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Research funding, time allocation and academic productivity: Evidence from university faculties in China

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Abstract

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Keywords: Research funding; Funding sources; Academic productivity

1. Introduction

As universities develop "triple helix" relationships with the government and industry, a growing number of university research activities are steered by grants from multiple agents (Etzkowitz & Leydesdorff, 2000). China's government used to play a major role in financing higher education research. According to the R&D statistics, public funds account for about 60% of the R&D budget share for higher education institutions in China, and the proportion is even higher in selective universities. More recently, university research becomes more resource-intensive while public budgets for university are limited, therefore, there is an increasing awareness of the importance of reforming the research funding system. On the one hand, there is a need to assess the effectiveness of public funding and optimize the funding mechanisms. On the other hand, enlargement of external funding sources for universities is put on agenda. Policy makers in China have been pushing for the cooperation between university and industry. Some platforms are established, including the industry–university cooperative office, technology transfer centers, etc.(Guo, 2013). Government-sponsored projects, such as the Plan 2011, have also been implemented to strengthen industry–university bonds. These policies are expected to enhance the academic excellence of the university research in China.

A considerable account of research has focused on the relationship between research funding from different sources and academic productivity. Many studies have found public funding is positively related to academic productivity (Carayol & Matt, 2006, Hottenrott &Thorwarth 2011; Payne & Siow, 2003). However, little is known about the mechanism through which public funding influence academic productivity. On the other hand, there are controversies on the relationship

between industrial funding and academic performance. Some scholars point out that science may benefit from the initiation of new ideas from industry or the use of industry funds for hiring additional researchers and investment in lab equipment (Siegel et al. 1999; Hottenrott & Lawson, 2014). However, there are concerns that a researcher confront with a tradeoff between doing research for non-public sectors and publishing due to the time constraint (Manjarre´s-Henrı´quez et al., 2009).

Time spent on research is an important mediator connecting research input and academic output. Understanding the inputs that allow university faculties to make the most of their time is a critical question to enhance academic productivity (Bellas & Toutkushian, 1999; Rouser & Tabata, 2010). However, most of previous studies only focus on the direct effect of input and academic outcomes, few studies have paid attention to the mediating effect of research time that explain the relationship between financial inputs and academic productivity.

This study intends to examine the influence of public and non-public funding on faculty's academic productivity. Especially, we concern faculty's allocation of research time, which is assumed to mediate the association between research funding and academic productivity. Using a survey on academic faculties from 24 universities in China, we take use a four steps approach proposed by Baron and Kenny (1986) to investigate the effect of research funding and the mediating role for research time on academic productivity. The results are expected to shed some light on the process of academic production and provide policy implications for reforming the research finance system.

The paper is organized as follows. In Section 2, we review the literature about the effects of funding on academic productivity and studies on research time allocation. Section 3 describes the data and empirical strategy. Section 4 presents the results, followed by Section 5 that concludes and discusses the implication of this research.

2. Literature Review

According to the literature review by Carayol and Matt(2006), the scientific productivity generally rests on two foundations: 1) Individual characteristics, such as age, gender, position in the institution, scientific discipline (Levin & Stephan 1991; Lehman, 1960; Xie & Shauman, 2003), and 2)collective factors, including the prestige, peer effects, research funding, and scale of the research institution or group (Bonaccorsi & Daraio, 2002; Gulbrandsen & Smeby, 2005; Hottenrott & Lawson, 2014; Manjarrés-Henríquez et al., 2009; Payne & Siow, 2003).

Research funding is considered as an important factor explaining research productivity. It is acknowledged that not only size of funding, but also sources of funding can be critical factors affecting academic productivity (Carayol & Matt, 2006). Most of researches find that public grants can increase research productivity (Carayol & Matt 2006; Hottenrott &Thorwarth 2011; Jacob & Lefgren, 2011; Payne & Siow ,2003). Hottenrott and Thorwarth(2011) use a sample of professors in science and engineering in Germany and find the share of public research grants has a positive and significant effect on publication output both in terms of publication count and citations per publication. Payne and Siow (2003) examine the impact of federal research funding on university-level research output in the US, in which they find that $1 million in federal research funding is associated with 10 more articles and 0.2 more patents. A few researchers point out that publicly funded research may "crowd out" the opportunities of collaborative innovation between higher

education and enterprises, as a result, reducing the academic productivity (Salter, et al., 2001; Carayol, 2003). In sum, most of previous studies are based on survey in developed countries, and little is known about the situations in developing countries as China. Moreover, there are different mechanisms to appropriate public research funding, such as competitive research grants, earmarked grants, etc. In-depth research is needed to identify the effectiveness of different funding mechanisms.

In the past decades, as universities witnessed greater industrial involvement in research, an increasing amount of studies have focused on the relationship between industrial funding and academic performance. Some scholars argue that non-public funding can not only be used to hire additional scientists who increase the overall research output for research(Azoulay et al., 2009), but also stimulate new research ideas that benefit scientific production (Godin & Gingras, 2000; Gulbrandsen & Smeby, 2005; Van Looy et al., 2004). On the other hand, some researchers show evidence of negative effects from industry sponsoring on the research results. One of the reasons is the restriction on disclosure result (Blumenthal et al., 2006; Czarnitzki et al., 2014). For example, Blumenthal et al. (2006) explore factors associated with data withholding in biomedical science in the U.S., and they find that participation in relationships with industry is one of the significant factors. Despite the problem of result disclosure, additional funding from industry may distort the incentives and reduce researchers' time spent on traditional academic work (Slaughter & Leslie, 1997). Some recent papers have noticed the "skewing problem" that higher budget share from industry could reduce publication output (Banal-Estanol et al., 2015; Hottenrott & Thorwarth, 2011). Hottenrott and Thorwarth's analysis (2011) shows that Germany professors in science and engineering publish less in subsequent years the higher the share of industry funds relative to their total budget. Banal-Estanol et al. (2015) take use of a panel of engineers employed at major UK universities, and they find that industry sponsorship is positively related to publication output only for low levels of funding, while hamper academic output at higher levels. In general, the influence of non-public funding on academic productivity is still inconsistent.

From existing studies, it is clear that there are different mechanisms that funding influences academic performance, and it is pertinent to look into the intermediate process of academic production. Time for research is recognized as a critical determinant of academic productivity (Bellas & Toutkoushian, 1999； Braham et al., 2014; Libaers et al., 2012). Bellas and Toutkoushian analyze data from the 1993 National Survey of Postsecondary Faculty (NSOPF-93), and find that Asian faculty spend an extremely high percentage of time in research and also produce higher outputs. Libaers (2012) find that scientists spending more time on research funded by federal grants and industrial contracts have higher propensity of being engaged in technology commercialization efforts.

There is a growing literature concerning time allocation of university faculty. It is found that time allocation is affected by a serial factors, including: 1) faculty characteristics such as age, gender, marital status, number of children, 2) career issues, such as academic field, tenure and promotion, administration issues and 3) university features such as research orientations and reward structure (Bellas &Toutkoushian,1999; Braham et al., 2014; Singell, Lillydahl & Singell ,1996; Walstad & Allgood , 2005). So far, however, few studies have examined the influence of funding on research time. A relevant study is conducted by Jensen et al.(2010). They develop a theoretical model of consulting which incorporates faculty decisions on the allocation of research time between their university lab and a firm's lab. Their analysis indicate that an increase in government funding or industrial funding decrease consulting time, which lead to increase in research time. Unfortunately,

few empirical studies have examined the relationship between funding and research time, and little is known about whether research time mediate the relationship between research funding and academic productivity.

Our study extends previous work by examining the relationships between research funding, research time and academic, focusing on the mediating effect of research time. Based on previous literature, we formulate the following hypothesis:

H1: Faculties receiving more public funding have more academic output;

H2a: Faculties receiving more non-public funding have more academic output;

H2b: Faculties receiving more non-public funding have less academic output;

H3: Faculties receiving more public funding spend more time on research;

H4: Faculties receiving more non-public funding spend more time on research;

H5: Research time mediate the relationship between public funding and academic productivity;

H6: Research time mediate the relationship between non-public funding and academic productivity.

3. Method

3.1 Data

The sample of this study is drawn from the Changing Academic Profession in Asia (APA) survey conducted by Peking University in 2012. The APA survey applied a stratified sampling strategy in 30 public higher education institutions in China. Of the 3,000 academics contacted to complete the questionnaire, 2,807 responded, resulting in a response rate of 93.6%. The full sample of the APA survey contains academics in different disciplines. We select 1,092 samples in Science and Engineering(S&E) fields for the analysis because we intend to examine the effect of non-public funding, while S&E faculties cooperate more with industry and other non-public sectors compared with those in the fields of humanity and social science.

In order to construct the instrumental variables to deal with the endogeneity problem, we collect data from other sources. The Natural Science Foundation of China (NSFC) reports the average number of NSFC government projects granted from 2007 and 2009. It is supposed to influence the public research grant between 2010 and 2012, thus we take it as instrument for public funding. In addition, we use the China National Knowledge Infrastructure (CNKI), one of the largest publishes databases containing Chinese e-journals, to gather the publication data of the university to which a faculty affiliated. This indicator reflects the institution academic productivity that may affect the amount of public funding. For the instrument of non-public funding, we collect data from the China's R&D Statistics Compilation in 2009 (CRDSC: 2009), which contains information about the industrial R&D expenditure per capital for higher education sectors in each province. Another instrument of non-public funding is the patent amount of the university, which is obtained from the State Intellectual Property Office. These instruments are merged with the APA dataset by matching the location and code of the university to which a faculty affiliated.

Table 1 presents the summary descriptive statistics for the variables used in our analysis. The academic output is measured by the number of articles published during 2010-2012. We distinguish between two types: articles published in domestic journals and those published in international

journals. The latter are reviewed and acknowledged by international experts, thus considered as academic output of higher quality. The average number of paper published in domestic journals is 5.16, compared with 3.49 in international journals.

The central independent variable in this study is research funding. Respondents were asked the amount of research funding received from different sources. We categorize two types of funding: public funding from central and local government, and non-public funding from industry, non-profit organizations, and international organizations. The average public funding received is ￥191,000, more than the average amount of non-public funding(￥66,700). The mediating variable we focus in this study is the time spent on research per week. The S&E faculties in our sample spend about 16 hours a week on research.

Table 1 Summary statistics of variables

Variables	**Obs.**	**Mean**	**Std. Dev.**	**Min**	**Max**
Domestic articles	914	5.16	6.76	0	100
International articles	766	3.49	6.37	0	67
Non-public funding(￥10,000)	1092	6.67	49.44	0	1300
Public funding(￥10,000)	1092	19.10	76.78	0	1450
Research time (hrs/week)	996	16.04	13.64	0	82
Controls					
Age	1,040	38.38	7.32	26	66
Gender: Female (%)	1,076	44.70			
Academic position	1,036				
Assistant professor (%)		45.56			
Associate professor (%)		38.32			
Professor (%)		16.12			
University type	1,092				
Less prestigious university (%)		71.06			
Prestigious university (%)		19.87			
Most prestigious university (%)		9.07			
Instrumental variables					
Average NSFC grants(2007-2009)	1092	83.48	142.32	1	605
Articles published at institutional level	1092	3181.84	3523.98	320	15413
Patent received at institutional level	1092	3.67	2.08	0.41	7.562
Industrial R&D expenditure per capital for HE(￥10,000)	1092	110.63	248.52	0	1148

To examine the relationship between funding, research time and academic productivity, several factors are considered as controls, including the age, gender, academic position, and university type. The sample consists of faculties with an average age of 38. Among them, 44.70% are female, and 45.56% are in entry-level position. The universities are categorized into three types: the most prestigious universities are funded by Project “985”, aiming to develop the world class universities in China; the prestigious universities are funded by Project “211”, which targets high-level research universities in China. These two types of universities receive large amount of special funding from the central government. The majority of our sample are from the third type of institution, less prestigious university, which is mainly financed by local government.

3.2 Empirical strategy

The aim of the study is to determine the relationships between research funding, time on research and academic productivity. The focus is to identify the mediating effect of research time that might account for the relationship between funding and academic productivity. To test the mediating effect of research time, we perform analysis using a four step strategy proposed by Baron and Kenny(1986). We first access the direct effects of research funding on academic productivity. Next we examine how research funding affects research time. The third step is to explore the impact of research time on academic productivity. The final step is to test whether research time mediate the influence of research funding on academic productivity.

In the first step, the dependent variable is number of published articles in domestic and international journals. These variables are count measures, which takes only non-negative integer values and are skewed with high proportions of the responses being "0". Poisson model can be used to estimate a non-negative count measure, but it requires the variance of the dependent variable to being equal to its mean (Demidenko, 2013). However, our dependent variables suffer from the over-dispersion. For example, the mean of domestic publication is 5.16 while the variance is 45.70. A solution for the problem can be found in a negative binomial regression, which is used to account for over-dispersion(Baba et al., 2009). The basic specification of the model is as follows:

$$Step\,1: nb(Y_{ij}) = f(F_{ij}, X_{ij}, \varepsilon_{ij}) \tag{1}$$

where Y_{ij} indicates the amount of published articles. F_{ij} represents the average amount of public or non-public funding received during the past three years, taking a logarithmic form. X_{ij} are taken as controls in the model, including gender, age, discipline, academic position and the type of university by which an academic was employed. ε_{ij} is the error term.

In the second step, following the research by Link et al. (2007), we specify a regression of faculty research time as a function of research funding, faculty characteristics, and university characteristics. We are especially interested in the effects of public and non-public funding research funding, after controlling for individual and institutional characteristics. Our regression approach is an OLS regression of the following equation

$$Step\,2: T_{ij} = f(F_{ij}, X_{ij}, \upsilon_{ij}) \tag{2}$$

where T_{ij} indicates the amount of time spent on research. F_{ij} represents the public or non-public funding received during the past three years. X_{ij} are the same control variables in equation (1). υ_{ij} is the error term.

In the third step, we employ negative binominal model to test the relationship between research time and academic productivity, controlling for individual and institutional characteristics. The regression in the final step involves both research funding and research time. According to Baron and Kenny(1986), a mediation occurs when both the predictor and mediator are related to the outcome. In Eq. (4), if research funding is no longer significant when research time is controlled, the result supports full mediation of research time on the association between funding and academic productivity. If both research funding and research time are significantly predict academic output, then we could infer to the impartial mediation. The model in the last two steps are specified below:

$$Step\,3: nb(Y_{ij}) = f(T_{ij}, X_{ij}, \varepsilon_{ij}) \tag{3}$$

$$Step\,4: nb(Y_{ij}) = f(F_{ij}, T_{ij}, X_{ij}, \varepsilon_{ij}) \quad (4)$$

The main econometric concern is the endogeneity problem, which means some unobserved factors that determine research funding and academic productivity may be correlated. For example, the scientific output depends on some inherent characteristics of the researchers, such as the motivation and ability, which also affect the amount of research funding one received. While we try to control for most of the factors that might affect the academic productivity, it is inevitable to have omitted variables in our data. This creates the problem of endogeneity that may over-estimate the effect of non-public funding.

To deal with the potential endogenous problem, we estimate our model using a two-stage instrument variable (IV) strategy. Instrumental variables can directly explain research funding, but are uncorrelated with the unobserved items of academic productivity. Some researchers have adopted aggregate data as instruments, such as the average amount of grants by scientists per university (Beaudry & Allaoui, 2012), the university alumni representation on U.S. congressional appropriations committees (Payne & Siow, 2003). Following previous studies, we also instrument research funding using aggregate data at regional and institutional level. Two variables are selected as instruments for public funding. One is the NSFC grants received by the institution during 2007 and 2009, and another is the amount of articles published by the university to which a faculty affiliated. Both factors reflect the academic competence of the university, which may explain public funding received afterwards, but have no direct relationship with individual's ability or motivation. As for non-public funding, we apply a regional level instrument, the average regional industrial R&D expenditure per capital for higher education. It is assumed that university-industry R&D collaboration does not affect individual research performance, but has positive influence on an academic's likelihood to access to non-public funding. Another instrument is the patent number received at institutional level during the past three years. This factor reflects the university's excellence in commercializing academic research, which is supposed to increase the individual's ability to obtain non-public funding.

Another issue we have to deal with is that a number of respondents have not received research funding, so funding is obviously censored and may cause inconsistent estimation. Vella (1993) suggests a two-step procedure for obtaining consistent estimates for censored endogenous variable. The first step involves estimating a Tobit model for the endogenous variable and getting the generalized residual. It comprises additional information on funding that is not explained by the exogenous factors. Then the generalized residual enter as explanatory variable into the model on scientific output. If the coefficient on the generalized residual is statistically significant, it indicates that the public or non-public funding is endogenous (Wooldridge, 2002; Terza, et al, 2008).

4. Results

4.1 The effect of research funding on academic productivity

We first estimate separate productivity functions for the number of papers published in domestic journals and international journals. Table 2 presents the negative binomial regression of the effects of non-public funding on scientific output, controlling for an academic's gender, age,

academic position and university type. The regressions in Column (1) and (3) of Table 2 evaluate the effect of non-public funding without considering the endogeneity. To account for the potential endogeneity of research, we adopt two stage instrument variable regression. The first stage regressions show a significant positive relationship between each instrumental variable and the amount of research funding, allowing us to reject the hypothesis of weak instrument estimator that may lead to large asymptotic bias. In Column (2) and (4) of Table 2, we report the results from the second stage regression. The Durbin-Wu-Hausman test confirms the endogeneity of both public and non-public funding concerning the amount of domestic articles, thus IV model in Column (2) of Table 2 is preferred. On the other hand, the IV model in Column (4) is rejected because the coefficient of the generalized residual is not significant.

Table 2 Regression of effects of research funding on academic productivity

	Domestic article		**International article**	
	(1) NB	(2) IV	(3) NB	(4) IV
Ln(Non-public funding)	0.016***	0.008+	-0.001	-0.007
	(0.004)	(0.004)	(0.005)	(0.006)
Ln(Public funding)	0.014***	0.011***	0.025***	0.022***
	(0.003)	(0.003)	(0.004)	(0.005)
Female	-0.022	-0.006	-0.295**	-0.272***
	(0.065)	(0.065)	(0.095)	(0.095)
Age	0.015*	0.016*	-0.045***	-0.042**
	(0.006)	(0.006)	(0.009)	(0.009)
Academic position(Assistant professor as reference)				
Associate professor	0.156+	0.167*	0.373**	0.355**
	(0.083)	(0.084)	(0.122)	(0.123)
Professor	0.342**	0.250+	0.975***	0.922***
	(0.125)	(0.129)	(0.187)	(0.192)
University type (Less prestigious university as reference)				
Prestigious university	-0.046	-0.047	0.351***	0.328
	(0.081)	(0.081)	(0.117)	(0.117)
Most prestigious university	-0.033	-0.256+	1.074***	0.921
	(0.112)	(0.119)	(0.143)	(0.151)
Generalized residual_non-public		0.014***		0.009
		(0.004)		(0.006)
Generalized residual_public		0.000*		0.000
		(0)		(0)
Constant	1.307***	1.096***	2.556***	2.340***
	(0.228)	(0.234)	(0.336)	(0.352)
Nb observations	855	824	727	702
LR chi2	134.69***	149.18***	200.90***	194.79***

Note: *** p<0.1%， **p<1%， *p<5% ，+p<10%;

In Column (2), most of the independent variables are insignificant despite age and academic position. The results show that elder and senior faculties tend to be more productive in domestic journals. The independent variable we focus in our study is research funding. The result show that

faculties receiving more public funding publish more domestic papers (Coeff.$_{public}$=0.011, p<0.001), confirming Hypothesis 1. The effect of non-public funding on domestic publication is also positive (Coeff.$_{public}$=0.008), although it is only significant at the 0.1 level.

In Column (3) of Table 2, most of the independent control variables show significant effects as hypothesized. An academic who is female, in entry-level position, employed in less-selective university and received less public funds tends to publish fewer papers in international journals. Contrary to previous literature, the international publications decline with age, since the young academics in China are usually more internationalized than the older ones. As for the effect of research funding, we find a significant positive effect of public funding on international publication after controlling for all other factors, (Coef.$_{international}$=0.025, P-value<0.001); however, the effect of non-public funding is insignificant. The result leads to reject Hypothesis 2a that faculties receiving more non-public funding will have more academic publication.

4.2 Research time as mediator of research funding on academic productivity

To analyze the mediation effect, we first regress research time on funding and all other controls. Table 3 shows the regression results of estimating Eq. (2)-(4). The first column show the regular OLS regression without considering the endogeneity of research funding, while Column 2-4 applied two stage IV model to deal with the potential endogenous problem. In the second stage, we use the Durbin-Wu-Hausman test to find that each coefficient of the generalized residual in the first stage regression is significantly different from zero ($F_{resid\_non\text{-}public}$ =15.47, p=0.0001; F_{resid_public}=6.49, p=0.011), confirming the endogeneity of research funding concerning the amount of research time. Therefore, the regression results in Column (2) are preferred. We find that faculties receiving more public funding devote more time on research (Coeff.$_{public}$=0.153, p<0.01), supporting Hypothesis 3. The influence of non-public funding on research is positive without considering the endogeneity in Column (1), however, after controlling for the endogenous part, we find that faculties obtaining more non-public funding do not allocate more hours to research. Therefore, we reject Hypothesis 4 that non-public funding increase research time

To further investigate the mediating effect of research time, we conduct a regression to assess whether research time increase academic output. The results are presented in Column (3) and (5) of Table 4. As we expected, faculties devoting more time on research have more publications in both domestic and international journals. In the third step, we include both research time and research funding into the negative binominal model estimated for academic productivity. The results are presented in Column (4) and (6) of Table 3. In Column (4), it is found that both funding and research time have significant positive influence on domestic articles (Coeff.$_{PubFund\_domestic}$=0.014, p<0.001; Coeff.$_{time\_domestic}$=0.007, p<0.01), supporting partial mediation of research time on the relationship between pubic funding and publishing domestic articles. Non-public funding shows positive effect on domestic publication (Coeff.$_{Non\text{-}pubFund\_domestic}$=0.01, p<0.05), but it's influence does not mediated through faculty's time on research, since we find no significant effect on research time.

The results in Column (6) also confirms the partial mediating role of research time that explain the positive influence of public funding on international publication (Coeff.$_{PubFund\_international}$=0.026, p<0.001; Coeff.$_{time\_international}$=0.022, p<0.001). However, we find no significant influence of non-public funding on researcher's academic productivity in international journals. In sum, the results support Hypothesis 5 but reject Hypothesis 6. Research time mediate the relationship between

public funding and academic productivity, but is not affected by non-public funding.

Table 3 Regression of mediating effects of research time on research productivity

	Research time		Domestic article		International article	
	(1)	(2)	(3) NB	(4 IV	(5) NB	(6) NB
Ln(Non-public funding)	0.122*	-0.008		0.010*		-0.006
	(0.054)	(0.075)		(0.004)		(0.005)
Ln(Public funding)	0.168***	0.153**		0.014***		0.026***
	(0.041)	(0.086)		(0.003)		(0.005)
Female	-2.23**	-2.101*	-0.065	0.002	-0.221*	-0.190*
	(0.861)	(0.868)	(0.066)	(0.066)	(0.097)	(0.096)
Age	-0.233**	-0.218**	0.010	0.017**	-0.053***	-0.043***
	(0.081)	(0.082)	(0.006)	(0.006)	(0.009)	(0.009)
Academic position(Assistant professor as reference)						
Associate professor	1.143	1.274	0.207*	0.073	0.521***	0.349**
	(1.095)	(1.11)	(0.082)	(0.084)	(0.12)	(0.122)
Professor	4.154*	3.747*	0.487***	0.177	1.225***	0.864***
	(1.706)	(1.756)	(0.122)	(0.13)	(0.179)	(0.185)
University type (Less prestigious university as reference)						
Prestigious university	2.330*	2.564*	0.039	-0.012	0.240*	0.216+
	(1.074)	(1.069)	(0.083)	(0.082)	(0.117)	(0.116)
Most prestigious university	11.204***	9.347***	0.071	-0.261*	0.969***	0.835***
	(1.574)	(1.619)	(0.119)	(0.121)	(0.148)	(0.151)
Research time			0.012***	0.007**	0.024***	0.022***
			(0.002)	(0.002)	(0.004)	(0.004)
Generalized residual_non-public		0.284***		0.012**		
		(0.072)		(0.005)		
Generalized residual_public		6.44e-08*				
		(0)				
Constant	27.591***	23.17***	0.859***	1.035**	2.104***	1.975***
	(3.076)	(3.200)	(0.236)	(0.241)	(0.341)	(0.352)
Nb observations	934	900	797	771	681	681
LR chi2	19.44***	17.70***	101.68***	153.01***	210.30***	242.16***

Note: *** p<0.1%， **p<1%， *p<5% ，+p<10%;

5. Conclusion

With the rapid development of research in higher education, the channels of research funding become increasingly diversified, and there is on-going debate on the impact of research funding on academic productivity. Using a sample of 1,092 academics in science and engineering fields in China, we examine the influence of research funding on academic's academic productivity. We

focus on the allocation of research time, which is supposed to mediate the association between funding and academic performance.

As expected, the results demonstrate positive influence of public funding on publication in both domestic and international journals, hence supporting some previous work (Carayol & Matt 2006, Hottenrott &Thorwarth 2011; Payne & Siow ,2003). This positive association could be partially explained by the mediating effect of research time. Faculties receiving more public funding devote more time on research, which further promotes publication in both domestic and international journals.

As for non-public funding, we find it has mild positive influence on domestic publication, consistent with some published studies (Gulbrandsen & Smeby, 2005; Van Looy et al., 2004); however, we have not found evidence that non-public funding increases publication in international journals, implying that non-public funding is unable to stimulate high quality research. According to previous study, an explanation is that researchers receiving non-public funding have to devote more time on the industry activity while sacrifice their time spent on research (Manjarre´s-Henrı´quez et al., 2009). However, this study suggests that research time is not affected by non-public funding, despite it's significant influence on academic productivity. Therefore, the mediating effect of research funding is rejected with regard to the relationship between non-public funding and academic productivity.

Based on the results of empirical analysis, we can formulate some policy implications for the debate on widening the financial base for universities. One the one hand, policy makers may underline the importance of public funding and improve the funding mechanism in stimulating academic production. There are two major methods often used in allocating public funding in China. One is special funding appropriated to institutions, which is often earmarked for a high proportion of expenditure on materials, equipment and facilities. Another is competitive project funding allocated to individuals that has some discretion in budgeting. According to our research, research time is a mediator that connects public funding and academic performance, which imply that research funding for personnel expenditure and incentive pay may be emphasized to stimulate academic productivity. On the other hand, increasing reliance on non-public funding is not conductive for academic publication. Since research time is a significant determinant of academic productivity, current initiatives aiming strengthening university-industry bonds may reform current reward structure or provide supporting policies for academics to encourage academics allocate more time on research when cooperating with industry.

This study is the first attempt to assess the mechanism that research funding affects academic productivity. A number of important limitations need to be considered. First, our research only presents mediating effect of research time on the relationship between research funding and academic productivity. More research is needed to investigate other mechanism behind the phenomenon, such as improving facilities, hiring research assistant, and reforming the cooperation contracts, etc. Second, we only examined the mediating role of research time, while the association between funding and academic productivity may also be accounted for by other factors such as upgrading research equipment and hiring additional research assistant. Further research might explore the mediating effect of other factors. Finally, due to the limitation of the dataset, we have not been able to assess the quality of scientific output. A better understanding of the relationship between non-public funding and quality of scientific research needs to be developed.

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