The Influence of Government Intervention on Logistics Enterprise's Adoption of Information Technology

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ABSTRACT: With emphasizing the process of innovation, this paper classifies government intervention focused on innovation adoption into three dimensionalities: information support, financial support and personnel support. It also refines technological cognition into two aspects: perceived benefits including functional benefits and social benefits, and perceived costs including financial cost and risk. This paper develops an information technology adoption model of logistic enterprise for the context of government intervention, which based on the technology adoption theories of behavior perspective and follows the corresponding basic principle that government intervention affects adoption intention indirectly via technological cognition. Then, the study takes standard TMS and investigates some logistic enterprises in Zhejiang province to conduct empirical research. With collected 113 valid data, the author tests the model by regression analysis. The results demonstrate that adoption intention is affected by government intervention through technological cognition, and reveals the path in which different kinds of government intervention affect technological cognition.

Categories and Subject Descriptors:
K.6.1 [Project and People Management] H.4.2 [Types of Systems] Logistics

General Terms: Information Services, Technology Management, Enterprise Management

Keywords: Government Intervention, Innovation Policy, Technology Adoption, Logistics Enterprise

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1. Introduction

Recently, Logistics highlights its role increasingly in the national economy as a new productive service industry. However, since the backward technical level and operation efficiency of logistics enterprise in China, the cost of logistics keeps high which restricts the development of national economy. In order to improve this situation and gain competitive advantage, government has taken a series of measures to encourage logistics enterprise to use advanced information technology. But the enterprise didn't positively accept it. Researching the influence of government intervention on logistics enterprise's adoption intention on information technology will be helpful to explain the causes. Meanwhile, it is also helpful to guide government take relevant intervention measures specifically, improve government's resource allocation efficiency greatly.

At present, researches on government intervention are concentrated on innovation development phase. Only few scholars have researched government intervention in innovation diffusion. Besides, the literature about the influence of government intervention on logistics enterprise's adoption intention on information technology is rare. The related researches can be separated into two aspects. One is the literature about the influencing factor of technology adoption, which takes the government intervention or policy as a factor in external environment variables, and discuss the effects of each variable (such as organization, technology, environment) on technology adoption[1-3]. The other is the effect of specific and single government intervention method (such as fund subsidies,

information publicity, etc.) on technology adoption [4-7]. However, these researches had no deep and systematic discussion to government intervention and didn't reveal the mechanism how government intervention influences enterprise's technology adoption in microcosmic field. This paper first defines the government intervention variables which influence technology adoption systematically, and proposes its component factors and measurement method which make up the shortage of government intervention research. Meanwhile, technology adoption theories based on the behavior perspective refine enterprise's technological cognition into perceived benefits including functional benefits and social benefits, and perceived costs including financial cost and risk. Developing an information technology adoption model of logistic enterprise for the context of government intervention to discuss action mechanism of different government intervention patterns on logistics enterprise's information technology adoption intention, thus enrich and perfect the behavior theory system of information technology adoption further.

2. Literature Review

2.1 Technological innovation adoption

Schumpeter pointed out that innovation is a process, including invention, innovation and diffusion three stages in 1912 [8]. Innovation diffusion is not only the behavior of innovation holder transferring his technology innovation, but also including the adoption behavior of new adopter [9]. The microexamination of technological innovation adoption is usually based on the analysis of potential adopter individual's decision behavior [10]. Therefore, there are no qualitative differences between technological innovation adoption and technological innovation diffusion.

It can be regarded as technological innovation adoption as long as it's the first time to adopt a technology from the perspective of potential technology adopter. So, technological adoption and technological innovation adoption are equivalent in this paper. The theory of technological adoption can be studied from the perspective of institutionalism, communication, behavior and so on. Institutionalism holds that the environmental factors affect the adoption decision potential adopter makes, which ignore the importance of technology. It's more suitable to research technology diffusion.Technological adoption theories of communication perspective pays more attention to how the communication channel and leader's vision contribute to adoption as Rogers's theory in 1962 Diffusion of Innovation (DOI) [11]. Technological adoption theories of behavior perspective concern the technological adoption decision process from microcosmic field which follows the corresponding basic principle that government intervention affects adoption intention indirectly via technological cognition.

This paper mainly concerns individual adoption process. Therefore, in order to analyze how government behaviors affect enterprise's technology adoption intention, it develops a model framework, "*government intervention—technological cognition—adoption intention*", based on technology adoption theories of behavior perspective.

2.2 Government intervention

At present, researches in the field of technological innovation are rare. Considering technological innovation policy is an effective measure of government intervention in technological innovation [12], and government often use different intervention methods in different stages. Therefore, the research of government intervention in technological innovation mainly contains two aspects: technological innovation policy and government intervention methods.

The researches about technological innovation policy concentrate more on the development and less on the innovation diffusion of innovation [13]. The prevailing policy analysis framework that divides policy into supply-oriented, demand-oriented and environment-oriented policy proposed by Rothwell and Zegveld [12], mainly analyze innovation policy from developers' view, and neglect the innovation policy about technology adopter and technology diffusion. King and Gurbaxani, etc. [14] hold that there are two methods organization use to intervene innovation: influence and regulation. In the process of technological development, the government may play some different and interactive roles simultaneously [15]. Moon and Bretschneider [16] think that government act as the sponsor and spreader respectively in innovation development and diffusion. As a spreader, government promotes innovation diffusion in four ways: information flow, financial flow, personnel cooperation and regulation convenience.

This paper mainly concerns the adoption of technological innovation. From the potential technology adopter's view, we divide government intervention method into three dimensionalities based on Moon and Bretschneider's [16] research: information support, financial support and personnel support. Information support means measures government taken to improve potential adopters' understanding of technology and help them to choose and use technology. It includes promotion, policy guidance, standard setting and so on. Financial support means preferential measures and support policies government taken to subsidize potential adopter's innovative behavior. It includes fund subsidies, tax breaks, loan guarantee and so on. Personnel support means government provides relevant person and organization to offer potential adopter technical training and support.

2.3 Technological cognition

Compared with individual technology adoption, organizations mainly concern technology's economic benefits when making adoption decisions [17]. Combining researches of Guo xunhua [18], and Zhu, Kraemer etc. [19], this paper refines technological cognition into two aspects: perceived benefits and perceived costs., and it includes four dimensionalities: functional benefits, social benefits, financial cost and risk.

Perceived benefits are the benefits an organization expected to gain from adopting a certain technology. It contains direct benefits and indirect benefits [20-21]. In China's special institutional environment, small and medium enterprises depend much on government. In order to keep good relationship with government, they usually tend to adopt the technology government recommended. Therefore, this paper holds that perceived benefits include functional benefits and social benefits. Functional benefits mean benefits derived from the technology's functional characteristics, including reducing the cost of enterprise management, optimizing the work flow and so on. Social benefits mean benefits derived from good relationship with relevant organizations and institutions, including qualification certification, government or industry association's approval.

Perceived cost is the cost an organization expected to pay through adopting a certain technology. It contains financial cost and risk. Financial cost is the funds that an enterprise needs to pay through using a technology prospectively, which includes the cost of acquisition, implementation and maintenance. Risk is the possible loss caused by imperfect or unsuitable technology.

2.4 Adopt intention

Adopt intention is a predictive index of adoption behavior. The theory of reasoned action (TRA) raised by Fishbein and Ajzen [22], defines behavioral intention as "*the intention of behavior one person performed that determines behavior directly*". Combined with the research contents of this paper, we define behavioral intention as the willing strength potential technology adopter adopts the technology.

3. Conceptual Model

3.1 The relationship between technological cognition and adoption intention

Chwelos, Benbasa etc. [23] point out the higher technical benefits enterprise perceived, the stronger adoption intention will be. An enterprise may tend to use a technology if perceived technology benefits are high. On the other hand, the higher of the perceived cost, the weaker of adoption intention. So we put forward hypotheses as follows:

H1a: Functional benefits have direct significantly positive influence on adoption intention

H1b: Social benefits have direct significantly positive influence on adoption intention

H1c: Financial cost has direct significantly negative influence on adoption intention

H1d: Risk has direct significantly negative influence on adoption intention

3.2 The relationship between government intervention and technological cognition

1. The relationship between information support and technological cognition Brennan's research[5] demonstrates that government's propaganda about the knowledge and technology of water-saving irrigation is helpful to improve farmers' consciousness of saving water, and make them realize the value of using advanced irrigation technology which has important effects on their decision of choosing irrigation technology. Zhu & Thatcher etc. [1] hold that it can increase potential adopter's understanding of the technological value if government participants in the innovation project.

Thus, we put forward hypotheses as follows:

H2a: Information support has direct significantly positive influence on functional benefits

H2b: Information support has direct significantly positive influence on social benefits

H2c: Information support has direct significantly negative influence on financial cost

H2d: Information support has direct significantly negative influence on risk

2. The relationship between financial support and technological cognition Government's provision of fund subsidies, tax breaks, loan guarantee are all regarded as financial support to enterprises. Obviously, these measures can reduce the acquisition cost of new technology [1], and relieve risk pressure enterprise should have taken. Meanwhile, tax breaks and loan guarantee can reduce operating cost and enhance profit level. Calantone and Griffith etc. [24] have studied the technology adoption in Chinese enterprises. They point out the financial support from government and society can increase enterprise's opportunity to get new resources. So we put forward hypotheses as follows:

H3a: Financial support has direct significantly positive influence on functional benefits

H3b: Financial support has direct significantly positive influence on social benefits

H3c: Financial support has direct significantly negative influence on financial cost

H3d: Financial support has direct significantly negative influence on risk

3. The relationship between personnel support and technological cognition With the training and consultation, enterprise can decrease the cost of training and consultation and increase the cognition of technological benefits. Koch and Eriksson's [25] discovery demonstrates that the person who have not received training don't think new technology is better than traditional technology because of their unfamiliar with technology. And persons who have received training are inclined to adopt new technology. Amoako-Gyampah and Salam [26] point out training will influence people's belief of ERP benefit, and then influence the perceived usefulness. So we put forward hypotheses as follows:

H4a: Personnel support has direct significantly positive

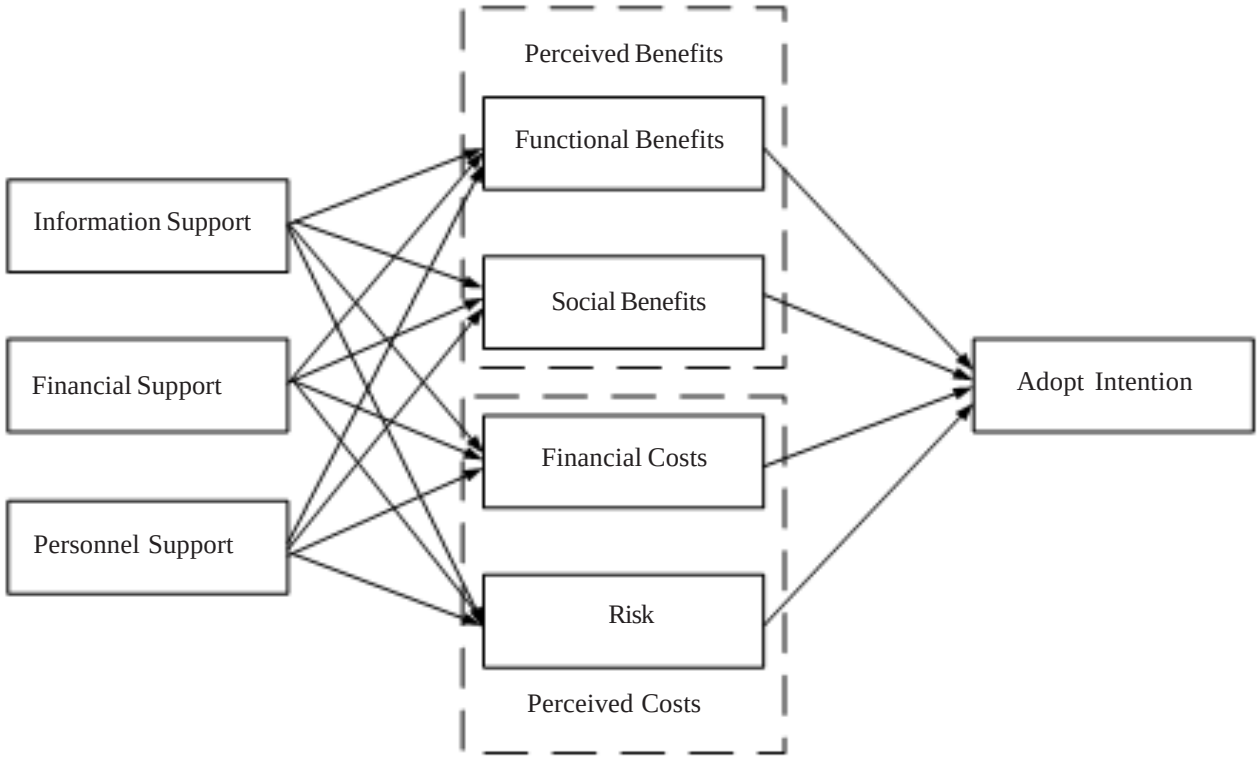

Figure 1. The information technology adoption model for the context of government intervention

influence on functional benefits

H4b: Personnel support has direct significantly positive influence on social benefits

H4c: Personnel support has direct significantly negative influence on financial cost

H4d: Personnel support has direct significantly negative influence on risk.

3.3 Research model

This paper develops an information technology adoption model of logistic enterprise for the context of government intervention, which is based on the analyses and hypotheses above as figure-1 shows.

4. Methods

4.1 Questionnaire design

This paper mainly uses Likert's 7 points scale to measure each variable. The design of scale refers to relevant mature scales. To those can't be used directly, we modify and expand the origin scale based on variable definition through field interview and expert discussion.

4.1.1 Government intervention

The measurement scale of government intervention is mainly designed on the basis of Moon and Bretschneider [16], Amoako-Gyampah and Salam [26], Calantone and Griffith etc. [24]. It composes of 12 questions, concludes three factors: information support, financial support and personnel support. In order to measure accurately, the respondents will be asked whether they have received personnel support from government before the asking terms, because personnel support needs the actual contact of government officials and enterprises. If the respondents have received relevant personnel support, the score is what they filled in. And if not, the score should be 1.

4.1.2 Technological cognition

The measurement scale of technological cognition designs mainly base on the researches of Kuan and hau [21], Zhu and Kraemer [19], Guo xunhua [18]. It composes of 14 questions, concludes four factors: functional benefits, social benefits, financial cost and risk.

4.1.3 Adoption intention

The measurement scale of adoption intention designs mainly base on the researches of Teo and Wei etc. [27], Calantone and Griffith etc [24]. It composes of 3 questions.

4.2 Survey setting

The study investigates some logistic enterprises whose main businesses are package or vehicle transportation in Zhejiang province and researches their adoption intention on standard transport management system (standard TMS). Standard TMS is the system following the data interface standards of LOGINK—— a National Transportation Logistic Public Information Platform, and can exchange data through LOGINK. We distributed questionnaires via spatial distribution and E-mail in July to September 2012. We use general and senior managers' cognition in enterprises to instead enterprises' cognition, so the questionnaires filled in by non-general and senior managers are deleted. Meanwhile, To avoid post-adoption

Variables	Questions	Factor load	α
Information support	The information likes announcement and policy or activities like promotion taken by government are the important ways for my company to understand standard TMS.	.755	.820
	These information and activities improve my understanding of standard TMS in essence.	.797	
	My company knows well the policy government takes to promote standard TMS.	.747	
	I think government support standard TMS.	.691	
Financial support	My company can reach the standard of relevant financial subsidy policy if we use standard TMS.	.671	.781
	My company can enjoy relevant financial subsidy if we use standard TMS.	.786	
	I think government's financial support take high percentage of the cost my company impose or modify standard TMS.	.755	
	Financial support can release the financial burden my company impose or modify standard TMS.	.770	
Personnel support	Personnel and organization's supplies of consulting or training are professional.	.813	.901
	The contents of consulting or training are overall and detailed.	.801	
	The consulting or training improves my understanding of standard TMS in essence.	.816	
	The consulting or training makes me have confidence in standard TMS.	.809	
Financial benefits	Improve staffs' work efficiency	.865	.948
	Standard business process and improve service quality	.889	
	Reduce my company's operating cost	.866	
	Improve my company's operating performance	.886	
Social benefits	Improve my company's imagine and status in the industry	.790	.925
	Obtain the approval from government and profession association	.832	
	It is benefit to pass relevant standard identification future for my company.	.864	
	It is benefit to gain privilege in policy future for my company.	.783	
Financial cost	My company needs fund to modify or purchase equipment and technology in order to use standard TMS.	.895	.906
	It will increase our operating cost in the process of using standard TMS.	.903	
	It needs large amounts of money to maintain and upgrade standard TMS in later period.	.856	
Risk	I think the operation of standard TMS is not mature.	.869	.948
	I think our using of standard TMS will take disadvantage to our operating state now.	.852	
	I worry about the security of standard TMS to my company.	.883	
Adoption intention	I am considering making my company to use standard TMS in one year.	.885	.867
	My company will use standard TMS in one year possibly.	.884	
	I am pleased to use standard TMS if I can make decision for my company.	.898	

Table 1. The test results of reliability and validity

intention affect the research, the questionnaires filled in by the enterprises which have already used standard TMS are deleted. After selection, we collected 113 valid data. Among the respondents, senior managers take the percentage of 76.99 and the middle managers are 23.01%.

5. Empirical Analysis

This paper tests samples' reliability and validity first, and then analysis the relationship between each variable in the way of correlation, and at last tests the hypotheses gradually.

5.1 Reliability and validity

Samples' reliability tested by Cronbach's α coefficient, and the results demonstrate that each variable's Cronbach's α coefficients are greater than 0.7 which indicate the samples have good reliability (table-1). It indicates that using factor analysis to analyze the sample is rational after KMO and Bartlett's Sphere test. Then we can extract the common factors whose eigenvalues are greater than 1 with principal components analysis. The results demonstrate the sample pass the reliability test and fit the research design above.

	A1	A2	A3	B1	B2	B3	B4	C
Pearson								
A1 Information support	1							
A2 Financial support	.379**	1						
A3 Personnel support	.617**	.473**	1					
B1 Functional benefits	.631**	**.172**	.509**	1				
B2 Social benefits	.578**	.531**	.607**	.597**	1			
B3 Financial cost	-.379**	-.617**	-.435**	**.001**	-.303**	1		
B4 Risk	-.642**	-.427**	-.677**	-.408**	-.528**	.473**	1	
C Adoption intention	.770**	.510**	.654**	.671**	.682**	-.545**	-.681**	1

Notes: **means significantly relevance at 0.01 level (two sides)

Table 2. Correlation coefficient matrix

5.2 Correlation analysis

The correlation analysis results of each variable as table-2 show that the relationships between each variable are significantly correlated at 0.01 level expect functional benefits and financial cost, financial cost and information support. It indicates the model and hypotheses are reasonable preliminarily and then analyze the relationships between each variable further.

5.3 Regression analysis

Regression analysis in this paper has three phases: first phase test the relationship between technological cognition and adoption intention, second phase test the relationship between government intervention and technological cognition, third phase test the intermediation between government intervention and adoption intention.

5.3.1 Regression analysis between technological cognition and adoption intention

Take four dimensionalities of technological cognition as independent variables and adoption intention as dependent variable to regression analyze gradually. The results as table-3 showed. The whole regression effect is significant because R^2 is 79.7%. The Standard regression coefficient β of functional benefits and social benefits are 0.493 and 0.157, and significance levels are all less than 0.05, which reveals functional benefits and social benefits have direct significantly positive influence to adoption intention, and hypotheses of H1a and H1b get verified.

Independent variables	Standard β	T value	Significance levels	R^2
(Constant)		7.468	.000	
Functional benefits	.493	8.554	.000	
Social benefits	.157	2.601	.011	.797
Financial cost	-.400	-7.678	.000	
Risk	-.208	-3.626	.000	

Table 3. Regression analysis results of technological cognition and adoption intention

5.3.2 Regression analysis between government intervention and technological cognition

Regression analysis results of government intervention and technological cognition as table-4 show. Model 1 takes functional benefits as dependent variables and three dimensionalities of government intervention as independent variable to regression analyze gradually. The independent variables are information support and personnel support, and R^2 is 42.1%. The Standard regression coefficient β of information support and personnel support are 0.511 and 0.194, and significance levels are all less than 0.05, which reveals information support and personnel support have direct significantly positive influence to functional benefits, and hypotheses of H2a and H4a get verified. Financial

Independent variables	Model 1 Functional benefits		Model 2 Social benefits		Model 3 Financial cost		Model 4 Risk	
	Standard β	Sig.	Standard β	Sig.	Standard β	Sig.	Standard β	Sig.
(Constant)		.023		.001		.000		.000
Information support	.511	.000	.289	.001	——	——	-.362	.000
Financial support	——	——	.282	.000	-.530	.000	——	——
Personnel support	.194	.038	.295	.002	-.185	.029	-.453	.000
R^2	.421		.496		.407		.539	
F	39.967**		35.716**		37.783**		64.313**	

Table 4. Regression analysis results of government intervention and technological cognition

support doesn't enter the model which reveals financial support has no significant influence to functional benefits, and hypothesis of H3a doesn't get verified. According to the analysis results of model 2, hypotheses of H2b, H3b and H4b get verified. According to the results of model 3, hypotheses of H3c and H4c get verified, but information support has no significant influence to financial cost. According to the results of model 4, hypotheses of H2d and H4d get verified, but financial support has no significant influence to risk.

5.3.3 Intermediary function analysis

In general, the test of intermediary effect in regression analysis should content the requirements as follows: the testing intermediary variables have significant influence to dependent variables, independent variables have significant influence to dependent variables above, and dependent variables above have significant influence to independent variables. Intermediary variables and dependent variables both enter regression model. There are some intermediary functions if dependent variables' regression coefficients decrease and significance levels exist. But if dependent variables' regression coefficients have no significant level, there exist complete intermediary function.

Through the regression analysis above, the first two requirements get tested. And after that, it tests the intermediary function of technological cognition to the eligible variables gradually.

Financial support has no significant influence to functional benefits according to model 1's results in table-4, so we only need to test functional benefits' intermediary function in information support, personnel support and adoption intention. Model 1 in table-5 takes information support and personnel support as independent variables, and adoption intention as dependent variable to regression

Independent variables	Model 1 Standard β	Sig.	Model 2 Standard β	Sig.	Independent variables	Model 3 Standard β	Sig.	Model 4 Standard β	Sig.
(Constant)		.470		.128	(Constant)		.009		.000
Information support	.593	.000	.460	.000	Information support	.565	.000	.548	.000
Personnel support	.288	.000	.237	.001	Financial support	.195	.002	.150	.019
					Personnel support	.213	.005	——	——
Financial benefits	——	——	.260	.000	Social benefits			.285	.000
R^2	.645		.684			.674		.693	

Notes: dependent variable is "*adoption intention*"

Table 5. Intermediary function analysis results of functional benefits and social benefits

Independent variables	Model 1		Model 2		Independent variables	Model 3		Model 4	
	Standard β	Sig.	Standard β	Sig.		Standard β	Sig.	Standard β	Sig.
(Constant)		.125		.000	(Constant)		.470		.044
Information support	.258	.001	.460	.000	Information support	.593	.000	.509	.000
Personnel support	.532	.000	.514	.001	Personnel support	.288	.000	.184	.022
Financial benefits			-.322	.000	Risk		.000	-.322	.285
R^2	.479		.511			.645		.6693	

Table 6. Intermediary function analysis results of financial cost and risk

analyze gradually. R^2 is 42.1% and the standard regression coefficients β of information support and personnel support are 0.593 and 0.288, and significance levels are all less than 0.05, which reveals information support and personnel support have direct significantly positive influence to adoption intention. Model 2 adds functional benefits in original variables. Standard coefficients of information support and personnel support decrease, but significance levels exist compared with model 1, which means functional benefits have partial intermediary function between information support, personnel support and adoption intention, and hypothesis of H5a get partial verified. Compared with model 3 and model 4 in table-5, it concludes that social benefits have partial intermediary function between information support, personnel support and adoption intention, and hypothesis of H5b gets partial verified.

Compared with model 1 and model 2 in table-6, it concludes that financial cost has complete intermediary function between financial support and adoption intention, and partial intermediary function between personnel support and adoption intention, hypothesis of H5c gets partial verified. Compared with model 3 and model 4 in table-6, it concludes that risk has partial intermediary function between information support, personnel support and adoption intention, and hypothesis of H5d gets partial verified.

Integrating the results above, besides H2c, H3a and H3d, all the hypotheses pass the test. Hereby, we modify the model, and the modified model as figure-2 shows.

6. Conclusions

This paper develops an information technology adoption

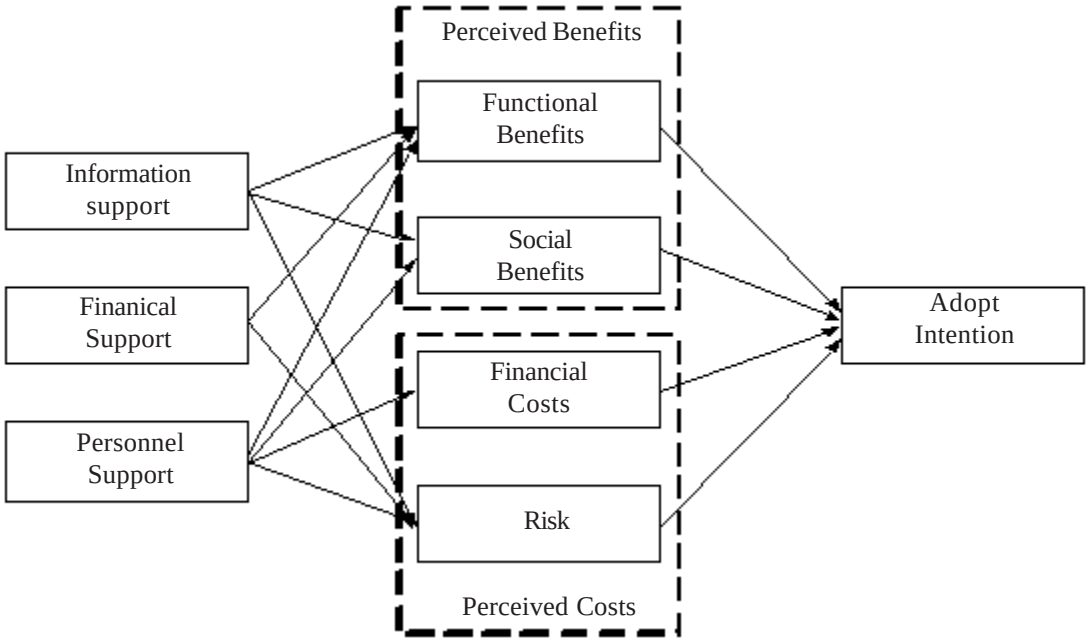

Figure 2. The modified information technology adoption model for the context of government intervention

model of logistic enterprise for the context of government intervention, which based on the technology adoption theories of behavior perspective and follows the corresponding basic principle that government intervention affects enterprises' adoption intention indirectly via technological cognition. The conclusions are as follows:

1. Four dimensionalities of technological cognition all have direct significantly influence to adoption intention. The cognition of functional benefits determines enterprises' consideration of direct benefits derived from using the technology. The cognition of social benefits determines enterprises' anticipation of the probability to gain more resources and opportunities. The cognition of financial cost and risk reflect the constraints of their use of a technology in financial and operational aspects.

2. Three dimensionalities of government intervention have significantly different influence to technological cognition.

(1) Information support and personnel support have direct significantly positive influence to functional benefits, but financial support has no. It indicates government's financial subsidies can't influence enterprises' cognition of technology functional benefits significantly, which helps them understand the main patterns of technology functional benefits are information support and personnel support.

(2) Three dimensionalities of government intervention all have positive influence to social benefits of technological cognition, and the influence among them are no significantly differences. For enterprises, no matter which pattern government uses to encourage enterprises' adoption of a technology, it means this technology has relationship with government and thus social benefits of this technology will be improved.

(3) Financial support and personnel support have significantly negative influence to financial cost, but information support has no.

(4) Information support and personnel support have significantly negative influence on risk, but financial support doesn't have obvious influence. The possible explanation is that the main modes of government's financial support are limited to financial subsidy and free software at present. These can only reduce enterprises' cost of technology acquisition once, but not concerns the possible loss maybe occur in the future.

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