the tertiary sector of the economy, fixed effects regression is performed with lnIND3 and then with the two control variables, lnEDL and lnPOP.

According to the values presented in the model (3), (4) and (5), the significance level of the explaining variables and goodness of fit are increased with the addition of the control variable lnPOP. The significance level is decreased with the addition of the control variable lnEDL. Therefore, lnPOP should be kept in the model, and lnEDL should be eliminated. The model (4) is the final model that is used to analyze.

From the results shown by the model (4), lnIND1 and lnIND3 are positively related to employment, while lnIND2 is negatively related to employment. However, only lnIND3 is significant at the 1% level. The coefficient of lnIND3 with respect to lnY1 is 0.005, suggesting lnY1 increases by 0.005 as lnIND3 increases by 1 at the significant level of 1%.

4.3 Empirical analysis of the tertiary sector growth and residents' income

In this section, the model employed is the same as the one in 4.2. The method of the FE model is given below:

$$lnY2_{i,t} = \alpha_0 + \beta_1 lnIND1_{i,t} + \beta_2 lnIND2_{i,t} + \beta_3 lnIND3_{i,t} + \beta_4 lnEDL_{i,t} + \beta_5 lnPOP_{i,t} + \varepsilon_{i,t}$$

where the parameter meanings are the same as 4.2.

Table 4 Empirical analysis of the tertiary sector growth and residents' income

	(1)	(2)	(3)	(4)	(5)
lnIND1		0.001 (9.612×10^{-4})	5.871×10^{-4} (9.035×10^{-4})	7.360×10^{-4} (7.939×10^{-4})	6.728×10-4 (8.302×10-4)
lnIND2		-0.002 (0.002)	3.655×10^{-4} (0.002)	-4.159×10^{-4} (0.001)	6.945×10-4 (0.001)
lnIND3	-0.007*** (0.002)	-0.007*** (0.006)	0.003 (0.002)	0.003 (0.002)	0.004* (0.002)
lnEDL			0.232*** (0.017)		0.037* (0.022)
lnPOP				0.691*** (0.032)	0.626*** (0.049)
Constant	10.799*** (0.002)	10.797*** (0.006)	7.931*** (0.210)	0.335 (0.484)	0.850 (0.582)
Sample Size	1050	1050	950	1050	950
R-squared	0.0001	0.0001	0.0013	0.0016	0.0009
Prob>F	0.0052	0.0159	0.0000	0.0000	0.0000

Compared to values from models (2), (3), (4) and (5), the addition of the two control variables lnEDL and lnPOP both decrease the significance level but increase the goodness of fit. However, in all models, the goodness of fit is low. Based on the above considerations, model (5) is used to analyze.

In model (5), lnIND1, lnIND2, and lnIND3 are positively related to per capita income. lnIND3 is significant at the 10% level. The coefficient of lnIND3 to lnY2 is 0.004, which means lnY2 increases by 0.004 as lnIND3 increases by 1 at the significant level of 10%.

4.4 Robustness test of the tertiary sector growth and residents' employment and income

This study applies two models, the OLS model and the OLS+ model, to test robustness.

Table 5 Robustness test of the tertiary sector growth and residents' employment and income

	OLS		OLS+	
	lnY1	lnY2	lnY1	lnY2
lnIND1	-2.868×10-4 (0.001)	-0.701×10-4 (0.003)	-2.868×10-4 (8.762×10-4)	-7.009×10-4 (0.003)
lnIND2	8.959×10-4 (0.001)	-0.006 (0.005)	8.959×10-4 (0.002)	-0.006 (0.005)

lnIND3	0.010*** (0.003)	0.005 (0.007)	0.010*** (0.003)	0.005 (0.007)
Control Variable	YES			
Constant	-9.026*** (0.051)	10.798*** (0.124)	-9.026*** (0.058)	10.798*** (0.115)
Sample Size	950	950	950	950
R-squared	0.9938	0.0043	0.9938	0.0043
Prob>F	0.0000	0.5452	0.0000	0.6452

The results show that when testing the model of the relationship between the tertiary sector growth and residents' employment, the significance level is not affected, so the model is robust. Nevertheless, there is no significant result when testing on the model of the relationship between the tertiary sector growth and residents' income. It can be explained by that personal income in the service sector are various. Siami-Namini and Hudson conclude that service sector growth has increased income inequality [11]. Additionally, the order of magnitude difference can be caused by the unit difference.

4.5 Heterogeneity analysis of the tertiary sector growth and residents' employment and income

This paper researches the influence of tertiary sector growth on residents' employment and income in different states. The United States is a large country. Different regions have various geographical conditions and industrial structures. As a result, in this section, the 50 states in the United States are divided into three groups based on geographic position and time zone: eastern states, central states, and western states. FE model is applied to compare their parameters of lnIND3. To process standard errors, cluster-robust standard errors are measured. The outcomes are shown below:

Table 6 Heterogeneity analysis of the tertiary sector growth and residents' employment and income

	Eastern States		Central States		Western States	
FE Model	lnY1	lnY2	lnY1	lnY2	lnY1	lnY2
lnIND1	-4.802×10^{-4} (0.001)	7.505×10^{-4} (0.002)	5.711×10^{-4} (8.032×10^{-4})	0.001 (0.002)	2.935×10^{-4} (4.393×10^{-4})	0.001 (7.554×10^{-4})
lnIND2	0.002*** (0.002)	0.002 (0.003)	1.263×10^{-4} (0.001)	0.002 (0.003)	-0.001 (9.294×10^{-4})	-5.583×10^{-4} (0.002)
lnIND3	0.012*** (0.003)	0.019*** (0.005)	0.002 (0.001)	0.003 (0.004)	-1.564×10^{-4} (0.001)	7.087×10^{-4} (0.002)
lnEDL	-0.068*** (0.023)	-0.048 (0.043)	-0.076*** (0.016)	0.048 (0.045)	-0.063*** (0.014)	0.1092*** (0.024)
lnPOP	1.062*** (0.041)	0.534*** (0.078)	1.241*** (0.035)	1.197*** (0.098)	1.110*** (0.039)	0.242*** (0.068)
Constant	-9.853*** (0.438)	3.413*** (0.837)	-12.378*** (0.420)	-7.722*** (1.179)	-10.652*** (0.501)	5.702*** (0.861)
Sample Size	190	190	323	323	437	437
R-squared	0.9984	0.0064	0.9887	0.0045	0.9947	0.0086
Prob>F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Table 7 Group coefficients difference test

P-values	lnIND1	lnIND2	lnIND3	lnEDL	lnPOP
lnY1					

Eastern States versus Central States	0.640	0.494	0.996	0.000	0.000
Eastern States versus Western States	0.500	0.111	0.071	0.196	0.247
Central States versus Western States	0.320	0.580	0.194	0.000	0.000
lnY2					
Eastern States versus Central States	0.217	0.269	0.154	0.000	0.000
Eastern States versus Western States	0.982	0.680	0.320	0.000	0.000
Central States versus Western States	0.107	0.305	0.558	0.017	0.005

In Table 6, lnIND3 has a positive relationship with residents' income in all groups but has a negative relationship with residents' employment in western states. Only in central states, residents' income and employment are positively related to the development of all industry sectors. The results can be counter-intuitive because many wealthy states like New York and California are in the western part and eastern part of the United States. It can result from that the regional development being uneven.

Table 7 presents the p-values used to test the significance level of group coefficients difference with the method of suest.

5. Research conclusions and policy implications

5.1 Research conclusions

This study uses the whole samples of the 50 states in the United States and builds several models to analyze the data collected from 2000 to 2020. The relationship between the tertiary sector growth and employment is significant and positive from the models. The tertiary sector growth and per capita income are also positively related. In addition, when looking at different regions in the U.S., the relationship can be different, which may be caused by unbalanced regional development and different industrial structures.

5.2 Policy implications

Based on the conclusions, policy implications are provided. Because the tertiary sector accelerates employment growth and per capita income growth, the government can continue promoting tertiary sector development like encouraging technology research and development. Meanwhile, the government needs to establish the monetary policies to reduce income inequality caused by the service sector growth. Moreover, the government should focus on regional development and may help to strengthen cooperation between states to narrow the development gap.

References

[1] M. Datta. The significance and growth of the tertiary sector: Indian economy, 2001,1950-97. https://books.google.com/books?hl=en&lr=&id=IpVyfQGLDQ8C&oi=fnd&pg=PA1&dq=definition+of+tertiary+sector&ots=U3qQflpxOb&sig=eOSGdWAk2ZwCYWIJEoRdJPrVo0o#v=onepage&q=definition%20of%20tertiary%20sector&f=false

[2] F. J. Pallares, R. V. Adkisson. The impact of industrial diversification on employment growth in the 50 U.S. states: 2000-2013. Economic Development Quarterly, 2017, 31(4), 275–284. https://doi-org.proxy2.library.illinois.edu/10.1177/0891242417731599

[3] C. Schlump, T. Brenner. University education, public research and employment growth in regions - An empirical study of Germany. Berichte Zur Deutschen Landeskunde, 2010, 84(2), 115–136.

[4] J. G. Altonji, J. C. Ham. Variation in employment growth in Canada: the role of external, national, regional, and industrial factors. Journal of Labor Economics, University of Chicago Press, 1990, 8(1), 198-236.

[5] G. Bosch, S. Lehndorff. Working in the service sector: A tale from different worlds. Routledge Taylor & Francis Group. https://doi-org.proxy2.library.illinois.edu/10.4324/9780203500583

[6] A. Johnston, R. Huggins. Regional growth dynamics in the service sector: the determinants of employment change in U.K. regions, 1971–2005. Growth and Change, 2018, 49(1), 71–96. https://doi-org.proxy2.library.illinois.edu/10.1111/grow.12221.

[7] P. W. Bauer, M. E. Schweitzer, S. A. Shane. Knowledge matters: the long-run determinants of state income growth. Journal of Regional Science, 2012, 52(2), 240-255. https://doi.org/10.1111/j.1467-9787.2011.00729.x

[8] B. Eichengreen, P. Gupta. The two waves of service-sector growth. Oxford Economic Papers, 2013, 65(1), 96–123. https://doi-org.proxy2.library.illinois.edu/https://academic.oup.com/oep/issue

[9] M. D. Clemes, B. Hu, X. Li. Services and economic growth in China: an empirical analysis. Journal of the Asia Pacific Economy, 2016, 21(4), 612–627. https://doi-org.proxy2.library.illinois.edu/http://www.tandfonline.com/loi/rjap20

[10] O. Aarnio. Can we trust the service sector to generate decent rates of growth and employment? Personnel Review, 1999, 28(5): 382-405. https://www.proquest.com/scholarly-journals/can-we-trust-service-sector-generate-decent-rates/docview/214812916/se-2?accountid=14553.

[11] S. Siami-Namini, D. Hudson. The impacts of sector growth and monetary policy on income inequality in developing countries. Journal of Economic Studies, 2019, 46(3), 591–610.