Does Administrative Management Matter? The Relationship between Administrative Expenditure and Universities' Performance

Yung-Yu Tsai*

June, 2019

Abstract

This paper investigates the impact of different categories of expenditure on organizations' resources inputs as well as the impact of resources on universities' teaching and research performance. The results suggest that instructional and research expenditure improve the resources in universities, but administrative expenditure has no effect. Further, The evidence shows that resources improve research performance but not teaching performance for universities. However, administration factor serves no role in organization performance.

***Keywords*—** Administrative Expenditure, University Performance

1 Introduction

The government and society invest a great amount of money on higher education. The per-student expenditure at higher education level is even higher than in the primary and secondary level. Figure 1 presents the per-student expenditure by the level of education of different countries. For Organisation for Economic Co-operation and Development (OECD) countries,

*Department of Public Administration, National Chengchi University

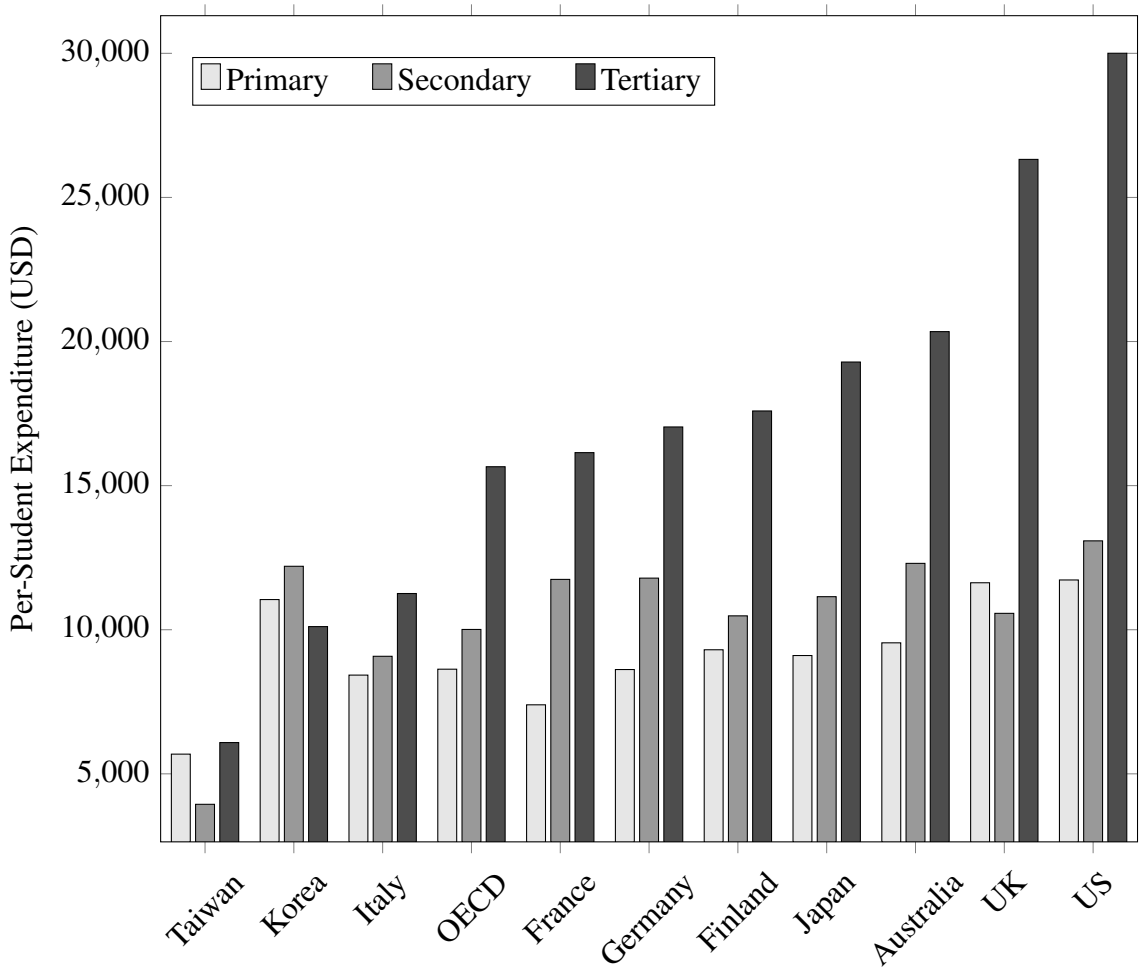

Figure 1: Per-student expenditure by level of education

Notes: Year of Data are 2015 to 2016. Data from OECD (2017) Education at a glance 2017: OECD indicators & MOE (2017) Education statistics.

per-student expenditure at tertiary level (USD 15,656) is 56% greater than the secondary level (USD 10,010) and 81% greater than the primary level (USD 8,631). For Taiwan, per-student expenditure at tertiary level (USD 6,085) is 54% greater than the secondary level (USD 3,943) and 7% greater than the primary level (USD 5,684).

Moreover, the government plays an important role in the funding of higher education. Figure 2 presents the funding sources distribution of different countries. For Taiwan, 46.85% of the funding of higher education comes from the government. Even for countries with highly marketized of higher education, such as the United States, government funding still accounts for 35.21% of total higher education expenditure. In Taiwan, the expenditure on higher educa-

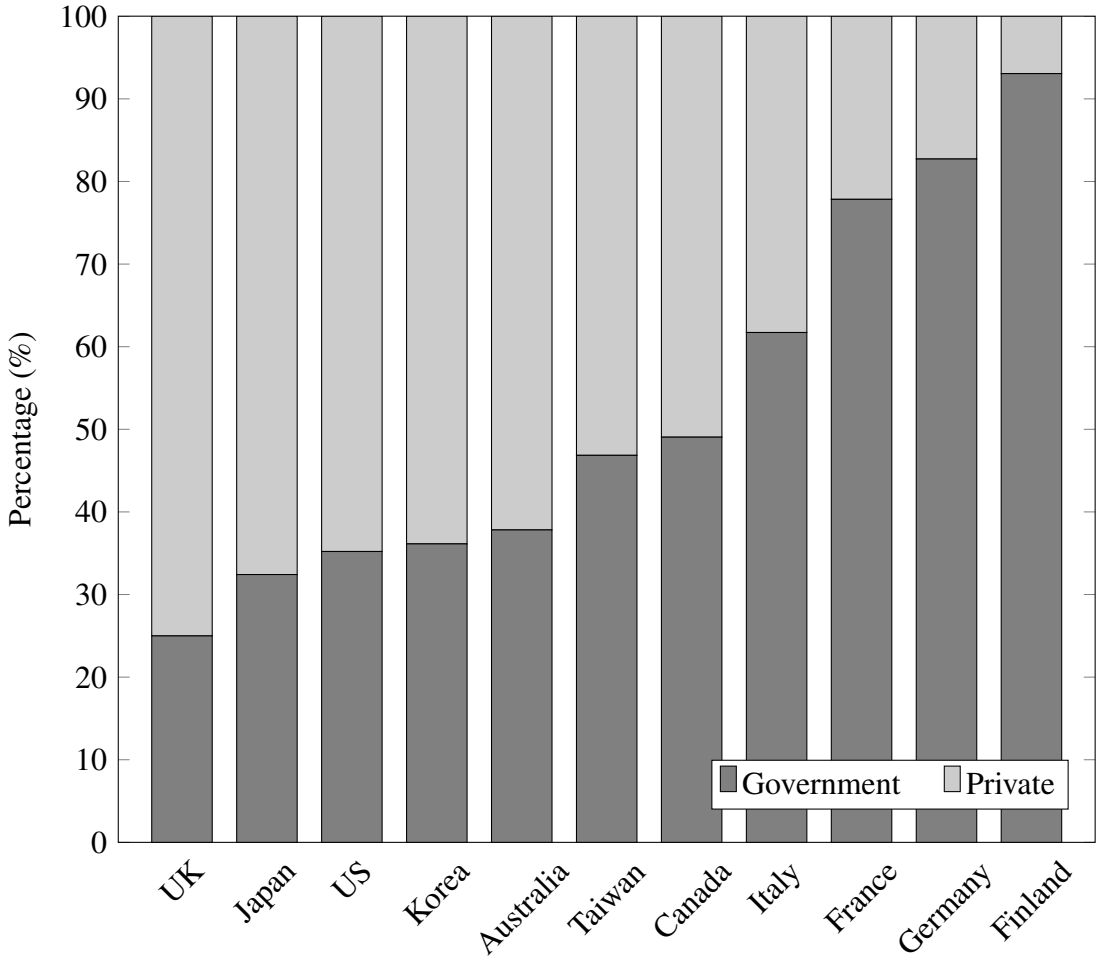

Figure 2: Percentage of government and private funding sources for higher education

Notes: Year of Data are 2015 to 2016. Data from OECD (2017) Education at a glance 2017: OECD indicators & MOE (2017) Education statistics.

tion of the Ministry of Education (MOE) of 2017 is NTD 89 billion (around USD 2.89 billion) which accounts for 4.62% of the total central government expenditure (DGBAS, 2018; MOE, 2018).

Given the great amount of investment in higher education, investigating whether these resources can improve organization performance is important. Coleman et al. (1966) suggest that school funding (measured in terms of per-pupil expenditure) has little effect on student achievement (measured in terms of test score and educational attainment). Hanushek and Luque (2003) review 163 studies regarding the expenditure on students' performance and find only 27% of studies support a significant and positive effect of educational expenditure on student per-

formance (measured as standardized test scores, class attendance, or educational attainment). "Does money matter in education" is still a controversial and unsolved question nowadays.

However, previous studies mainly focus on primary and secondary education (Hyman, 2017; Grogger, 1996; Wößmann, 2003). Higher education receives less attention compared to compulsory education. Even though the number of total students is greater in primary and secondary education than in higher education, the importance of higher education should not be less than primary and secondary education. The reasons are that the money invested in higher education is huge and that higher education may widely benefit the whole society (Bloom, Hartley, & Rosovsky, 2007).

On the other hand, previous studies usually focus on teaching resources or instructional expenditure spent on education (Dee, 2005; Jacques & Brorsen, 2002; Neely & Diebold, 2016). Administration and management factors are easily omitted by researchers as well as policymakers. Meier and O'Toole Jr (2003) suggest that management is an important factor for school district performance, but their investigation focuses on primary education rather than higher education.

To examine the role of administration in higher education, this paper investigates the different categories of expenditure effect (instructional, administrative and research expenditure) on universities and colleges' teaching and research performance. This paper aims at answering the following questions:

1. Does an increase in administrative expenditure leads to an increase in teaching performance?

2. Does an increase in administrative expenditure leads to an increase in research performance?

3. Comparing with the effect of instructional expenditure and research expenditure, to what extent does administrative expenditure matter?

2 Literature Review

This section firstly presents previous studies and theories regarding the factors that influence schools performance. Then, discuss the role of administration and management in promoting education performance. Lastly, based on the literature, this paper provides a research framework to describe the relationship between educational investment and performance.

2.1 Factors Influencing University Performance

University performance includes teaching and research performance. Teaching performance is usually represented by students' achievement, such as test score, class attendance, or drop rate) (Andrews, Boyne, & Walker, 2006; Hedges, Laine, & Greenwald, 1994). Research performance, on the other hand, is usually measured as the number of publication, values of university-industry collaboration, and number of patents or intellectual property (IP) rights (Frenken, Heimeriks, & Hoekman, 2017; Czarnitzki, Glänzel, & Hussinger, 2007).

The educational production function suggests that educational outputs are jointly determined by students' family background (B), characteristics of peer groups (P), school resources (S), and personal innate abilities (I) (Hanushek, 1979). That is school resources do play a role in school teaching performance. However, this model does not clearly explain the path from school resources to students' achievement. Levačić and Vignoles (2002) presents the "Context–Input–Process–Outcome Model" of school effectiveness. The model indicates that students' achievement is determined by the interaction of school context, student inputs, and resource inputs. The causal links are from the context and input variables to school processes, then determine student outcomes. Wenglinsky (1997) suggests that the effect of education spending on students' achievement is mediated by school inputs and school social environment.

Regarding research performance, Johnes and Johnes (1995) view funding as an input into the research process and result in improvement in research performance. Auranen and Nieminen (2010) and Fu (2017) also finds that higher research funding leads to more publications. To

conclude, an increase in funding or expenditure may bring out progress in performance, and the relationship is mediated by resources input or school process.

2.2 The Role of Administration & Management

Wu (2010) interviews the managers of universities which received funding from the MOE. The interviewees indicated that the funding helps them in organization reformation. Before getting the funding, the universities usually decentralize teaching quality management businesses between different departments or colleges. The funding helps them to establish specific administrative offices. These offices clarify the missions and planning of teaching improvement as well as help integrate resource and improve communication between different units. Administrative reformation really improves the teaching quality of these universities.

Horng, Klasik, and Loeb (2010) find that the more time the principals spent on organization management activities (such as hiring and managing staff and managing budgets), the better the students' test performance. Tickle, Chang, and Kim (2011) survey full-time, public school teachers in the US and suggest that administrative support is a powerful predictor of teachers' job satisfaction and commitment. Pogodzinski (2015) also indicates that when teachers perceive positive administrator-teacher relations in their schools, they can more concentrate on their core teaching work and has better performance.

Previous studies support that administration, to some degree, improve school performance. Comparing the effect of administrative inputs with instructional expenditure, Hanushek (1996) reviews 377 studies regarding educational resources and students' achievement. Among 163 estimates regarding the effect of per-pupil expenditure on student performance, 27 (17%) support positive and significant effects. Among 75 estimates investigating the effect of administrative inputs on student performance, 12 (16%) support positive and significant effects. The percentage of finding a significantly positive effect is almost the same for per-pupil expenditure and for administrative inputs. To conclude, this paper expects that administrative expenditure can predict school performance.

2.3 Research Framework & Hypotheses

Figure 3 presents the research framework of this paper. This paper expects that money investment (measured as expenditure) may affect teaching, administration and research resources within institutions. Then, resources inputs can improve teaching and research performance of institutions. Next section describes the definitions of the variables presented in the Figure 3.

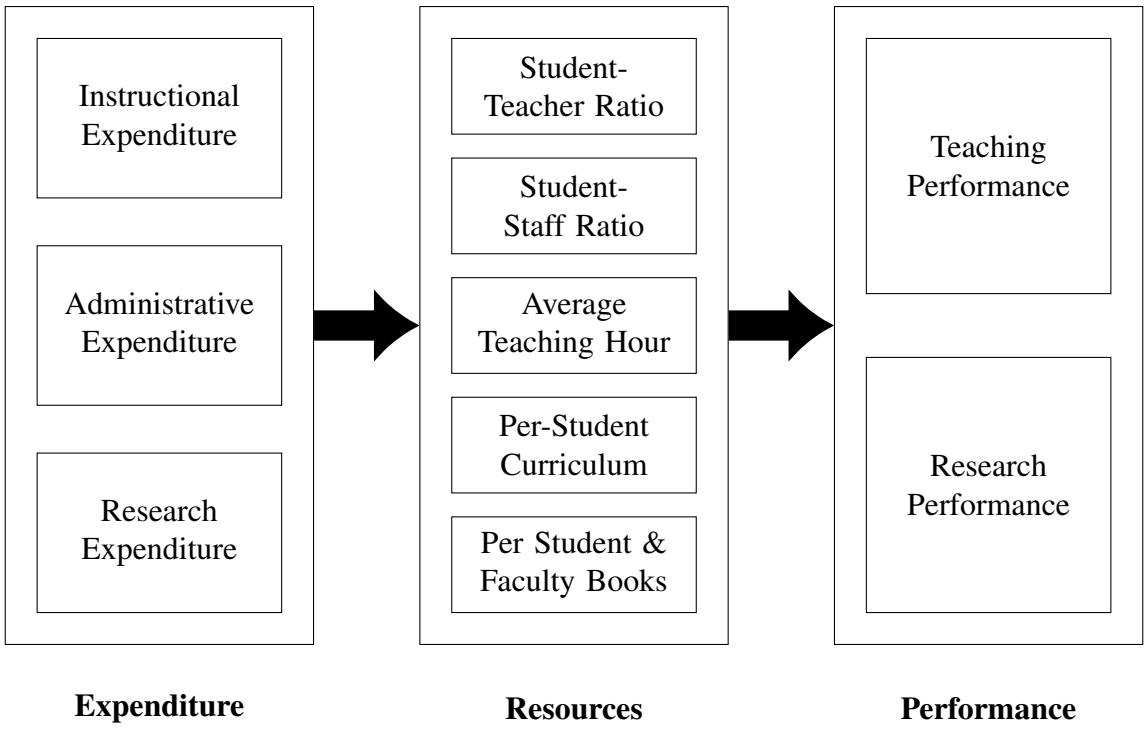

Figure 3: Research framework: From expenditure inputs to organization performance

This thesis aims to investigate the following hypotheses:

H_{1a} : Increase in per-student administrative expenditure leads to increase in institution resources.

H_{1b} : Increase in per-student instructional expenditure leads to increase in institution resources.

H_{1c} : Increase in per-student research expenditure leads to increase in institution resources.

H_{2a} : Increase in institution resources leads to increase in teaching performance.

H_{2b} : Increase in institution resources leads to increase in research performance.

3 Data & Method

3.1 Data & Samples

The samples of this paper are the public and private universities and colleges in Taiwan. Table 1 provides the number of observations by types and tracks. The total number of universities and colleges included in this paper is 139. One-third of institutions are public, the other two-thirds are private. Half of the institutions are general, the other half are vocational.

Table 1: Number of Observations, by Types and Tracks

	Public	Private	Total
General	33 (24%)	36 (26%)	69 (49%)
Vocational	12 (9%)	58 (41%)	70 (51%)
Total	45 (33%)	94 (67%)	139 (100%)

The observation period of this paper is school year 2017/2018 (from 2017 August to 2018 July). The data on expenditure comes from the financial reports of each university or college. The data on resources and performance comes from the Ministry of Education (MOE). The data on control variables comes from the MOE and the University Admission Committee.

3.2 Variables & Measurement

Table 2 summarizes the definitions of variables in this paper. The five resources variables include student-teacher ratio, student-staff ratio, average teaching hour, per-student curriculum, and per-student and faculty books. The student-teacher ratio indicates the number of students each teacher should take care of. The higher the ratio, the less attention and time each student can receive from teachers. Also, the higher the ratio, the less time and effort can each teacher contribute to research work. Similarly, the student-staff ratio means the number of students each administrative staff should take care of. The higher the ratio, the poor the administrative resources. Average teaching hour refers to on average, the number of courses credits per-week a full-time professor should spend on. The higher the number, the fewer time professors can contribute to each course as well as to research work. Per-student curriculum equals to the total

credits of curriculum divided by the number of day division students. The higher the number, the more choice of curriculum students have. Books resources denote the library resources per student and faculty possess. The higher the number, the more the teaching, learning, and research resources.

This paper measures teaching performance by using three indicators: the enrollment rate next year, the stable rate, and the drop rate. The higher the enrollment rate and stable rate, the better the teaching performance. Conversely, the lower the drop rate, the better the teaching performance. On the other hand, this paper measures research performance by using another three indicators: per-faculty industry-university cooperative (IUC) funding, per-faculty academic research project (ARP) funding, and per-faculty patent. The higher the value, the better the research performance.

Previous studies suggest that school context, environment, students' family background, and innate ability may affect the performance of school (Hanushek, 1979; Coleman et al., 1966; Meier & O'Toole Jr, 2003). Therefore, this paper includes institutions characters (measured as type and scale), students' family background (measured as the percentage of students received deductions in tuition), ability previous to enrollment (measured as average admission score), and the composition of colleges as control variables.

Table 2: Definition of Variables

Variables	Definition
Resources Variable	
Student-Teacher Ratio	Number of day division students divided by number of full-time professors (above associated professor)
Student-Staff Ratio	Number of day division students divided by number of full-time administrative staff
Average Teaching Hour	Average teaching hour per-week for full-time professors
Per-Student Curriculum	Total credits of curriculum divided by number of day division students
Per Student & Faculty Books	Total number of printed-book and e-books/e-journal divided by the number of students and faculty
Teaching Performance	
Enrollment Rate	The number of total students enrolled in the institutions divided by the number of quotas approved by the MOE
Stable Rate	The number of second-year students this year divided by the number of freshmen enrolled in the institutions last year
Drop Rate	The number of students dropping out of the institution divided by the number of total students
Research Performance	
Per-Faculty IUC Funding	The total amount of industry-university cooperative funding divided by the number of full-time professors
Per-Faculty ARP Funding	The total amount of academic research project funding divided by the number of full-time professors
Per-Faculty Patent	The total number of patent and plant variety rights divided by the number of full-time professors
Control Variables	
Institution Type, Track, and Level	A set of dummy variables indicating whether an institution is public or private, general or vocational, and university or college.
Number of Daytime Student	Total number of daytime student in the institution.
Ratio of Disadvantaged Student	Number of student received deductions in tuition divided by the total number of student.
Average Admission Score	Weighted average minimum admission score (converted into 0 to 100) of all departments within an institution.
Composition of Different Colleges	A set of variables indicating the percentage of students enrolling in departments of education, art, social science and law, business, science and biology, technology and engineering, and medicine.

3.3 Analysis

This paper uses path-analysis to examine the relationships between expenditure, resources, and performance. Path-analysis is composited by a set of regression analyses. However, path-analysis can integrate the relationships between different variables into a complex model. This analysis technic can help explain the casual relationship more comprehensively.

4 Results

4.1 Descriptive Statistics

Table 3 displays the distribution of different categories of expenditure. The administrative expenditure accounts for 10% to 17% of total expenditure. The instructional expenditure accounts for 54% to 67% of total expenditure. The research expenditure accounts for 6% to 29% of total expenditure. Instructional expenditure is the most important part of institution spending. The percentage of administrative expenditure is not considerable, but still worth to notice.

Table 3: Expenditure Distribution of Universities and Colleges

Unit: %

	Public		Private	
	General	Vocational	General	Vocational
Administrative	10.2	12.4	14.59	16.95
Instructional	54.3	64.46	59.52	66.75
Research	28.76	17.39	12.33	6.11
Scholarship	3.87	3.59	6.4	5.8
Continuing Education	1.26	0.83	3.83	2.07
Other Expenditure	1.61	1.33	3.34	2.32

Table 4 presents the descriptive statistics of the variables in this paper. The mean per-student administrative expenditure is NTD 35,532. The mean per-student instructional expenditure is NTD 142,866, which is 4 times of administrative expenditure. The mean per-student

research expenditure is 30,237, which is similar to administrative expenditure. The average student/teacher ratio is 26.93, indicating that one teacher should take care of 27 students. The average student/staff ratio is 35.61, which is higher than the student/teacher ratio. The average teaching hour for full-time professors is 10.97 credits per-week, ranging from 3.78 to 24.87. The per-student curriculum is 0.6. The number of per-student & faculty books is 140, ranging from 37 to 1,214. Overall, the level of resources various between different universities and colleges. Understanding whether the difference in resources leads to the difference in performance is important.

Table 4: Descriptive Statistics of Variables

	Mean	SD	Min	Max
Expenditure Variables				
Per-Student Administrative Exp.	35,532	24,137	9,971	203,279
Per-Student Instructional Exp.	142,866	68,177	59,850	515,692
Per-Student Research Exp.	30,237	42,619	1,623	208,055
Resources Variables				
Student/Teacher Ratio	26.93	7.86	6.73	51.59
Student/Staff Ratio	35.61	14.21	9.57	99.58
Average Teaching Hour	10.97	2.58	3.78	24.87
Per-Student Curriculum	0.60	0.25	0.00	1.63
Per Student & Faculty Books	140	124	37	1,214
Teaching Performance				
Enrollment Rate	79.91	15.86	29.87	100.00
Stable Rate	87.56	8.79	56.88	97.27
Drop Rate	6.93	4.10	1.39	27.75
Research Performance				
Per-Faculty IUC Funding	269,788	311,473	6,316	1,429,136
Per-Faculty ARP Funding	298,104	438,445	0	1,949,713
Per-Faculty Patent	0.04	0.07	0.00	0.42

Note: The sample size is 139 institutions.

4.2 The Relationship between Expenditure & Resources

Table 5 presents the estimated results of regressing resources variables on different categories of expenditure. Column (1) indicates the impact of expenditure on student/teacher ratio. The result denotes that both instructional and research expenditure have negative effects on student/teacher ratio (which means improve in teaching resources), but administrative expenditure has no effect on student/teacher ratio. The coefficient indicates that one deviation increase in per-student instructional expenditure leads to 0.48 deviation decrease in student/teacher ratio. One deviation increase in per-student research expenditure leads to 0.26 deviation decrease in student/teacher ratio. That is the more money input in instructional and research, the more teachers shared by a given number of students.

Column (2) shows the result of the student/staff ratio. Surprisingly, instructional expenditure has a significantly negative effect on student/staff ratio (which means improve in administrative resources), but administrative expenditure has no effect. The coefficient indicates that one deviation increase in per-student instructional expenditure leads to 0.31 deviation decrease in student/staff ratio. Column (3) displays the result on average teaching hour per teacher. Only research expenditure has a significant effect on average teaching hour. One deviation increase in research expenditure results in 0.308 decreases in average teaching hour. Hence, the higher the research spending, the more time teachers can spend on research works.

Column (4) investigates the impact of expenditure on the per-student curriculum. None of the categories of expenditure has a significant effect on per-student curriculum. Column (5) examines the effect on library resources (per student and faculty books). Once again, None of the categories of expenditure has a significant effect on library resources.

To conclude, instructional expenditure is the most powerful predictors for institution resources, following by research expenditure. Administrative expenditure has no role in improvement resources. Even for staff resources, the estimated coefficients of administrative expenditure is not significant and is lower than instructional expenditure. The evidences support the H_{1b} and H_{1c}, but fail to confirm the H_{1a}.

Table 5: The Impact of Different Categories of Expenditure on Institution Resources

	(1)	(2)	(3)	(4)	(5)
	Student/ Teacher Ratio	Student/ Staff Ratio	Average Teaching Hour	Per-Student Curriculum	Per Student & Faculty Books
Expenditure Variables					
Per-Student Administrative Exp.	-0.020	-0.188	-0.200	0.083	0.268
Per-Student Instructional Exp.	-0.480***	-0.310*	0.291	0.081	-0.047
Per-Student Research Exp.	-0.260**	-0.204	-0.308*	-0.153	0.154
Institution Characters					
Private	-0.026	0.196	-0.343*	0.037	-0.144
Vocational	0.328***	0.253*	0.238*	-0.157	-0.136
College	0.168*	0.041	-0.026	0.139	0.120
Studnet Characters					
Number of Students	0.288***	0.149	0.281**	-0.177	-0.092
Ratio of Disadvantaged Students	-0.318***	-0.224*	0.378***	0.326**	0.031
Average Admission Score	-0.098	0.076	-0.294*	-0.114	-0.121
% of Students in					
Education	-0.030	0.058	-0.120	0.002	0.034
Art	0.037	0.015	-0.083	-0.025	0.218
Social Science & Law	-0.111	-0.142	-0.148	-0.223**	0.088
Business	-0.006	0.125	-0.064	-0.136	0.041
Science & Biology	-0.093	0.121	-0.120	-0.047	-0.019
Technology & Engineering	-0.2068*	0.027	-0.211*	-0.047	0.015
Medicine	0.010	0.131	-0.268*	-0.121	-0.099
Observations	139	139	139	139	139
R-squared	0.715	0.545	0.517	0.572	0.279

Note: The coefficients shown in the table are the standardized regression coefficients.
* $p < 0.05$ ** $p < 0.01$ $^{***}p < 0.001$

4.3 The Relationship between Resources & Teaching Performance

Table 6 presents the estimated results of regressing teaching performance on resources variables. Column (1) displays the impact of resources on the enrollment rate of the next year. The higher the rate indicates better performance in teaching activities. The result denotes that the higher the student/teacher ratio and average teaching hour (which means that the less the teaching resources), the higher the enrollment rate (which means that the better the teaching performance). The result is not consistent with the expectation of the theories and the hypothesis. One explanation is the causal simultaneity between teaching resources and enrollment rate. The lower the enrollment rate means that the less number of students enrolling in the university or college. As a result, each student can receive more resources from the institution. Even though this paper uses the enrollment rate of the next year as the dependent variable, the correlation between the enrollment rate of the last year and next year may still confound the estimated result.

Column (2) presents the result on the stable rate (the percentage of the freshmen staying in the institution next year). Only the per-student curriculum has a significant effect on the stable rate, indicating that the more curriculum for students to choose, the less likely they continue their college study. One deviation increase in per-student curriculum leads to 0.289 deviation decrease in stable rate.

Column (3) report the estimated result on the drop rate. The higher the drop rate indicates the lower the teaching performance. The result suggests a negative effect of student/teacher ratio on drop rate. That is the greater number of students each teacher should take care of, the better the teaching performance. This estimation is not consistent with the expectation of the theories and the hypothesis. Similar to the case in the column (1), the unexpected result must due to the causal simultaneity. The higher the drop rate of the institution represents the lower number of students leave in the institution. Hence, each student can enjoy more teaching resources from their teachers.

Table 6: The Impact of Institution Resources on Teaching Performance

	(1)	(2)	(3)
	Enrollment Rate	Stable Rate	Drop Rate
Resources Variables			
Student/Teacher Ratio	0.391***	0.053	-0.348***
Student/Staff Ratio	0.005	0.152	-0.070
Average Teaching Hour	0.138*	0.091	-0.119
Per-Student Curriculum	-0.148*	-0.289***	-0.001
Per Student & Faculty Books	0.108	0.006	-0.071
Institution Characters			
Private	-0.037	-0.027	0.068
Vocational	-0.382***	-0.196	0.157
College	0.053	0.108	0.146*
Student Characters			
Number of Students	-0.044	0.015	0.064
Ratio of Disadvantage Students	0.030	-0.116	0.207*
Average Admission Score	0.712***	0.545***	-0.515***
% of Students in			
Education	0.152*	0.042	-0.091
Art	0.046	-0.055	-0.092
Social Science and Law	-0.018	-0.089	-0.014
Business	0.126*	-0.034	-0.152*
Science and Biology	0.031	0.011	-0.108
Technology and Engineering	0.154	-0.025	-0.222*
Medicine	0.261**	0.010	-0.393***
Observations	139	139	139
R-squared	0.727	0.635	0.673

Note: The coefficients shown in the table are the standardized regression coefficients.
* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

Regarding the control variables, the average admission score is the most predictive variable of teaching performance in the model. The higher the admission score, the better the teaching

performance. The average admission score represents the academic or cognitive ability of students previous to enrollment. In other words, the qualities of the original material are much more important than the process of manufacture (education investment) for higher education.

Figure 4 summarizes the path relationships from expenditure to resources to teaching performance. Both administrative expenditure and student/staff ratio have nothing to do with resources and teaching performance, supporting no effect of administrative factors on organization performance. Some of the resources are related to performance, but the effect direction is opposite to the relationships that this paper expects.

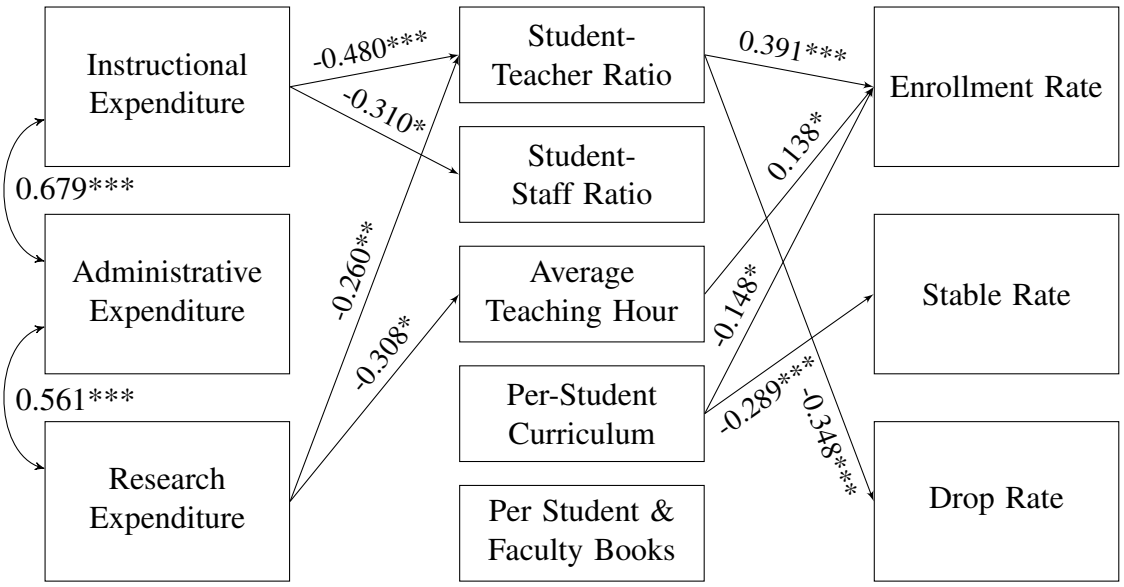

Figure 4: The path diagram of teaching performance

Notes: The coefficients shown in the table are the standardized regression coefficients. The paths with non-significant coefficients are omitted.
* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

4.4 The Relationship between Resources & Research Performance

Table 7 presents the estimated results of regressing research performance on resources variables. Column (1) displays the impact of resources on the per faculty industry-university cooperative (IUC) funding. Only the student/teacher ratio significantly affect per-faculty IUC

funding. The standardized coefficient is -0.311, indicating that one standard deviation decrease in student/teacher ration (which means more resources) leads to 0.311 standard deviation increase in per-faculty IUC funding. That is, if on average, a teacher takes care of less student, they can put more time and effort on research work and get more funding from industry.

Column (2) shows the impact of resources on per-faculty academic research project (ARP) funding. Both student/teacher ratio and average teaching hour have negative effects on per-faculty funding. Since less student/teacher ratio and less average teaching hour indicate more resources, the estimation suggests that more resources improve research performance. Once again, if teachers spend less time on teaching work, they can perform better on research works.

Column (3) investigates the effect on the per-faculty patent. Both student/teacher ratio and per-student curriculum have significant and negative coefficients. The lower the student/teacher ratio means the more the resources. The more the per-student curriculum means more teaching resources because students have more choice. However, the more the per-student curriculum means fewer research resources because teachers have less time to put into research work. Overall, resources improve research performance of universities and colleges. Among all kinds of resources, student/teacher ratio is the most important resources, indicating that human capital is the key resources for organizations.

Regarding the control variables, the number of students is a powerful predictor for IUC funding. This result is reasonable because the bigger the scale of universities, the most likely the universities can attract collaboration from the industries. The percentage of students in science and biology is a powerful predictor for ARP funding. The result also meets the expectation because that most of the APR funding comes from the Ministry of Science & Technology (MOST) and research in science always receive more attention from the MOST. The percentage of students in social science and law is a powerful predictor for the per-faulty patent with negative direction. Faculty in the departments of social science and law hardly can generate any patent, so the finding is not surprising.

Table 7: The Impact of Institution Resources on Research Performance

	(1)	(2)	(3)
	Per-Faculty IUC Funding	Per-Faculty ARP Funding	Per-Faculty Patent
Resources Variables			
Student/Teacher Ratio	-0.311**	-0.221**	-0.277*
Student/Staff Ratio	0.050	-0.112	-0.026
Average Teaching Hour	-0.107	-0.158*	-0.063
Per-Student Curriculum	-0.180	-0.123	-0.435***
Per Student & Faculty Books	0.006	-0.020	0.006
Institution Characters			
Private	0.034	-0.011	0.109
Vocational	-0.095	-0.153	0.099
College	0.043	0.012	0.010
Student Characters			
Number of Students	0.276**	0.192**	0.084
Ratio of Disadvantage Students	0.095	0.038**	0.006
Average Admission Score	0.275	0.269	0.061
% of Students in			
Education	-0.076	-0.066	-0.041
Art	0.015	-0.131*	-0.138
Social Science and Law	-0.158	-0.125*	-0.236*
Business	-0.186*	-0.111	-0.126
Science and Biology	0.043	0.227***	-0.063
Technology and Engineering	0.143	0.119	0.213
Medicine	-0.051	-0.037	-0.215
Observations	139	139	139
R-squared	0.520	0.776	0.403

Note: The coefficients shown in the table are the standardized regression coefficients.
* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

Figure 5 summarizes the path relationships from expenditure to resources to research performance. Student/teacher ratio is related to all of the research performance indicators, indicating that human capital is the most important factor for research performance. Average teaching hour and per-student curriculum are negatively correlated with research performance. Namely, if teachers need to spend more time on teaching works, their research performance decrease. Therefor, organizations should notice the trade-off between teaching and research works.

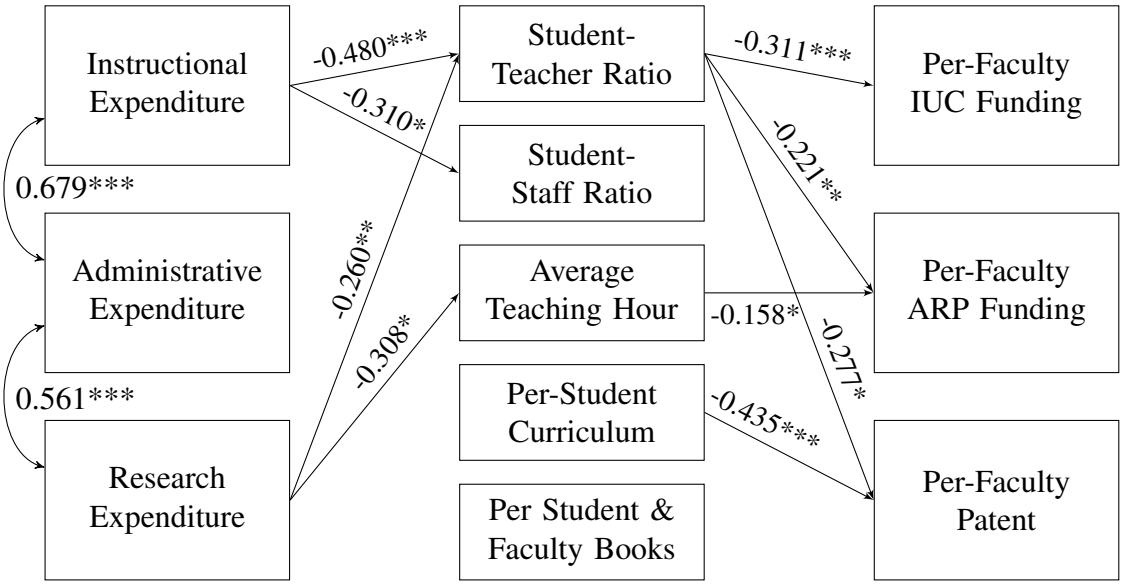

Figure 5: The path diagram of research performance

Notes: The coefficients shown in the table are the standardized regression coefficients. The paths with non-significant coefficients are omitted.
* $p < 0.05$ ** $p < 0.01$ $^{***}p < 0.001$

5 Discussion & Conclusion

5.1 Research Finding

This paper finds that more instructional expenditure and research expenditure lead to more resources, supporting H_{1b} and H_{1c}. However, Administrative expenditure has nothing to do with resources, providing no evidence for H_{1a}. The results support that increase in institution

resources leads to an increase in research performance, confirming H_{2b}. Conversely, resources inputs do not improve reaching performance, denying H_{2a}.

The estimation denotes that students' family background (measured as the percentage of disadvantaged students in this paper) and initiate ability (measured as average admission score in this paper) are more important for teaching performance than school resources. This finding is consistent with precious researches (Coleman et al., 1966; Wößmann, 2003).

regarding research performance, this paper finds that resources inputs are very important for research performance. The finding is consistent with previous researches (Auranen & Nieminen, 2010; Fu, 2017). However, this paper does not control the ability of faculty (such as the amount of funding or the number of patents last year). Hence, the result provides no information on the comparison between the importance of resources and faculty personal characters.

Sadly, administration serves no role in organization resources allocation as well as performance. Even though this paper does not include all administrative factors, the result, at least, suggests that administrative expenditure and number of staff themselves do not affect organization performance.

5.2 Limitation & Recommendation for Future Studies

This section discusses the limitation of this paper and provides some suggestions for future studies. Firstly, this paper only includes one-year data. This fact leads to two undesirable results. One is the limitation in sample size, which is only 139 institution-year. Another is that this paper can not control for previous performance or fixed institution effect, which is really important to identify the relationship between inputs and outcomes.

Secondly, this paper omits lots of factors regarding administration or management. Some administrative factors cannot be measured by money or real resources, such as management, network, organization structure…etc. However, this paper only considers administrative expenditure and the number of staff. The limitation makes this paper fail to investigate the impact

of administrative factors in a more comprehensive perspective.

Lastly, this paper does not consider the casual simultaneity between resources and performance. Correlation does not mean causality. Poor teaching performance may result in fewer students and lead to higher per-student resources. On the other hand, great research performance may attract more research funding. The evidence of strong relationships between resources and performance provides no information about resources causal effect on performance.

In conclusion, future studies can consider to include data with more year. As a result, the model can control for previous performance or fixed institution effect. Also, the model can regress performance of latter years on resources of previous years to identify the causal relationship. Besides, future studies can include more comprehensive variables regarding administrative factors to investigate the impact of administration and management.

References

Andrews, R., Boyne, G. A., & Walker, R. M. (2006). Subjective and objective measures of organizational performance. *Public Service Performance: Perspectives on Measurement and Management*, 14-34.

Auranen, O., & Nieminen, M. (2010). University research funding and publication performance—an international comparison. *Research policy*, *39*(6), 822-834.

Bloom, D. E., Hartley, M., & Rosovsky, H. (2007). Beyond private gain: The public benefits of higher education. In *International handbook of higher education* (p. 293-308). Springer.

Coleman, J. S., Campbell, E., Hobson, C., McPartland, J., Mood, A., Weinfeld, F., & York, R. L. (1966). *Equality of educational opportunity*. DC: US Government Printing Office.

Czarnitzki, D., Glänzel, W., & Hussinger, K. (2007). Patent and publication activities of german professors: an empirical assessment of their co-activity. *Research Evaluation*, *16*(4), 311–319.

Dee, T. S. (2005). Expense preference and student achievement in school districts. *Eastern Economic Journal*, *31*(1), 23-44.

DGBAS. (2018). *Financial statement of central government, fy2017*. Directorate General of Budget Accounting and Statistics.

Frenken, K., Heimeriks, G. J., & Hoekman, J. (2017). What drives university research performance? an analysis using the cwts leiden ranking data. *Journal of Informetrics*, *11*(3), 859–872.

Fu, Y. C. (2017). *Does the project of world class university (phase i) spur scientific productivity in stem fields?: A study of policy impact in taiwan* (Unpublished doctoral dissertation). The Graduate School College of Education, The Pennsylvania State University.

Grogger, J. (1996). School expenditures and post-schooling earnings: evidence from high school and beyond. *The Review of Economics and Statistics*, 628–637.

Hanushek, E. A. (1979). Conceptual and empirical issues in the estimation of educational production functions. *Journal of human Resources*, 351-388.

Hanushek, E. A. (1996). A more complete picture of school resource policies. *Review of Educational Research*, *66*(3), 397–409.

Hanushek, E. A., & Luque, J. A. (2003). Efficiency and equity in schools around the world. *Economics of education Review*, *22*(5), 481-502.

Hedges, L. V., Laine, R. D., & Greenwald, R. (1994). An exchange: Part i: Does money matter? a meta-analysis of studies of the effects of differential school inputs on student outcomes. *Educational researcher*, *23*(3), 5-14.

Horng, E. L., Klasik, D., & Loeb, S. (2010). Principal's time use and school effectiveness. *American journal of education*, *116*(4), 491–523.

Hyman, J. (2017). Does money matter in the long run? effects of school spending on educational attainment. *American Economic Journal: Economic Policy*, *9*(4), 256–80.

Jacques, C., & Brorsen, B. W. (2002). Relationship between types of school district expenditures and student performance. *Applied Economics Letters*, *9*(15), 997-1002.

Johnes, J., & Johnes, G. (1995). Research funding and performance in uk university departments of economics: a frontier analysis. *Economics of Education Review*, *14*(3), 301–314.

Levačić, R., & Vignoles, A. (2002). Researching the links between school resources and student outcomes in the uk: A review of issues and evidence. *Education Economics*, *10*(3), 313-331.

Meier, K. J., & O'Toole Jr, L. J. (2003). Public management and educational performance:

The impact of managerial networking. *Public Administration Review*, *63*(6), 689-699.

MOE. (2017). *Education statistics*. Ministry of Education.

MOE. (2018). *Financial statement of the ministry of education, fy2017*. Ministry of Education.

Neely, S. R., & Diebold, J. (2016). Public expenditures and the production of education. *education policy analysis archives*, *24*, 88.

OECD. (2017). *Education at a glance 2017: Oecd indicators*. Organisation for Economic Co-operation and Development.

Pogodzinski, B. (2015). Administrative context and novice teacher-mentor interactions. *Journal of Educational Administration*, *53*(1), 40–65.

Tickle, B. R., Chang, M., & Kim, S. (2011). Administrative support and its mediating effect on us public school teachers. *Teaching and Teacher Education*, *27*(2), 342–349.

Wenglinsky, H. (1997). How money matters: The effect of school district spending on academic achievement. *Sociology of Education*, 221-237.

Wößmann, L. (2003). Schooling resources, educational institutions and student performance: The international evidence. *Oxford Bulletin of Economics and Statistics*, *65*(2), 117-170.

Wu, S.-Y. (2010). *A study of the university teaching excellence program and teaching quality* (Unpublished master's thesis). Graduate Institute of Educational Policy Administration, National Taiwan Normal University.