Vilnius University Press

Contents lists available at Vilnius University Press

Organizations and Markets in Emerging Economies
2020, vol. 11, no. 1(21), pp. 222–243

ISSN 2029-4581 eISSN 2345-0037
DOI: https://doi.org/10.15388/omee.2020.11.32

Financial Constraint on R&D Activities in Vietnamese Universities – an Empirical Research

Nguyen Dang TUE

Hanoi University of Science and Technology, Vietnam
tue.nguyendang@hust.edu.vn; nguyendangtue@gmail.com
https://orcid.org/0000-0002-8640-6428

Abstract. *R&D is one of the most important roles of universities. Many previous studies examined the impact of financial factor on university R&D activities but reached no consensus view. This article contributes to the current literature by exploring how financial factor and other factors influence R&D activities in Vietnamese universities. The author employed a survey dataset from the Association of Vietnam universities and colleges to check whether unfavourable financial condition hindered university R&D activities. Using structural equation modelling, the author found empirical evidence that financial constraint could hamper R&D productivity. On the other hand, favourable conditions in management, communication, infrastructure and human resources were found to improve R&D activities. This led to some policy suggestions to improve R&D activities in Vietnam higher education institutions.*

Keywords: *financial constraint; barriers; R&D; university; SEM*

1. Background

Universities play many important roles in the modern society. Universities can function as communities dedicated to learning and personal development, sources of expertise and vocational identity or sites for knowledge evaluation and application (Vallance, 2016). Among these roles, university's performing research and development (R&D) to evaluate and apply new knowledge is one of the most essential (Watson et al., 2011).

According to OECD (2015), research and development (R&D) consists of creative and systematic work undertaken to increase the knowledge stock and devise new applications of available knowledge. University's R&D activities help discover, explicate and assess new knowledge, ideas, and technologies. Knowledge generated by R&D is

Received: 14/4/2019. **Accepted:** 17/3/2020

the basis of sustainable growth (Gibbs, 2009). University's R&D activities also foster professional excellence, which is vital for better higher education and training. Publications and intellectual properties from R&D activities not only strengthen a university's academic reputation but also promote its industry involvement. Indeed, previous studies found consistent positive relationship between universities' R&D result and their commercialization activities. For example, Perkmann et al. (2011) used a dataset covering all UK universities and found that in technology-oriented disciplines, departmental faculty research results positively related to industry involvement. The higher rank a department was in terms of research quality, the more likely its members would get involved in industry collaboration. Likewise, Mansfield (1995) and Balconi and Laboranti (2006) showed that industry involvement was strongly complementary with excellent scientific research in technology-oriented disciplines.

Despite its importance, there was no firm conclusion about which factors can influence university R&D activities. Especially, previous lines of research did not explicitly examine financial constraint as a barrier for R&D activities.

In Vietnam, academic research is still largely undertaken at research institutes instead of universities due to a legacy of the old Soviet-based system (Australian Government, 2018). Vietnam research sector remains relatively underdeveloped and underfunded by international comparison (World Bank, 2008). The number of research publications by Vietnamese scholars is far below that of other countries in the South East Asia such as Thailand (Trines, 2017). For example, Vietnam's four leading universities each generated 15-30 times fewer publications than Thailand's two most prestigious universities (Pham, 2010). In scientific disciplines such as medicine and agriculture where laboratory investment is indispensable, there was lack of resources to facilitate research and publication (Pham, 2010). Harman and Le (2010) reviewed Vietnamese publication rates and found that university research productivity level was low. The number of articles published was 0.36 per staff member in national universities and 0.09 in regional universities. Vietnamese university academics had little time available for research due to high student teaching load and had access to very limited funding (Welsh, 2010).

Furthermore, Vietnamese government have put into implementation various policies to renovate higher education system and institutions in recent years. The government scaled back various regulations and at the same time extended the autonomy of higher education institutions in terms of training, scientific research, organization, personnel, finance and international cooperation. In 2014, Vietnam ministry of Education and Training approved a list of 233 universities to participate in a pilot program and awarded them more autonomy to improve university capacity and capability (Resolution 77). The autonomy in the Resolution covered university governance, university financing, curriculum design and R&D activities. However, together with more autonomy, financial support from government budget to these universities severely decreased. Consequently, many universities in autonomy program had to face difficulties in diversifying their sources of revenues, which predominantly came from tuition fees. They

had to struggle in stabilising their operation with much less financial support from the state budget (Pham, 2010). Many policy makers and academics argued that the cut in state budget subsidy might seriously hurt those universities' income and consequently worsen their R&D activities.

In this context, the discussions about whether lack of financial resources is a major obstacle to university R&D and which factors are the main determinants of university R&D activities are drawing attention from both policy makers and university managers. This study hence explores factors affecting R&D activities in Vietnamese universities with the emphasis on the financial factor. Using the data collected by the Association of Vietnam universities and colleges, the author applied the structural equation modelling method to examine how infrastructure, management, communication, human resources and financial constraint may influence R&D activities. The results showed that various factors affect R&D productivity of university, and the financial factor was a major R&D constraint.

This research enriched the current literature with the following main points. First, it would be the first of its kind to examine financial constraint on R&D activities in Vietnamese science and technology universities. Next, it confirmed the significance of factors affecting university R&D activities such as infrastructure, human resources, management and communication. Lastly, it could serve to assist R&D policy makers to revise current policies and devise new policy measures to help Vietnamese universities promote their R&D activities.

The structure of this article is as follows. Part 1 presents background of the study. Part 2 reviews some related literature and summarizes variables used in previous research. Part 3 presents data and model. Part 4 presents findings and discussions. Finally, Part 5 gives some conclusion remarks.

2. Literature review

Many previous studies were dedicated to determining factors affecting R&D activities. They referred to R&D activities as various terms such as academic productivity, scientific yield, publication rate, research results, etc.

Finkelstein (1984) suggested 7 main factors affecting faculty publication rate, which all related to faculty's ability and characteristics. Creswell (1985) divided university research result determinants into two groups of individual traits (e.g., faculty's time for research, academic exchange with colleagues) and institutional characteristics (e.g., size and reputation of the university). Similarly, Dundar & Lewis (1998) divided determinants of research activities outcomes into individual and environmental groups. Individual group comprised characteristics and experience of university lecturers, while environmental group included those related to university characteristics such as the number of professors and the size of the faculty. Uncles (2000) argued that there were at least three impediments to research productivity including inadequate training, sub-optimal concentrations of research activity, and competing commitments.

Brocato (2001) used data obtained from U.S. universities and divided research result determinants into groups of factors related to psychological and demographic characteristics of individuals and factors related to university and faculty. Chan et al. (2001) ranked research productivity among the 97 Asia-Pacific universities using a set of 17 finance journals in the 1990s and found that management factors such as motivation and the degree of research emphasis played an important role in determining research productivity. Ynalvez & Shrum (2011) found that publication productivity significantly linked to professional network factors, but there was no evidence of any association with scientific collaboration.

Beerkens (2013) empirically examined the effect of management on academic research productivity. The results suggest that management practices had consistent positive effect on research productivity. Universities with a more intensive management approach achieved both higher absolute level and faster growth in R&D productivity.

Dhillon et al. (2015) studied the research outcomes of a faculty of Universiti Teknologi Malaysia and detected three groups of factors that affected research results including the individual factor, environmental factor and behaviour factor. Banal-Estanol et al. (2015) analysed the channels through which degree of industry collaboration affected research output using a panel dataset of engineering department researchers in UK universities. The findings indicated that the relationship between collaboration degree and publication rates was curvilinear, i.e. the effect of collaboration depended on the degree of collaboration. The number of publications increased both with the presence of research funding and with the fraction of funding in collaboration with industry, but only up to around 30–40%. Ibegbulam and Jacintha (2016) analysed the contributors to high publication output among librarians in Nigerian University libraries and the barriers to research and publication among librarians. They showed that lack of a research grant and a tight work schedule hindered research. Sahoo et al. (2017) examined research productivity in Indian management schools by developing a composite indicator of research productivity and using the directional-benefit-of-doubt model. They found that faculty members who had their doctoral degrees from foreign schools were more productive than those who had similar degrees from Indian schools. Research of Ghabban et al. (2018) found empirical evidence supporting the role of knowledge sharing in improving scholarly publication performance. Most recently, Nafukho et al. (2019) found that individual characteristics (e.g., gender, rank, terminal degree, and experience) and institutional characteristics (e.g., number of undergraduate students enrolled, percentage of PhD students enrolled and funding allocated for research function) influenced faculty research productivity.

To be brief, different authors utilised different sets of factors affecting R&D activities. Table 1 summarizes the most frequently mentioned factors including infrastructure, communication, human resources and management.

Financial factors were included in many studies as major determinants of R&D activities from various points of view.

The first line of research explored universities' financial resources for doing research and how research fund was distributed. Grimpe (2012) studied scientists' strategies for obtaining project-based research funding in the presence of multiple funding opportunities using data of scientists at German universities and public research institutes. The results indicated that scientist productivity determined the chance of obtaining foundation and industry grants. Hicks (2012) found that complex, dynamic performance-based research funding systems compromised important values such as equity or diversity and enhanced control by professional elites. Laudel and Gläser (2014) analysed projects funded by the European Research Council (ERC) and argued that important research for the progress of a field could be difficult to fund with common project grants. The predominance and standardization of grant funding reduced the chances of unconventional projects across all disciplines. Wu (2015) used a Chinese longitudinal panel dataset of the projects sponsored by the National Natural Science Foundation to investigate the distribution of scientific funding across universities and research disciplines. The author found that the inequality of funding distribution decreased following generalized Pareto distribution and geometric distribution function.

Another line of research determines whether more financial resources can boost R&D activities. Many authors found positive relationships between the two. Defazio et al. (2009) examined how funding conditional on collaboration requirement affected collaborative behaviour and researcher productivity using data of 294 researchers in 39 EU research networks over a 15-year period. The authors found a positive impact of funding and collaboration on research productivity. Specifically, in the post-funding period, there was evidence that funding opportunities promoted collaboration, which in turn enhanced research productivity.

Bolli & Somogyi (2011) analysed the impact of private and public third-party funds on the productivity of Swiss university departments and public research institutions. The authors found that public donors focused on publications, while private donors fostered technology transfer. Both private and public third-party funding improved publication productivity, while private funding mainly fostered technology transfer productivity. Ubfal & Maffioli (2011) evaluated the impact of research grants on the amount of collaboration among scientific researchers by comparing collaboration indicators for researchers with financially supported projects against those of a control group who did not receive the grant. The results showed a positive and statistically significant effect of the grants on both the total number of different co-authors and a measure of researchers' integration into the scientific community. Fedderke and Goldschmidt (2014) evaluated whether a substantial increase in public funding to researchers was associated with a material difference in their productivity. They compared performance measures of researchers who obtained substantial funding against those with similar scholarly standing but did not receive such grant. The results showed that substantial funding improved researcher performance, but such increase was conditional on the quality and disciplines of the researchers. Muscio et al. (2013) used financial data for the whole

population of Italian university departments engaged in research in the engineering and physical sciences to estimate a set of probit and tobit panel data models to answer the questions whether and to what extent government funding affected the external funding options available to universities. They found evidence that government funding to universities played a role as a complement to funding from research contracts and consulting and helped promote universities' industry collaboration. Callaert et al. (2015) found a positive and significant relationship between budget from university-industry collaboration activities and the university's scientific yield. Research of Banal-Estanol et al. (2015) also found that the availability of financial resources was key to success of applied research programs.

Nevertheless, some researchers found a negative relationship between funding and R&D activities.

TABLE 1. **Factors affecting R&D activities in previous research**

	Factors		Research
1	Infrastructure/institutional ability		Creswell, 1985; Dundar & Lewis, 1998; Brocato, 2001; Dhillon et al., 2015; Nafukho et al., 2019
2	Management		Chan et al., 2001; Beerkens, 2013; Ibegbulam & Jacintha, 2016
3	Communication		Uncles, 2000; Ynalvez & Shrum, 2011; Banal-Estanol et al., 2015; Dhillon et al., 2015; Ghabban et al., 2018
4	Human resources/faculty's ability		Finkelstein, 1984; Creswell, 1985; Dundar & Lewis, 1998; Uncles, 2000; Brocato, 2001; Dhillon et al., 2015; Sahoo et al., 2017; Nafukho et al., 2019
5	Financial factor	Positive impact	Defazio et al., 2009; Bolli & Somogyi, 2011; Ubfal & Maffioli, 2011; Fedderke & Goldschmidt, 2014
		Negative impact	Auranen & Nieminen, 2010; Toole & Czarnitzki, 2007; Goldfarb, 2008; Bolli et al., 2016

Source: the author's summary of previous literature.

Research of Toole and Czarnitzki (2007) revealed that academics receiving grant from a small business innovation research program were more productive than their colleagues. However, their publication productivity diminished after getting the fund. Goldfarb (2008) analysed data collected from 221 NASA funded university researchers and found that those who were constantly funded by the NASA experienced a reduction in academic productivity. Auranen and Nieminen (2010) analysed whether competitive funding systems were more efficient in producing scientific publications from a macro-level. The results showed that there were significant differences in the competitiveness of funding systems, but no straightforward connection between financial incentives and the efficiency of university research activity. Similarly, Bolli et al. (2016) estimated

a simultaneous two-stage stochastic frontier model and found that international public funds decreased the productivity of the best performing universities.

In analysing previous literature, it was not conclusive whether the financial factor positively or negatively affected R&D activities (Table 1). Besides, little research explicitly examined financing as a constraint factor together with other R&D determinants. This research includes financial constraint into a comprehensive framework to answer the question whether it can be a hindrance to R&D activities.

3. Model and data

3.1. Conceptual model

Based on literature review of previous studies presented in Section 2, the author proposed a structural model in which five factors are assumed to affect R&D activities of the universities. Infrastructure, communication, human resources and management are included as motivating factors, while the financial factor is included in the model as a constraint.

Because most of previous studies were accommodated for universities in developed countries, the author implemented a small qualitative study to amend the measures. 15 higher education experts associated with the Association of Vietnam universities and colleges were interviewed to propound evaluation measures. These experts proposed at minimum 3 aspects for each factor's evaluation. The proposed measures were then summarized, arranged and filtered for repetition and unsuitability. Next, the list of proposed measures was emailed to the experts to give importance score for each item. These items were retained if they met the conventional threshold average score of 6.5 out of 10. In the last step, a trial survey was conducted to evaluate the reliability of the developed items.

Figure 1 presents the conceptual model.

The author thus attempted to validate the following five hypotheses:

H1: *Infrastructure favourable condition positively relates to university R&D activities.*

H2: *Management favourable condition positively relates to university R&D activities.*

H3: *Communication favourable condition positively relates to university R&D activities.*

H4: *Human resource favourable condition positively relates to university R&D activities.*

H5: *Financial constraint negatively relates to university R&D activities.*

The factors were evaluated based on the answers of questions in a 5-level Likert with the value of 1 equivalent to "totally agree" and the value of 5 equivalent to "totally disagree".

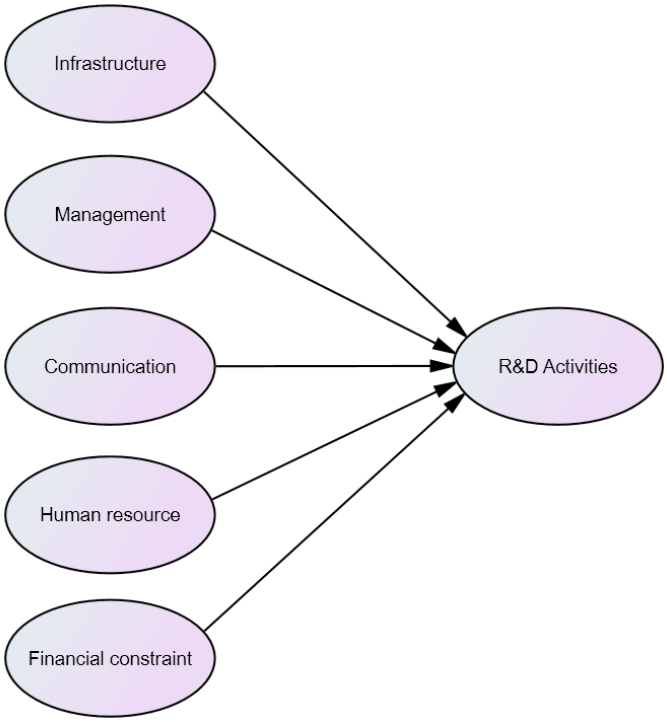

FIGURE 1. **Structural equation conceptual model**

According to Banal-Estanol et al. (2015), research and development activities are difficult to measure empirically and even more difficult to compare across institutions and time. Besides, currently there is no official statistics about university R&D activities in Vietnam. In this study, the author measured R&D activities based on respondents' opinions about whether the university R&D achieved its target, matched the university ability, increased in the period of 5 years and was well applicable in the industry.

The management factor was measured based on the answers to the questions about the internal regulation, support activities, etc. of the university for R&D activities. The communication factor was measured by the view of respondents on the matter such as whether the university set up good connection with the industry, whether the faculty exchanged information frequently to each other. Similarly, the human resources factor was evaluated based on the respondents' opinions about the questions whether the university faculty had adequate research skills, ability, etc. Finally, the financial constraint measure was evaluated based on the questions about whether R&D projects could not be completed due to lack of financial sources, whether the university department lacked ability to attract financial sources for R&D activities. Appendix 1 presents the details of the questions used for factor measure evaluation.

For robustness check, the values of the constructs were taken average to aggregate data at university level. First the values of each item composing the measures in the conceptual model (namely, infrastructure, human resources, communication, management, financial constraint and R&D activities) were taken average to create general indices for the measures. Then, the calculated index values obtained from respondents of each university were taken average by equal weights to create the index value for each university. It means there are 115 values of each index variable. Each index is a continuous variable with values ranging from 1 to 5.

A simple OLS regression was conducted in the form:

$$RD_i = \beta_0 + \beta_1 INF_i + \beta_2 HUM_i + \beta_3 COM_i + \beta_4 MGT_i + \beta_5 FIN_i + \gamma X_{ij} + \varepsilon_i \quad (1)$$

where:

INF – Index for university infrastructure;

HUM – Index for university human resource;

COM – Index for university communication;

MGT – Index for university management;

FIN – Index for university financial constraint;

X_j – A vector of control variables including university student number, years in operation, university location dummy (1 if the university locates in a big city, 0 otherwise), private ownership dummy (1 if the university is a private university, 0 otherwise);

ε_i an error term.

3.2. Data

This research used data from a survey conducted by the Association of Vietnam Universities and Colleges on 115 science and technology universities in Vietnam. A university was chosen for this survey if it had at least 40% of its training programs in science and technology (List of universities in the survey can be found in Appendix 2). The Association carried out the survey in May and June 2018 through direct and indirect channels. Lecturers and high level managers from targeted universities were asked to fill out questionnaire answer sheets that they received in a national conference organized in Hanoi in May 2018 (i.e. direct channel) or in mails sent to them at the same period (i.e. indirect channel). The respondents expressed each individual's opinions about their universities' R&D activities and the factors affecting their universities' R&D activities. The total number of valid questionnaire answers was 632, which accounted for 75.5% of the total number of distributed questionnaires.

For control variables for the robustness check regression, data about the number of university students, the location of the universities, years in operation and whether the universities are private were all collected from Annual Handbook for University Enrolment (2018) published by the Ministry of Education and Training.

4. Findings

4.1. Reliability and validity

Before CFA analysis, the author conducted a standard EFA analysis to arrange the factor groups. Table 2 presents the final constructs. Six unidimensional scales were utilized in the model including infrastructure, management, communication, human resources, financial constraint and R&D activities. The result of CFA analysis for each factor showed that the model achieved overall fit to the actual data. The factor loadings of items in each factor were larger than 0,5 indicating convergent validity of the constructs. The Cronbach's Alpha and composite reliability coefficients were all larger than 0.7. The AVE values were all larger than 0.50. Therefore, it can be concluded that the constructs are reliable.

TABLE 2. **Reliability, convergent validity and model fit index**

Constructs (Number of Items)	**Mean (Variance)**	**Range of loadings**	**CR**	**AVE**	**Cronbach's Alpha**
Infrastructure (5)	1.621 (077)	0.596-0.826	0.845	0.526	0.799
Management (7)	1.444(0.003)	0.656-0.832	0.890	0.537	0.860
Communication (5)	2.606 (0.025)	0.851-0.899	0.944	0.771	0.931
Human resources (5)	1.577(0.001)	0.733-0.863	0.882	0.600	0.855
Financial constraint (4)	1.249(0.001)	0.685-0.832	0.842	0.574	0.774
R&D outcomes (4)	2.936 (0.088)	0.746-0.892	0.903	0.701	0.875
Model fit index	Chi-square/df = 2.94; CFI = 0.919; TLI = 0.911; IFI = 0.919; RMSEA = 0.055				

Source: Author's calculation

The result data analysis of the final model showed that the model achieved overall fit to the actual data: the ratio of Chi-square/df was 2.94, which was smaller than 3. CFI (0.919), TLI (0.911) and IFI (0.919) are all larger than 0.9, while RMSEA (0.055) was smaller than 0.08.

4.2. Structural model and hypotheses test

Table 3 presents results of the estimated equations.

The structural model results matched the conceptual framework where all the coefficients had the expected signs. All hypotheses were accepted. H1 and H2 were accepted at the 10% confidence level, H3 at the 5% confidence level, H4 and H5 at the 1% confidence level. The documented positive signs for coefficient estimates of infrastructure, management, communication and human resources factors imply that more favourable conditions in infrastructure, management, communication and human resources

would improve the university R&D activities. On the other hand, financial constraint coefficient estimate had a negative sign and the largest absolute value implying, finance was a substantial deterrent to university R&D activities.

TABLE 3. **SEM model results**

Variables	Coefficient estimates	Standard error	p values	Hypothesis	Conclusion
Infrastructure	0.134	0.07	0.055	H1	Accepted at 10% confidence level
Management	0.151	0.079	0.056	H2	Accepted at 10% confidence level
Communication	0.09	0.037	0.014	H3	Accepted at 5% confidence level
Human resources	0.256	0.07	0.000	H4	Accepted at 1% confidence level
Financial constraint	-0.907	0.12	0.000	H5	Accepted at 1% confidence level

Source: Author's calculation

4.3. Robustness check

Table 4 shows that about 59% of the universities in this study are based in big cities of Vietnam, 29% of them are private, and the average number of students is about 2269.

TABLE 4. **Summary statistics of explanatory variables for robustness check**

Variables	Mean	SD	Min	Max
Infrastructure index	1.62	0.28	1.20	2.65
Management index	1.44	0.22	1.00	2.18
Communication index	2.63	0.45	1.42	3.50
Human Resources index	1.58	0.28	1.20	2.65
Financial constraint index	1.27	0.28	1.20	2.65
Number of Students	2269	1506	140	7340
Location (Dummy)	0.59	0.49	0	1
Private (Dummy)	0.29	0.45	0	1
Years in operation	26.37	21.02	4	117
R&D Activity index	2.93	0.35	1.8	3.55

Source: Author's calculation

Following the method described in 3.1, the author calculates index values for Infrastructure, Management, Communication, Human Resources, Financial constraint and R&D Activity based on respondents' answers.

Table 4 shows that the average values of infrastructure, management and human resources index for universities under investigation are small, which shows that infrastructure, management and human resources factors are adequate, according to the respondents. Communication index has the mean value of 2.63, which shows that this factor is just mediocre among universities under study. Financial constraint index has the mean value of 1.27, which shows that it is a major concern in most universities. R&D Activity Index has rather a high value of 2.93 brought about by the fact that many respondents tend to disagree when answering the R&D activity evaluation questions, showing that R&D activity result is not quite satisfactory in Vietnam universities in the research.

The result for robustness check is presented in Table 5.

TABLE 5. **Factors affecting R&D results – OLS regressions with index value**

Variables	Coefficient	Robust standard errors	Coefficient	Robust standard errors
Infrastructure	-0.020	0.135	-0.007	0.138
Management	0.127	0.151	0.172	0.162
Communication	0.018	0.065	-0.005	0.068
Human Resources	0.222*	0.121	0.224*	0.122
Financial constraint	-0.371***	0.066	-0.455***	0.084
Number of Students			0.000	0.000
Location			-0.015	0.063
Private			0.029	0.077
Years in operation			0.001	0.002
Observations	115		115	
R-squared	0.2379		0.2575	
*, **, *** mean statistically significant levels at 10%, 5% and 1%, respectively.				

Source: Author's calculation

In the table, regressions without control variables and with control variables are presented. The OLS results were consistent with the results obtained by SEM method where most of the coefficients have the same signs except for infrastructure index. However, only human resources index and financial constraint index coefficients are statistically significant.

After controlling for university characteristics, financial constraint index still has significant effect on university R&D activity index. The effect of financial constraint index is even higher (i.e. larger absolute coefficient values) after controlling for university characteristics. It thus consolidates the result from SEM model that financial constraint does negatively affect university R&D activity.

5. Discussions

The results in the previous section lead to several implications as follows.

First, the research results imply that financial constraint is a major obstacle of university R&D. This is consistent with previous reports and studies in which Vietnam is shown not to have built yet a complete and synchronous financial mechanism for science and technology activities to attract enough financial resources (Bui, 2014). At the same time, the existing financial resources have not been allocated and used effectively as expected (Nguyen, 2015). Financial resources for research mainly focus on research institutes, creating a separation between research and teaching. The limitation of funding for science and technology research at universities has limited the active participation of lecturers in scientific research. As a result, the research capacity of lecturers and students is not fully promoted, the next generation of researchers has not received adequate training. This led to the decline of the quality of human resources in science and technology research and the effectiveness of science and technology research over time (Bui, 2016).

Second, given potentially large social returns of university R&D, policy makers should attribute more emphasis to the role that funding can play as a motivation to help university attract more external financial sources such as those from donors and companies through collaboration activities. These gains should be more explicitly considered in designing policy instruments and in estimating their rate of return. There is growing political pressure on universities to intensify their interaction with industry and to enlarge their own research funding options, in a context characterized by increasing constraints on public spending on higher education. Universities in Vietnam and other countries are facing the decreasing trend of government funds to finance their operational and research expenditures. Therefore, it indicated a menace to university R&D activities and required universities to find other financial sources to compensate for this reduction.

Third, results from this research can guide universities in R&D activities improvement. Besides making sure that financial source is adequate, university should also pay attention to improving their infrastructure such as laboratory and experiment equipment. University should as well care about maintaining good communication among lecturers while at the same time upgrading its R&D management. In addition, university managers should not neglect R&D ability of the faculty. In other words, policy makers and university managers should launch new initiatives that generate university financial income and at the same time improve other factors affecting university R&D.

One of the examples is royalty-sharing arrangements, which can stimulate researchers' efforts and ultimately improve university R&D activities (Arqué-Castells et al., 2016). Other program interventions that encourage academic researchers to collaborate with industry could also be beneficial. These programs not only facilitate the transfer of knowledge and accelerate the exploitation of new inventions, but also increase academic research output (Banal-Estanol et al., 2015).

Fourth, as it is shown in the findings, financial constraint coefficient estimate had a negative sign and the largest absolute value. It indicates that financial sources may be a precondition for other factors to effectuate to allow Vietnam science and technology universities to attain notable R&D outcomes in the context (Vietnam) where many science and technology universities are state-owned and hence lack funding for R&D activities. Taking the above into consideration, the relation between financial constraint and other factors should be exhaustively studied in future research.

6. Conclusions

This research yielded some preliminary conclusions, which should be useful for theory, practice and policymaking. The evidence from the data suggested that the financial factor was the most important factor influencing R&D activities in universities. The author found supportive evidence of a significant negative effect of financial constraint on university R&D activities. Compared with previous studies, this research bolstered empirical evidence about positive impact of favourable conditions of infrastructure, communication, human resources and management on R&D activities.

This article extends the current literature in two key points. First, it is one of the first studies to include the financial factor as a constraint to R&D activities. The model explicitly included financial constraint beside other potential factors that affected R&D activities. Second, it is one of the first empirical studies about the impact of various determinants on R&D activities in Vietnam universities. Vietnam, being in the process of transition from a planned economy to a market economy, has an institutional context and level of economic development very different from the developed countries where most previous studies were conducted. The author used a large, comprehensive dataset including all Vietnam science and technology universities, which provided a rather broad insight into the country's higher education.

Nevertheless, this study suffers several limitations that readers should take into account when considering its results and implications.

First, the author had to limit the analysis to R&D activities evaluated by opinions of university managers and lecturers. The research examines R&D activities from their specific viewpoints in a short period. Managers and lecturers themselves may give biased estimates about what the university can and has accomplished in terms of R&D activities. Future research should use other objective R&D measures and approaches from a different viewpoint to gain a more comprehensive picture of the problem area.

Second, the results of this research are non-experimental and should be interpreted with caution. The methods used in this paper will give biased estimates if there are differences in R&D outcomes across universities due to unobserved factors that are not fixed over time. In other words, further work is needed to test the robustness of the results with regard to the heterogeneity of universities and their staff characteristics, and the changes over time, and to control for problems related to endogeneity between these characteristics. Future research should apply other theories to examine the viability of long-term research results.

Third, this research is based on a survey covering only science and technology universities in Vietnam. Research in the future may seek to cover all universities in Vietnam to give a broader picture of R&D activities in Vietnamese higher education system. Besides, data obtained from university R&D activities such as number of researchers, number of research projects, number of patents or total value of grants should be combined with data from this survey to allow for more inclusive analysis.

Universities may also have various R&D activities and subsidize them by various financial sources. However, the discussion provided here cannot describe the full range of complexities that mark university R&D activities and their evolution over time. Instead, the author aimed to provide a concise account of the impact rather than all possible outcomes. Further research is needed to examine the specific sources of finance and other determinants in promoting various kinds of R&D activities. With more comprehensive and homogeneous information, it could be possible to compare between the effects of determinants on a specific type of R&D activities.

7. Acknowledgement

This article presents part of the research BKA-2017-41 funded by the Ministry of Education and Training, Vietnam. The author would like to thank Economic Research Centre, Graduate School of Economics, Nagoya University, Association of Vietnam Universities and Colleges and Professor Eiji Mangyo for their kind support and sponsorship.

Appendices

Appendix 1: ***Scales, Items and Measures Included in the Survey Questionnaire***

Infrastructure
Your university's R&D infrastructure is adequate
Your university's R&D infrastructure is up-to-date
Your university's R&D infrastructure is constantly upgraded
Your university's R&D infrastructure is fully integrated
Your university's data and information sources for R&D are profuse

Management
Your university creates favourable conditions for R&D activities
Your university frequently organises R&D related competitions
Your university periodically publishes information about R&D activities
Your university has special rewards to faculty staff having excellent R&D results
Your university's R&D funding procedure is simple
Your university supports faculty in completing application to get external R&D sources
Your university's R&D funding procedure is public to all related personnel
Communication
Faculty staff have good communication with related professional network
Faculty staff have frequent academic communication with each other
Information about external sources for R&D activities is widely available
Your university frequently organizes R&D workshops/symposia/conferences
Human resources
The number of faculty is large enough to conduct R&D activities
Your university faculty staff is well trained to conduct R&D activities
Your university's faculty staff has good R&D skills
Your university's faculty staff follows ethical principles in R&D activities
Your university's faculty staff has good reputation in doing R&D activities
Financial constraint
R&D projects cannot be implemented due to lack of university funding
Financial source from university is inadequate to complete R&D activities
University lacks agents to attract funding for R&D activities
Faculty cannot acquire enough funding for R&D activities
Your university's faculty staff is not trained how to search for appropriate source of funding for R&D activities
R&D activity results
R&D results meet the targets set by your university
R&D results adequately match your university's capability
The number of good publications published by your university tended to increase in the last 5 years
Outcomes of your university's R&D activities are well applied in the industry

Appendix 2: ***List of Vietnamese science and technology universities included in the Survey***

1	Trường Đại học Công nghệ Thông tin và Truyền thông - Đại học Thái Nguyên
2	Trường Đại học Khoa học - Đại học Thái Nguyên
3	Trường Đại học Kỹ thuật Công nghiệp - Đại học Thái Nguyên
4	Trường Đại học Nông Lâm - Đại học Thái Nguyên
5	Trường Đại học Y Dược - Đại học Thái Nguyên
6	Trường Đại học Bách khoa Đà Nẵng - Đại học Đà Nẵng
7	Trường Đại học Khoa học - Đại học Huế

8	Trường Đại học Nông Lâm - Đại học Huế
9	Trường Đại học Y Dược - Đại học Huế
10	Trường Đại học Tây Bắc
11	Trường Đại học Y Dược Cần Thơ
12	Trường Đại học Dầu khí Việt Nam
13	Trường Đại học Kiến trúc Hà Nội
14	Trường Đại học Tài nguyên và Môi trường Thành phố Hồ Chí Minh
15	Trường Đại học Quảng Bình
16	Trường Đại học Tài nguyên và Môi trường Hà Nội
17	Trường Đại học Khánh Hòa
18	Trường Đại học Thăng Long
19	Trường Đại học Hoa Sen
20	Trường Đại học Trà Vinh
21	Trường Đại học Lạc Hồng
22	Trường Đại học Sài Gòn
23	Trường Đại học Dân lập Hải Phòng
24	Trường Đại học FPT
25	Trường Đại học Giao thông Vận tải Thành phố Hồ Chí Minh
26	Trường Đại học Tây Nguyên
27	Trường Đại học Hồng Đức
28	Trường Đại học Hàng hải Việt Nam
29	Trường Đại học Lâm nghiệp Việt Nam
30	Trường Đại học Đồng Tháp
31	Trường Đại học Đà Lạt
32	Trường Đại học Y Phạm Ngọc Thạch
33	Trường Đại học Thủ Dầu Một
34	Trường Đại học Sư phạm Kỹ thuật Hưng Yên
35	Trường Đại học Xây dựng
36	Trường Đại học Mở Thành phố Hồ Chí Minh
37	Trường Đại học Công nghệ Giao thông Vận tải
38	Trường Đại học Điện lực
39	Trường Đại học Công nghiệp Thực phẩm Thành phố Hồ Chí Minh
40	Trường Đại học Nông Lâm Thành phố Hồ Chí Minh
41	Trường Đại học Dược Hà Nội
42	Trường Đại học Vinh
43	Trường Đại học Công nghiệp Hà Nội
44	Trường Đại học Công nghệ Thành phố Hồ Chí Minh
45	Trường Đại học Nguyễn Tất Thành

46	Trường Đại học Nha Trang
47	Trường Đại học Y tế Công cộng
48	Trường Đại học Thủy lợi
49	Trường Đại học Mỏ - Địa chất
50	Trường Đại học Quy Nhơn
51	Trường Đại học Giao thông Vận tải
52	Học viện Công nghệ Bưu chính Viễn thông
53	Học viện nông nghiệp
54	Trường Đại học Công nghiệp Thành phố Hồ Chí Minh
55	Trường Đại học Y Hà Nội
56	Trường Đại học Sư phạm Kỹ thuật Thành phố Hồ Chí Minh
57	Trường Đại học Y Dược Thành phố Hồ Chí Minh
58	Trường đại học Lê Quý Đôn (Học viện Kỹ thuật Quân sự)
59	Trường Đại học Cần Thơ
60	Trường Đại học Duy Tân
61	Trường Đại học Bách khoa Hà Nội
62	Trường Đại học Công nghiệp Việt-Hung
63	Trường Đại học Công nghiệp Dệt May Hà Nội
64	Trường Đại học Công nghiệp Quảng Ninh
65	Trường Đại học Công nghiệp Việt Trì
66	Trường Đại học Điều dưỡng Nam Định
67	Trường Đại học Khoa học và Công nghệ Hà Nội
68	Trường Đại học Kiến trúc Thành phố Hồ Chí Minh
69	Trường Đại học Kinh tế - Kỹ thuật Công nghiệp
70	Trường Đại học Kỹ thuật Y - Dược Đà Nẵng
71	Trường Đại học Kỹ thuật Y tế Hải Dương
72	Trường Đại học Mỹ thuật Công nghiệp
73	Trường Đại học Mỹ thuật Thành phố Hồ Chí Minh
74	Trường Đại học Mỹ thuật Việt Nam
75	Trường Đại học Nông Lâm Bắc Giang
76	Trường Đại học Phạm Văn Đồng
77	Trường Đại học Sao Đỏ
78	Trường Đại học Sư phạm Kỹ thuật Nam Định
79	Trường Đại học Sư phạm kỹ thuật Vĩnh Long
80	Trường Đại học Hải Dương
81	Trường Đại học Xây dựng miền Trung
82	Trường Đại học Y Dược Hải Phòng
83	Trường Đại học Sư phạm Kỹ thuật Vinh

84	Trường Đại học Bình Dương
85	Trường Đại học Chu Văn An
86	Trường Đại học Công nghệ Đông Á
87	Trường Đại học Công nghệ Đồng Nai
88	Trường Đại học Công nghệ Sài Gòn
89	Trường Đại học Công nghệ và Quản lý Hữu nghị
90	Trường Đại học Công nghệ Vạn Xuân
91	Trường Đại học Công nghiệp Vinh
92	Trường Đại học Đại Nam
93	Trường Đại học Hải Phòng
94	Trường Đại học Văn Lang
95	Trường Đại học Yersin Đà Lạt
96	Trường Đại học Đông Á
97	Trường Đại học Hòa Bình
98	Trường Đại học Kiến trúc Đà Nẵng
99	Trường Đại học Kinh doanh và Công nghệ Hà Nội
100	Trường Đại học Kinh tế - Công nghiệp Long An
101	Trường Đại học Kinh tế- Kỹ thuật Bình Dương
102	Trường Đại học Lương Thế Vinh
103	Trường Đại học Ngoại ngữ Tin học Thành phố Hồ Chí Minh
104	Trường Đại học Nguyễn Trãi
105	Trường Đại học Nam Cần Thơ
106	Trường Đại học Phương Đông
107	Trường Đại học Quang Trung
108	Trường Đại học Quốc tế Bắc Hà
109	Trường Đại học Quốc tế Hồng Bàng
110	Trường Đại học Thành Đô
111	Trường Đại học Võ Trường Toản
112	Trường Đại học Đồng Nai
113	Trường Đại học Kỹ thuật - Công nghệ Cần Thơ
114	Trường Đại học Tiền Giang
115	Trường Đại học Lao động - Xã hội

References

Arqué-Castells, P., Cartaxo, R. M., García-Quevedo, J., & Godinho, M. M. (2016). Royalty sharing, effort and invention in universities: Evidence from Portugal and Spain. *Research Policy, 45,* 1858–1872.

Auranen, O., & Nieminen, M. (2010). University research funding and publication performance: An international comparison. *Research Policy, 39*, 822–834.

Australian Government. (2018). *Vietnam High Education:Policy and Systems Update.* Hanoi: Department of Education and Training.

Balconi, M., & Laboranti, A. (2006). University–industry interactions in applied research: the case of microelectronics. *Research Policy, 35*(10), 1616–1630.

Banal-Estanol, A., Jofre-Bonet, M., & Lawson, C. (2015). The double-edged sword of industry collaboration: Evidence from engineering academics in the UK. *Research Policy, 44*, 1160–1175.

Beerkens, M. (2013). Facts and fads in academic research management: The effect of management practices on research productivity in Australia. *Research Policy, 42*(9), 1679-1693.

Bolli, T., & Somogyi, F. (2011). Do competitively acquired funds induce universities to increase productivity? *Research Policy, 40*, 136–147. https://doi.org/10.1016/j.respol.2010.10.001

Bolli, T., Olivares, M., Bonaccorsi, A., Daraio, C., Aracil, A. G., & Lepori, B. (2016). The differential effects of competitive funding on the production frontier and the efficiency of universities. *Economics of Education Review,* 1-14. doi: http://dx.doi.org/10.1016/j.econedurev.2016.01.007

Brocato, J. J. (2001). *The research productivity of family medicine department faculty: a national study dissertation*. Michigan: Michigan State University.

Bui, T. D. (2014) Financial mechanism for science and technology public units. *Review of Finance, 1*(2014), 15–22.

Bui, T. D. (2016) More financial solutions for scientific and technological development. *Review of Finance, 3*(2016), 33–39.

Callaert, J., Landoni, P., Looy, B. V., & Verganti, R. (2015). Scientific yield from collaboration with industry: The relevance of researchers' strategic approaches. *Research Policy, 44,* 990–998.

Chan, K. C., Chen, C. R., & Steiner, T. L. (2001). Research productivity of the finance profession in the Asia-Pacific region. *Pacific-Basin Finance Journal, 9*(3), 265-280.

Creswell, J. W. (1985). *Faculty Research Performance: Lessons from the Sciences and Social Sciences*. Washington, DC: Association for the Study of Higher Education.

Defazio, D., Lockett, A., & Wright, M. (2009). Funding incentives, collaborative dynamics and scientific productivity: Evidence from the EU framework program. *Research Policy, 38*, 293–305. http://dx.doi.org/10.1016/j.respol.2008.11.008

Dhillon, S. K., Ibrahim, R., & Selamat, A. (2015). Factors associated with scholarly publication productivity among academic staff: Case of a Malaysian public university. *Technology in Society, 42*, 160–166.

Dundar, H., & Lewis, D. R. (1998). Determinants of research productivity in higher education. *Research Higher Education, 39*, 607–31.

Fedderke, J., & Goldschmidt, M. (2014). Does massive funding support of researchers work?: Evaluating the impact of the South African research chair funding initiative. *Research Policy, 44*(2), 467–482.

Finkelstein, M. J. (1984). *The American Academic Profession: A Synthesis of Social Scientific Inquiry since World War II*. Columbus: Ohio State University Press.

Ghabban, F., Selamat, A., & Ibrahim, R. (2018). New model for encouraging academic staff in Saudi universities to use IT for knowledge sharing to improve scholarly publication performance. *Technology in Society, 55*, 92–99.

Gibbs, A. (2009). *The importance of 'research on research'*. Retrieved 3 16, 2019, from https://www.universityworldnews.com/post.php?story=20090622215201783

Goldfarb, B. (2008). The effect of government contracting on academic research: Does the source of funding affect scientific output? *Research Policy, 37*(1), 41-58.

Grimpe, C. (2012). Extramural research grants and scientists' funding strategies: Beggars cannot be choosers? *Research Policy, 41*, 1448–1460. https://doi.org/10.1016/j.respol.2012.03.004

Harman, G., & Le, T. N. (2010). The Research Role of Vietnam's Universities. In G. Harman, M. Hayden, & N. T. Pham (Eds.), *Reforming Higher Education in Vietnam* (pp. 87-107). Springer.

Hicks, D. (2012). Performance-based university research funding systems. *Research Policy, 41*, 251–261.

Ibegbulam, I. J., & Jacintha, E. U. (2016). Factors That Contribute to Research and Publication Output Among Librarians in Nigerian University Libraries. *The Journal of Academic Librarianship, 42*(1), 15–20.

Laudel, G., & Gläser, J. (2014). Beyond breakthrough research: Epistemic properties of research and their consequences for research funding. *Research Policy, 43*, 1204–1216.

Mansfield, E. (1995). Academic research underlying industrial innovations: sources, characteristics, and financing. *Review of Economics and Statistics, 77*(1), 55–65.

Muscio, A., Quaglione, D., & Vallanti, G. (2013). Does government funding complement or substitute private research funding to universities? *Research Policy, 42*, 63–75.

Nafukho, F. M., Wekullo, C. S., & Muyia, M. H. (2019). Examining research productivity of faculty in selected leading public universities in Kenya. *International Journal of Educational Development, 66*, 44-51.

Nguyen, H. S. (2015) Financial mechanism for science and technology activities in Vietnam: Some limitations and complete solutions. *World Economic and Political Issues, 6*(194), 57–66.

OECD. (2015). *Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development*. Paris: OECD Publishing.

Perkmann, M., King, Z., & Pavelin, S. (2011). Engaging excellence? Effects of faculty quality on university engagement. *Research Policy, 40*, 539–552.

Pham, D. H. (2010). *A Comparative Study of Research Capabilities of East Asian countries and Implications for Vietnam*. Springer Science.

Pham, T. N. (2010). The Higher Education Reform Agenda: A vision for 2020. In G. Harman, M. Hayden, & N. T. Pham (Eds.), *Reforming Higher Education in Vietnam* (pp. 51-64). Springer.

Sahoo, B. K., Singh, R., Mishra, B., & Sankaran, K. (2017). Research productivity in management schools of India during 1968-2015: A directional benefit-of-doubt model analysis. *Omega, 66*(A), 118-139.

Toole, A. A., & Czarnitzki, D. (2007). Biomedical academic entrepreneurship through the SBIR program. *Journal of Economic Behavior & Organization, 63*(4), 716-738.

Trines, S. (2017). *Education in Vietnam: Current Trends and Qualifications. World Education News Reviews.* Retrieved from https://wenr.wes.org/2017/11/education-in-vietnam

Ubfal, D., & Maffioli, A. (2011). The impact of funding on research collaboration: Evidence from a developing country. *Research Policy, 40*, 1269–1279. https://doi.org/10.1016/j.respol.2011.05.023

Uncles, M. (2000). What Can Be Done to Enhance the Research Productivity of Junior Staff? *Australasian Marketing Journal (AMJ), 8*(2), 73-79.

Vallance, P. (2016). The historical roots and development of the civic university. In J. H. Goddard (Ed.), *The Civic University: The Policy and Leadership Challenges* (pp. 16-33). Cheltenham, UK: Edward Elgar.

Watson, D., Hollister, R., Stroud, S., & Babcock, E. (2011). *The Engaged University: International Perspectives on Civic Engagement.* London: Routledge.

Welsh, A. R. (2010). Internationalisation of Vietnamese Higher Education. In G. Harman, M. Hayden, & T. N. Pham (Eds.), *Reforming Higher Education in Vietnam: Challenges and Priorities* (pp. 197–213). Dordrecht, The Netherlands: Springer.

World Bank. (2008). *Higher Education and Skills for Growth.* Vietnam: World Bank.

Wu, J. (2015). Distributions of scientific funding across universities and research disciplines. *Journal of Informetrics, 9*, 183–196. doi: http://dx.doi.org/10.1016/j.joi.2014.12.007

Ynalvez, M. A., & Shrum, W. M. (2011). Professional networks, scientific collaboration, and publication productivity in resource-constrained research institutions in a developing country. *Research Policy, 40*(2), 204–216.