Research scholarly productivity of universities: From the perspective of knowledge transfer

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Theme: 4. Universities as interactive partners

ABSTRACT: Knowledge transfer acts as essential mediator to build research scholarly productivity of university faculty. However, the effects that knowledge transfer takes on research scholarly productivity of universities are still quite ambiguous, which results in ignorance of procedural concern about how knowledge transfer promotes research scholarly productivity through interaction and synergy between university faculty and specific knowledge users (receivers). Therefore, we proposed a conceptual model and 13 hypotheses, which illustrate the elements influencing knowledge transfer while university faculty engage in research work and make contribution to research scholarly productivity. Later, correlation and regression analysis were done to verify the model and hypotheses, and the statistical results indicate: the processes of "conduct research work" (knowledge transmit) and "absorb research outcome" (knowledge accept) pose the first and second greatest total effects on research scholarly productivity, which implies university faculty should pay high attention to the procedural management while making research; "communication environment" takes the third place to influence research scholarly productivity, which suggests building proper communication environment for knowledge transmission by university faculty and absorption by specific knowledge receivers is indirectly important to the level of research scholarly productivity; the last but not the least, an unexpected finding that "knowledge characteristics" (complexity) does exert direct effect on research scholarly productivity, which probably reveals university faculty is eager to grasp open opportunities and difficult challenges- the more complex the knowledge, the stronger willing to undertake research and transfer knowledge.

Keywords: research scholarly productivity, knowledge transfer, conceptual model, regression analysis, total effect

0-4 JEL Classifications: I230

1. Introduction

Universities (academia) take an important role in Triple Helix model as novelty production (knowledge), while industry engages in wealth generation (market) and government responses for public control (regulation) (Loet Leydesdorff, Martin Meyer, 2006). In comparison with teaching scholarship, research scholarly productivity of universities hold more interactive involvements with economic growth and commercialization in terms of outputs (Cohen et al., 2002; Behrens, Gray, 2001; Agrawal, 2006; Perkmann, Walsh, 2007). It's found positive synergistic effects of the interaction between university and government, industrial R&D in regions with high entrepreneurial activity (Younghwan Kim, Wonjoon Kim, Taeyoung Yang, 2012). These suggest that universities should possess great capability of research productivity in the way of knowledge transfer. The available literature mostly takes total number of publications to measure research productivity (Ted D. Englebrecht, et al.,2008; James R. Hasselback, et al., 2011; John H. Kranzler, et al., 2011), and engages in determinants of research productivity including age, sex, scientific disciplines, professional status, reputation of university, laboratory size, quality of colleagues, funding and so on (Clete Snell, et al., 2009; Nicolas Carayol, Mireille Matt, 2006; Bonaccorsi, Daraio, 2002). However, the research productivity of university doesn't restrict to article publication, and actually encompasses more besides publication works, projects committed, tasks consignation, collaboration, patents, software, graduate programs, and basic initiative research.

Meanwhile, knowledge transfer acts as essential mediator to build research scholarly productivity of university faculty. Relative literature put focuses on: university technology transfer patterns such as patent authorization, collaborative research, commercial spin-offs (Siegel, et al., 2003; Wang Xiaoping, Gao Liangping, 2003; Landry et al., 2006); process and content of university-industry-government collaboration, and factors hindering technology transfer (Carayannis, et al., 2000; Meyer-Krahmer, Schmoch, 1998; Li Wengbo, 2003; Chen Guiyao, Sun Bocan, 2003); economic effects and institution of university technology transfer (Siegel, et al., 2003; Liu Hongmin,2004). Anyway, the literature didn't directly refer to "knowledge transfer" though technology transfer inevitably holds intensive relevance with it, didn't concentrate on micro analysis of how knowledge transfer takes effects on research scholarly productivity of universities.

Therefore, the following questions represent our specific interests in this paper: What are the important determinants of research scholarly productivity of university from the perspective of knowledge transfer? How important are the interaction and synergy between universities and specific knowledge users (receivers)?

2. Conceptual model and hypotheses

In general, knowledge transfer means knowledge flow from the sender to receiver, and covers two key processes of transmission and absorption (see Fig.1a). From the orientation of knowledge flow, knowledge transfer mainly involves the following elements: (1) knowledge sender who initiates the procedure of knowledge transfer, (2) receiver who accepts the transmitted knowledge, (3) the knowledge that is the object handled, (4) media and ways by which knowledge flow and transfer are implemented. Moreover, external environment exerts influences on knowledge transfer too, such as physical, cultural, institutional and technological environmental factors.

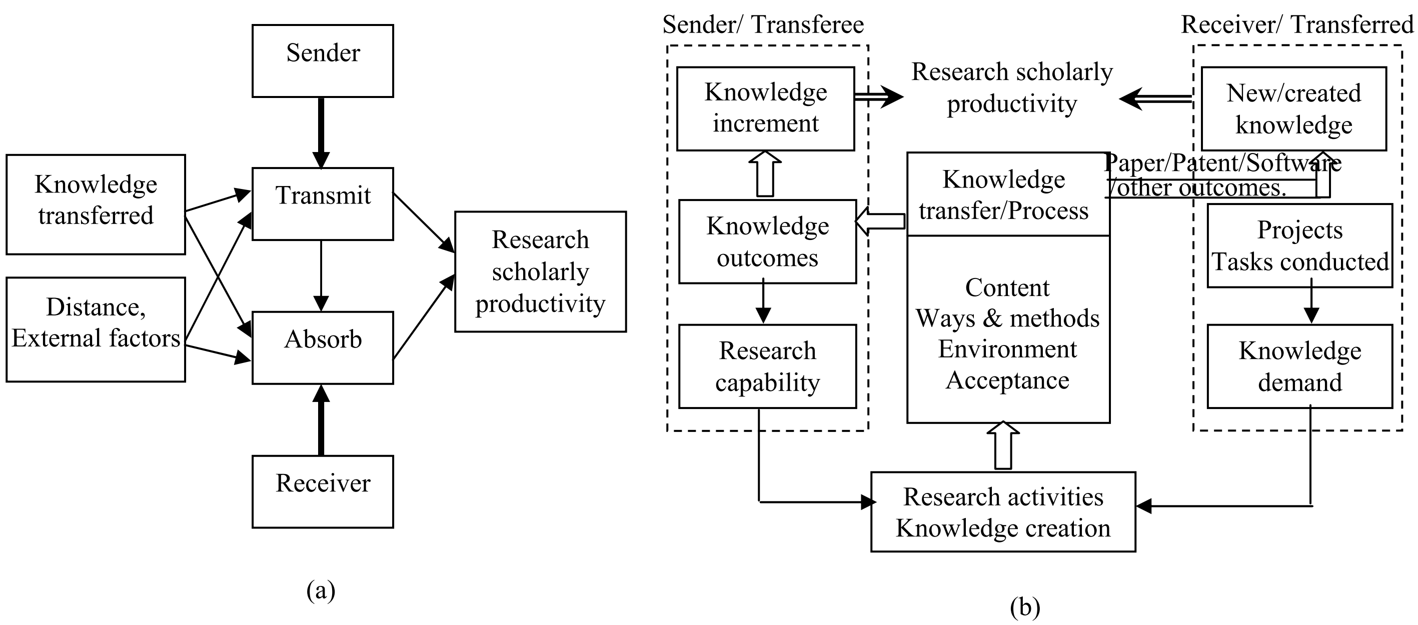

Figure 1 knowledge transfer

From the view of knowledge transfer, research scholarly productivity of universities here defines as capability to achieve knowledge creation and knowledge increment through research activities for relative stakeholders. It means not only competency for knowledge production (static outcomes), but also for academic course (dynamic process). University faculty and professional research staff act as knowledge senders, who attain knowledge advantages through research scholarly activities, while other parties outside of universities (industry, government, scholars) are eager for such knowledge, thus transfer of academic knowledge from university to outside is urged between these different parties. The knowledge receivers probably involve collaboration parties, publication readers, research work occupiers, project consigners and any party who absorbs knowledge outcomes from university research activities. So, university research activities imply fundamental elements of knowledge transfer: knowledge, sender, receiver, interaction between the knowledge transferee and the transferred (see Fig.1b).

Therefore, university research scholarly productivity implies the capability to make knowledge contribution and achieve knowledge increment for the relative participants through scholarly research activities, and the extent of thus capability as well as its explicit performance is mainly determined by two important processes: knowledge creation /research work, and absorption of knowledge outcome. Meanwhile, those two processes are greatly influenced by knowledge characteristics (e.g., complexity), knowledge distance and disparities between the transferee and transferred participants, communication and interactive environment, interaction activities, research capability of the knowledge transferee, and so on. Based on discussion of the relevant literature and findings of past studies, a conceptual model for research scholarly productivity of universities are proposed, from the perspective of knowledge transfer (see Fig.2).

Moreover, 13 hypotheses are suggested in Fig.2 as follows:

H1: Complexity of knowledge has a negative effect on research activities, i.e. academic process, of the knowledge senders (mainly research faculty in universities).

H2: Complexity of knowledge has a negative effect on research outcomes absorption of the knowledge receivers.

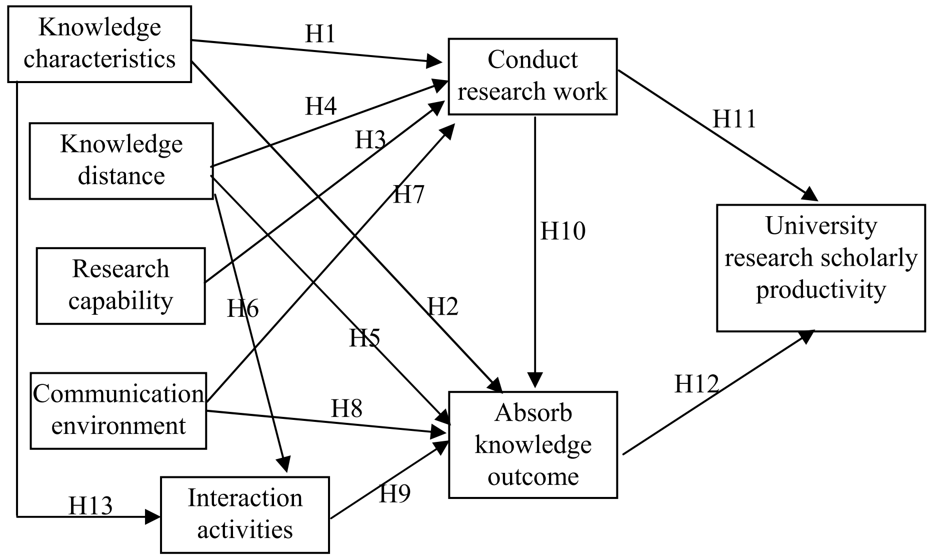

Figure 2 a conceptual model for research scholarly productivity

H3: The higher capability to conduct research activities, the better performance the research faculty in universities have, the easier goes the research process.

H4: Knowledge distance and disparities between relative participants or parties of university research activities influence the process of research conduction and knowledge transmission.

H5: Knowledge distance and disparities between relative participants or parties of university research activities influence the process of absorption of knowledge outcomes by the research receivers.

H6: The narrower knowledge distance between relative participants or parties of university research activities, or the more similar knowledge background they have, the more smoothly and easily interaction between them goes.

H7: The better interactive environment and communication, more helpfully promote the research faculty in universities to carry on the research activities and ensure the proper research progress.

H8: The better interactive environment and communication, more helpful to absorb knowledge outcomes from the relative research activities by the knowledge receivers.

H9: The smoother and better the interactions between the knowledge sender and receiver through research scholarly activities (i.e. relative participants or parties of university research activities), the better effect of knowledge absorption.

H10: Research work or knowledge transmission process executed by the research faculty in universities has a positive effect on knowledge absorption by research outcome users/receivers.

H11: Research work or knowledge transmission process executed by the research faculty in universities has a positive effect on research scholarly productivity of university.

H12: Absorption of knowledge outcome/ research production has a positive effect on research scholarly productivity of universities.

H13: Complexity of knowledge has an influence on interaction between relative participants or parties of university research activities.

3. Data and methodology

In this study individual faculty members were the unit of data analysis. First, a questionnaire about the elements (variables) proposed in the above conceptual model (see Fig.2) was designed and sent to sample faculty. Six items were proposed to measure the variable “knowledge characteristics (mainly about complexity)”, nine items for the variable “research capability”, three for “knowledge distance”, seven for “communication environment”, five for “interaction activities”, ten for the process “conduct research work”, five for the process “absorb research outcomes”, and seven for “research scholarly productivity”. Survey participants were asked to rate the measuring items of each variables according to their own research experience, and ratings were given on a 5-point scale representing different levels: 1=totally disagree, 2=not agree, 3=generally agree, 4=agree, 5=highly agree.

The sample included 103 full-time faculty, mostly affiliated to seven universities (Zhejiang University, Fudan University, Shanghai Jiaotong University, Nankai University, Harbin University of Technology, Donghua University, and Tsinghua University, etc.). 94 questionnaires were completed satisfactorily for a weighted valid response rate of 91.3%, and 67 were done by the male teachers and 27 by the female. 58.5% of them work in the domain of natural science and other 41.5% in the domain of social science; 49 teachers are titled as professor (52.13%), 22 as lecture (23.40%) and 23 as associate professor (24.47%).

Second, statistical analysis was made to confirm the rationality of each element (variable) and construct validity. While screening out right measuring items and achieving right quality of the items, some tests were made: Corrected-Item Total Correlation (CITC, demanded to be higher than 0.5), Cronbach's α coefficient (≥0.7), single dimensionality by factor analysis (demanding factor load coefficient more than 0.5) to ensure strong reliability, convergent and discrimination validity. The statistical results (after the measuring items were corrected, and CITC≥0.5) were listed in TABLE 1.

TABLE 1 Reliability and Convergent Validity of Variables

variables	Number of Items (adjusted)	Cronbach α	Kaiser-Meyer-Olkin （KMO）	R^2	Bartlett χ^2	Sig.
knowledge characteristics (complexity)	5	.7236	.655	48.873%	113.551	.000
research capability	9	.890	.908	56.380%	374.274	.000
knowledge distance	2	.628	.538	73.109 %	21.988	.000
communication environment	6	.861	.845	59.680 %	243.066	.000
interaction activities	5	.839	.828	61.371 %	180.874	.000
conduct research work	10	.917	.909	57.440 %	547.523	.000
absorb research outcomes	4	.732	.702	56.525%	87.049	.000
research scholarly productivity	7	.885	.876	59.472%	315.347	.000

Later, Correlation analysis and Regression (OLS) were taken to reveal the important determinants of research scholarly productivity of university from the perspective of knowledge transfer, and explore the effect of these determinants exerted on the research scholarly productivity. Considering the length of paper, the complete statistic processes were omitted here. The correlation coefficients were shown as follows (see TABLE 2).

TABLE 2 Correlations between the Measured Variables (Pearson)

variables	knowledge characteristics	research/ transfer capability	knowledge distance	communication environment	conduct research work	interaction activities	absorb research outcomes	research scholarly productivity
knowledge characteristics (complexity)	1.00							
research/transfer capability	0.31***	1.00						
knowledge distance	0.16	0.24***	1.00					
communication environment	0.37***	0.48***	0.28***	1.00				
conduct research work	0.38***	0.62***	0.40***	0.74***	1.00			
interaction activities	0.30***	0.17	0.33***	0.32***	0.36***	1.00		
absorb research outcomes	0.31***	0.41***	0.41***	0.37***	0.58***	0.40***	1.00	
research scholarly productivity	0.37***	0.46***	0.25**	0.37***	0.56***	0.27***	0.58***	1.00

*** Correlation is significant at the 0.01 level (2-tailed), p<0.01

** Correlation is significant at the 0.05 level (2-tailed), p<0.05

It was found from TABLE 2 that (1) the variable "research scholarly productivity" has positive correlativity with other seven variables with significance $p<0.01$ except the significance level related to "knowledge distance" ($0.01<p<0.05$); (2) the two process of knowledge transfer: conduct research work and absorb research outcomes, hold highest correlativity, respectively 0.56 and 0.58—which can provide preliminary confirmation of theoretical hypotheses H11 and H12; and (3) the correlation coefficients (Pearson) between "research scholarly productivity", "conduct research work", "absorb research outcomes" and the other five variables, reveal the corresponding variables involved in hypotheses H1~H13 does exist have correlativity.

In order to explore and determine the statistical relationship between the influential factors (of knowledge transfer) and the procedural and sequential variables (of university scholarly research), we made Regression analysis (OLS): respectively took “conduct research work”, “absorb research outcomes” and “research scholarly productivity” as dependent variables, chose corresponding elements as independent variables according to the conceptual model (see Fig. 2) and 13 hypotheses proposed, and then made regression analysis (Stepwise). The results were shown as follows (see TABLE 3).

TABLE 3 Regression Analysis (Stepwise)

Dependent variables	Independent	Unstandardized Coefficients	Standardized Coefficients	t	Sig.	multicollinearity Diagnosis Tol.	VIF	F	R^2	$\overline{R^2}$
(1) conduct research work	(constant)	0.253		0.820	0.414			58.30	0.66	0.65
	research capability	0.343	0.320	4.540	0.000	0.761	1.314			
	communication environment	0.451	0.535	7.509	0.000	0.743	1.346			
	knowledge distance	0.164	0.173	2.680	0.009	0.907	1.103			
(2) absorb research outcomes	(constant)	1.378		4.238	0.000			27.73	0.38	0.37
	conduct research work	0.484	0.499	5.637	0.000	0.871	1.149			
	interaction activities	0.144	0.223	2.514	0.014	0.871	1.149			
(3) research scholarly productivity	(constant)	0.000		0.000	1.000			27.76	0.48	0.46
	absorb knowledge outcomes	0.385	0.385	4.102	0.000	0.655	1.528			
	conduct research work	0.285	0.285	2.936	0.004	0.613	1.630			
	knowledge characteristics (complexity)	0.186	0.186	2.225	0.029	0.824	1.213			

Note: $p < 0.05$. Tol. is abbreviation of tolerance, VIF is shorted for variance inflated factor. In general, if tolerance (0.6~1) is more approaching 1 and VIF far less than 10, there is no or weak multicollinearity..

Through checking the values of Tolerance and VIF listed in TABLE 3, we found the independent variables that have been remained in each regression analysis hold no multicollinearity. While examining the values of t, F and p, we can see the regressive effect is significant, i.e., regression of relative variables has passed the statistical tests. Therefore, we can get following equations:

(1) Conduct research work

= research/transfer capability×0.320 + communication environment×0.535 + knowledge distance×0.173

(2) Absorb research outcomes

= conduct research work/trarnsmit×0.484 + interaction activities×0.144 + 1.378

(3) Research scholarly productivity

=conduct research work/trarnsmit×0.285 + absorb research outcomes×0.385 + knowledge characteristics/complexity×0.186

Equation (1) shows only research (transfer) capability, communication environment, knowledge distance influence the process of "conducting research work" (i.e. transmit knowledge), and exert positive effects. Thus, the hypotheses of H3, H4 and H7 have been supported; while H1 hasn't been verified statistically (the variable "knowledge characteristic" was deleted during the regression analysis with the method of Stepwise).

Equation (2) shows interaction activities and the process of "conducting research work" (i.e. transmit knowledge) affect the process of "absorb research outcomes" of the research knowledge receivers, which reveals H9 and H10 are supported, while H2, H5 and H8 are not verified.

Equation (3) shows research scholarly productivity is determined by the two processes of research knowledge transfer: "conduct research work", and "absorb research outcomes". This reflects H11 and H12 have been successfully verified. However, we got an unexpected result that "knowledge complexity" takes a direct effect on "research scholarly productivity", here we name it H14.

In sum of the above results, we can put forward the regression model for research scholarly productivity of universities from the perspective of knowledge transfer (see Fig. 3).

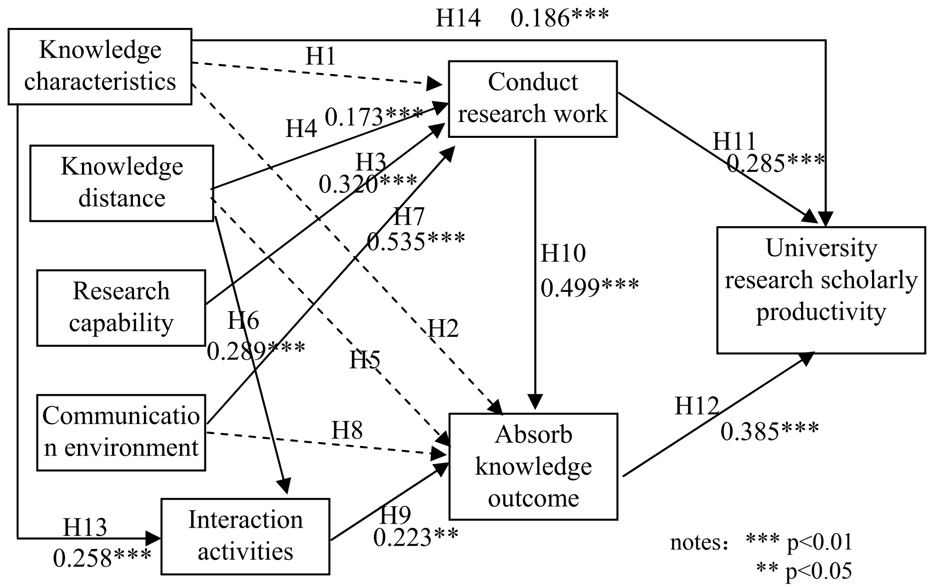

Figure 3 the regression model for research scholarly productivity of universities from the perspective of knowledge transfer

On the base of the results of regression analyses, we calculated the direct, indirect and total effects that relative variables put on research scholarly productivity of universities (see TABLE 4).

As for the process of “conduct research work”, communication environment plays greatest direct effect on it (0.535, see TABLE 4), and research capability does second greatest influence (0.320). That may suggests university faculty need essential conditions and atmosphere for proper communication and cooperation when they engage in research work.

As for the process of “absorb research outcomes”, direct influences are exerted by the process of “conduct research work” (0.499) and “interaction activities” (0.223), while indirect effects are put by “knowledge distance” (0.151) and “knowledge characteristics” (0.058). It’s obviously faculty’s research process plays the most important part for others to absorb knowledge from research outcomes.

TABLE 4 Direct, Indirect and Total effects

Dependent Variable	Relative Variables	Direct Effect	Indirect Effect	Total Effect
Conduct research work (Transmit knowledge)	Research capability	0.320	0.000	0.320
	Knowledge distance	0.173	0.000	0.173
	Communication environment	0.535	0.000	0.535
Absorb research outcome (Accept knowledge)	Conduct research work	0.499	0.000	0.499
	Interaction activities	0.223	0.000	0.223
	Knowledge characteristic (complexity)	0.000	0.058	0.058
	Knowledge distance	0.000	0.151	0.151
Research scholarly productivity of universities	Knowledge characteristic (complexity)	0.186	0.022	0.208
	Conduct research work	0.285	0.192	0.477
	Absorb research outcome	0.385	0.000	0.385
	Research capability	0.000	0.153	0.153
	Communication environment	0.000	0.345	0.345
	Interaction activities	0.000	0.086	0.086
	Knowledge distance	0.000	0.025	0.025

As for “research scholarly productivity”, 1 variable (the process of “absorb research outcomes”) exerts direct effect on it, 4 variables put indirect effects, and 2 variables take both direct and indirect effects. From the view of direct effect, the process of “absorb research outcomes” (0.385) contributes most to “research scholarly productivity”, which probably implies knowledge contribution deriving from faculty’s research requires more of the receivers’ assimilation and endeavor rather than the senders’ engagement.

From the view of total effect, the process of “conduct research work” (0.477) has the first greatest influence on “research scholarly productivity” and 23.9% greater than the process of “absorb research outcomes” (0.385, ranked the second greatest) has. Hence, it can be inferred that successful knowledge transfer through research scholarship requires dedication of relative participants, especially the knowledge sender and receiver.

Meanwhile, it is worthy of notice that, though “knowledge characteristics (complexity)” doesn’t pose direct effect on the process of either “conduct research work” or “absorb research outcomes”, it does exert direct influence on “research scholarly productivity” (with direct effect 0.186 and total effect 0.208). This is an unexpected finding, and the probably explanation is: the more complex and implicit the knowledge is, the more difficult to achieve and the more demand for such knowledge, so that arise more opportunities for cooperation and consignation of research programs, which eventually implemented through university faculty’s endeavor and transfer of knowledge outcomes, and hence the research scholarly productivity of universities are improved. It probably can be presumed that cooperation or consignation of research programs mainly are determined by the extent how the knowledge supply and demand match.

4. Findings and interpretation

According to statistical results, most variables had high reliability and construct validity except the variable “knowledge distance” (Cronbach α=.628, KMO=.538) was comparatively low but still in acceptable range. That means the questionnaire was proper for this study. We also arrive at following findings:

Finding 1: Nine hypotheses are supported by statistical results except H1, H2, H5 and H8 (see Fig.3). An exploratory outcome (H14) is unexpectedly attained: complexity of knowledge poses a positive effect on research productivity of universities. This might be due to the university faculty’s preference to challenges.

Finding 2: Considering total effects put on variables “conduct research work”, “absorb research outcome”, and “research scholarly productivity”, we discover:

(1) “Research capability”, “knowledge distance” and “communication environment” exert direct effect on the process of “conduct research work”, and “communication environment” exhibits the greatest positive

influence, which may imply university faculty need excellent communication atmosphere to tap out their research capability.

(2) “Knowledge distance”, “knowledge characteristics /complexity”, “communication environment” and the process of “conduct research work” have direct or indirect influence on “absorption of knowledge outcome”, and “conduct research work” process puts the largest effect. This requires research performance and its process should be given emphasis so that to stimulate effectiveness of knowledge transfer.

(3) Three variables “conduct research work” process, “absorb research outcome” and “knowledge characteristics (complexity)”, exert direct and positive influences on “research scholarly productivity”, and other four variables give indirect effects. However, “conduct research work”(0.477) and “absorb research outcome” (0.389) hold the first and second greatest total effect, from which it can be inferred high research productivity need right cooperation of relative parties, that is to say, university research faculty (knowledge sender) and research outcome absorber (knowledge receiver), with right match of knowledge supply and demand.

5. Conclusions

This study has discussed a conceptual model for university research scholarly productivity from perspective of knowledge transfer, and made an empirical analysis to confirm the determinants and their effects. The statistical results show: research activities held by university faculty plays the most important part on research productivity; absorption of knowledge outcome is the second important, which implies the performance of the knowledge sender and receiver directly and greatly determine the level of research productivity. Meanwhile, university faculty usually is eager to grasp open opportunities and difficult challenges: the more complex the knowledge, the stronger willing to transfer knowledge.

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