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Full Length Research Paper

Optimizing the acceleration of biotechnology innovation in government programs

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Science biotechnology has been attributed a superior platform in Malaysian government plan for wealth creation in the 9th Malaysian plan and policy of Malaysia's science and technology in 21st century; it has been accepted and categorized as a complicated emerging issue to illustrate high prominence combined with restricted knowledge in environment. Researchers emphasize on the importance of biotechnology knowledge evaluation to shape people's attitudes about technologies after acquirement of related information. Biotechnology industry has been developing dramatically all around the world since 30 years ago and it attempts to evolve technological and scientific information. Especially, developing countries struggling to fight against hunger via agricultural applications showed interest with this regard. Research on accelerating the rate of biotechnology innovation acceptance is necessary and useful to help the policy makers, researchers and biotechnology companies to ensure their effectiveness and growth.

Key words: Adoption, academic researchers, biotechnology companies, optimization, policy makers.

INTRODUCTION

Today the perspective of biotechnology as a significant science has proposed considerable potential development for environmental compatibility, economic viability and social responsibility. Biotechnology is the next wave of knowledge-based activities to contribute and create wealth, new investment, challenges and opportunities of employment as well as environmental, social and economical vantages. It is recognized as an important key technology to drive and support knowledge-based opportunities (Amin and Ibrahim, 2011). Developing countries fail to keep up with the established pace in the new bio-economy according to institutional insufficiency (Buctuanon, 2001). There are three sectors and areas in biotechnology science, the first one Industrial biotechnology (also referred to as "White Biotechnology"), second one is Healthcare biotechnology ("Red biotechnology") and the last one is Agricultural biotechnology ("Green biotechnology").

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The Malaysian Biotechnology Information Center (MABIC) attempts to make technical information accessible to non-technical individuals, enhance public biotechnology awareness level and support the government's effort to develop biotechnology as an effective power to enable economic growth (9th Malaysian Plan, 2006). The goal of public and private sectors is to facilitate and acquire biotechnology applications obtained from industrial countries to developing ones for more benefits; and also the mission of the government is alleviating poverty by enhancing productivity, generating more income and providing a safe environment for more sustainable development. A comprehensive framework is provided by National Biotechnology Policy in 2005 to conduct biotechnology development efforts and outline goals, strategies and priorities. It is predictable that the support will be performed by strong existing of natural resources and human capital talent by government.

Biotechnology in Malaysia is the prime mover to act and catalyst the knowledge from related articles and publications like: Overview-Malaysian industrial biotechnology (2009), that discussed about rapid growth

Table 1. Reliability statistics.

Questionnaire sections	Cronbach's alpha	
Based on IVs and DV	**Academic researchers**	**Biotechnology companies**
Level of knowledge	0.771	0.807
Amount of fund	0.776	0.798
Level acceptance and receptiveness	0.800	0.752
Level of cooperation	0.833	0.810
Level of transfer of technology	0.762	0.800
Level of adoption	0.816	0.913
Total questionnaire (Section B. to G. together)	0.880	0.902

and biotechnology sector; it is considered that obtaining this stage was a great achievement; speed of adoption rate is fast and phase one (Capacity building, 2006 to 2010) is not accomplished by Malaysia biotechnology and adoption rate is not so fast (Farid and Silong, 2011). Obviously, government is an important hub to strive to grow the Malaysian biotechnology program and accelerate biotechnology innovation to create more benefits; it attempts to achieve milestone as soon as possible in future by past accomplishments. So the goal of innovation policy is facilitate and develop the application of biotechnology in Malaysia and promote scientific advances of public understanding; it also creates more productivity, more capability for government and economic sectors.

Based on mentioned details the main goal of this paper is to accelerate the speed of biotechnology innovation in phase two (2010 to 2015), convergence tendency and estimation efficiency of Ministry of Science Technology and Innovation (MOSTI) programs.

MATERIALS AND METHODS

To accelerate biotechnology innovation the MOSTI programs was efficient and it was the first goal of this study. It can be mentioned in some active academic centers in Malaysia in field of agriculture biotechnology, Universiti Putra Malaysia (UPM), Universiti Malaya (UM), Universiti Kebangsaan Malaysia (UKM), Universiti Sains Malaysia (USM). In bio-valley project, these universities are the principal participants. USM is an exception in this field of study because its concentration is on pharmaceuticals biotechnology not on agricultural biotechnology. The number of biotechnology researchers who are working in UM, UKM, UPM based on information of official website of universities is 98 (Farid et al., 2010).

MOSTI in Malaysia declared the number of agriculture biotechnology companies which are supported by this organization was 51 (Farid et al., 2011). Investigation of whole target population sample faces to some restrictions and according to mentioned criteria target populations are viewed to be the same in this survey based on belief of Creswell (2008) and Thompson (2002).

To do the data collection, a questionnaire has been designed and this research was performed quantitatively. The questionnaire is made by the researcher and a pilot test and board of specialists guaranteed its validity. Cronbach's alpha internal consistency assisted to measure the reliability of the questionnaire (Levy and Lemeshow, 2008; Cohen et al., 2007; Ary et al., 2006). The questionnaire has been replied by 24 academic staff from USM university of Biological Science department and 10 Malaysian biotechnology companies to manage and conduct the pilot test reliability. The only non-participants of target population research were stated respondents and the reason is area of their biotechnological activities which is concentrated on pharmacological not on agricultural; but to measure the validity of the questionnaire they are picked up because of the same field of their work. Biotechnology and academic members have prepared two adapted versions of questionnaires. Cronbach's alpha was utilized for any single item of the questionnaire. Academic members who are experts in field of biotechnology in universities and companies, R&D managers and director management, replied to distributed questionnaire and 0.880 and 0.902 is the result of reliability coefficient (Table 1). It is indicated that all coefficients were more than 0.70 and stability and consistency in distinctive constructs of items can be seen in corresponding answers. 51 companies in field of agricultural biotechnology and 98 academic members and experts who are working in biotechnology filed in UPM, UM, and UKM universities received the validated and reliable questionnaire. Rate of feedback for participants in university was 89.79% (N = 88) and rate of biotechnology company managers response was 90.19% (N = 46).

To carry out Logit model this data was used. Data collection by the questionnaire encompasses nominal, ordinal, and ratio scales. Nominal form refers to some questions about some aspects of personal characteristics like, activities companies and publication channel, experience and gender. In likert-type data collection, questions are in the form of ordinal and questions about age, experience and financial position are in the form of ratio. This data can be seen in distinctive statistical analysis. Descriptive statistics defined data rudimentary features and statistic summary. Male and female were the respondents in universities, 38.6% males and 61.4% female with the age of 35 to 58 years old. The responses were listed as follow: 35 to 40 years were 25%, 41 to 45 years were 29.5%, 46 to 50 years were 27.2%, 51 to 55 years were 14.7%, and more than 55 years old were 3.4%. Age factor mean is 45 years. It should be considered that education level of all the academic staff members were Ph.D. degree (N = 88). 43.2% professor, 28.4% associate professors, 23.9% senior lecturers and 4.5% lecturers were respondents in the analysis. All respondents who were 88 answered the questionnaire. 5 to 21 years were the range of academic experience. Classification of responses is defined as follow: for the range of 5 to 10 years' experience were 42%, 11 to 15 years were 29.5%, 16 to 20 years 27.2% and more than 21 years' experience were 1.1%. Academic experience mean was 12

Table 2. Innovations presented annually (2005 to 2008).

Level of adoption	Frequency	Percent
Low	88	100.0
High	0	0
Total	88	100.0

Mean = 0.66; Median = 0.75; Std. deviation = 0.19; Skewness = 0.25.

years. During 2005 to 2008 number of innovations was low according to representation of academic data collection. Rating value was 0.75, standard deviation was equal to 0.19 and rate of mean was 0.66 refer to scale of median rating value.

Annually no more than two innovation adoptions can be received by academic researchers based on data representation; it is fixed in an agreement which includes less than two innovations rating with low measurement. 28.3% females and 71.7% males involved in biotechnology companies were compared and 46 responded questionnaires were collected. Respondents' age range was 31 to 58 years old. 30 to 35 years = 19.6%, 36 to 40 years = 26.1%, 41 to 45 years = 23.9%, 46 to 50 years = 21.7%, 51 to 55 years = 2.2% and more than 55 years = 6.5%. 42 was age factor mean. The percentage of R&D managers was 63.0% and director management's participation was 37.0%. The education degree and level of participants this group and company were bachelor's degree (N = 4.3%), master degree 65.2% and Ph.D. holders were 30.4%. Range of participants' experiences was from 3 to 16 years; where, 1 to 5 years = 21.7%, 6 to 10 years = 58.7%, 11 to 15 years = 17.4%, and more than 15 years = 2.2%. Mean for the factor of working experience length was 8 years.

Possibility of an event happening between independent variables which include knowledge, acceptance, funds, cooperation and technology transformation and dependent variables, biotechnology innovations adoption rate was measured by Logistic regression (Logit model).

Logistic regression

The present research analyses a problem with five independent variables and 1 dependent variable which is biotechnology innovations adoption rate. To have exact and precise estimation a new method for measuring the adoption rate in social science was found, the logistic regression (Adeogun et al., 2008). While the target variables are classified into two categories to form a categorical variable, logistic regression was utilized as a predictive model. A decision tree is included in logistic regression model that relates to nonlinear regression like a set of data values as fitting a polynomial. Logistic regression has significant role since it has several advantages in distinguish analysis. Actually, independent variable and dependent variables are not normally distributed and it seems there is no relationship between dependent and independent variable. Also nonlinear effect may be managed. It should be mentioned that there is no homogeneity in variance supposition.

Hosmer and Lemeshow (2000) have spoken about the advantage of logistic regression model to linear regression model, demonstrating the connection and relationship between the dichotomous attributes of interest and set of independent variables to discover the best fitting model is the aim of logistic regression. To predict the possibility of interest presence in *logit transformation,* logistic regression creates the coefficients (and its standard errors and significance levels) of a formula:

$$logit(p_i) = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_n X_{ni} \quad (1)$$

Where, p_i is the possibility of the characteristic of interest presence and specified by the logistic function:

$$p_i = \frac{e^{(\beta_0+\beta_1 x_{1i}+\beta_2 x_{2i}+\cdots+\beta_n x_{ni})}}{1 + e^{(\beta_0+\beta_1 x_{1i}+\beta_2 x_{2i}+\cdots+\beta_n x_{ni})}} \quad (2)$$

The definition of logit transformation as the log odds indicates as:

$$odds = \frac{p_i}{1 - p_i} \quad (3)$$

and therefore the logits (natural log of the odds), of the unknown binomial possibilities are designed as a linear function of the X_i generally known as link function as:

$$Logit\ (p_i) = Ln\left(\frac{p_i}{1 - p_i}\right) = \beta_0 + \sum_{j=1}^{n} \beta_j\ X_{j,i}\ . \quad (4)$$

The logit model supposed that underlying stimulus index $logit(p_i)$ is a random variable, which anticipated the possibilities of biotechnology innovation adoption:

$$Chance\ of\ adoption = p_i = \left(\frac{1}{1+e^{-Logit\ (p_i)}}\right) = \frac{e^{Logit\ (p_i)}}{1+e^{Logit\ (p_i)}} \quad (5)$$

To calculate and analyse the possible effectively of MOSTI programmes on speeding up the rate of biotechnology innovations, the preceding formula have been applied and the probabilities and chances of adopting the innovations is predictable.

RESULTS

Calculations and information about the number of biotechnology innovations created by academics which have been displayed to public is shown in Table 2. Data collection during 2005 to 2008 has been done by cooperation of three Malaysian universities, UPM, UKM, and UM including their academic members in biotech-nology section; innovation which is demonstrated to the

Table 3. Characteristics of companies' biotechnology activities.

Variable	Frequency	Percent
Train personnel		
Less than 10	12	26.1
10 - 15	20	43.5
16 - 20	8	17.4
More than 20	6	13
Total	46	100
Source of skill		
Company trained	2	4.3
Job experience	6	13
University educated	38	82.6
Total	46	100.0
Nature of company		
Government-linked company	22	47.8
International company	9	19.6
Private company	15	32.6
Total	46	100.0
Type of MOSTI support		
Loans and Grants	31	67.4
R&D and commercialization support	6	13.0
Biotechnology Information	9	19.6
Total	46	100.0
Biotechnology activities		
Industrial processing	5	10.9
Non-GM agricultural biotechnology	9	19.6
GM agricultural biotechnology	32	69.6
Kind of innovation		
Technology financing	7	15.2
Technology development	10	21.7
Technology evaluation	4	8.7
Technology dissemination	5	10.9
Technology introduction / selling	9	19.6
Technology training	4	8.7
Technology use	5	10.9
Technology purchase (local/international)	2	4.3
Total	46	100.0

Source: Farid (2011).

public (including biotechnology companies) for researchers was low. In agreement of used scale, the median of value rate was 0.75 and standard deviation was 0.19. Rate of mean was 0.66. Rating of less than two innovations is considered as low; based on this rating level Table 2 displays that no academic researchers had more than two innovation adoption annually.

There is a summary of information about number of personnel who trained in field of biotechnology and had cooperation with each company in Table 3 that illustrated briefly by Farid (2011). This table represents the percentage of companies and number of trained personnel;

Table 4. Innovations adopted by companies (2005 to 2008).

Level of adoption	Frequency	Percent
Low	39	84.8
High	7	15.2
Total	46	100.0

Mean = 1.32; median =1.50; std.deviation = 0.75; skewness = 0.12.

Table 5. Annual innovations commercialized by companies (2005 to 2008).

Year	Frequency	Percent
2008	58	46.0
2007	27	21.5
2006	22	17.5
2005	19	15.0
Total	126	100.0

Table 6. Case processing summary.

Cases		N	Percent
Academic researchers			
	Included in analysis	88	100.0
Selected cases	Missing cases	0	0.0
	Total	88	100.0
Unselected cases		0	0.0
Total		88	100.0
Biotechnology companies			
	Included in analysis	46	100.0
Selected cases	Missing cases	0	0.0
	Total	46	100.0
Unselected cases		0	0.0
Total		46	100.0

a. If weight is in effect, see classification table for the total number of cases.

less than 10 trained employees in 26.1% of the companies, 10 to 15 trained ones in 43.5% companies, 16 to 20 trained personnel in 17.4% companies and finally in big companies the percentage is 13% and trained ones are more than 20. It can be seen in this table source of acquired skills and profession of personnel in companies. It is mentioned the percentage of companies which recruit university graduates, employees who got job experience skill and prepare their personnel training situation; the percentage for each group is 82.6, 13.0, and 4.3%. Data representation is as follow: 47.8% refers to government-connection companies, 32.6% belongs to private companies and international companies are 19.6%. Great portion of companies, that is, 67.4% got the loan and biotechnology actions are supported by provided grants of MOSTI. Provided biotechnology information by MOSTI has been used by 19.6% of the companies and 13.0% of R&D; and also commercialization support is performed by MOSTI.

Concentration of this research is on biotechnology innovations of agricultural and target population includes only companies which are active in this field. The total number of involved companies is 46; the percentage of non-GM agricultural biotechnology companies was 19.6% while only 10.9% of companies were cooperating in the industrial processing field.

The technological innovation connection activities performed by the participant companies encompass financing, dissemination, development, introduction/ selling, evaluation, training, use and purchase which are shown in Table 3. The percentages for any single type of activity were 15.2, 21.7, 8.7, 10.9, 19.6, 8.7, 10.9, and 4.3%, respectively.

Information and calculation are shown in Tables 4 and 5; it is about number of adoption of biotechnology innovations and every company between 2005 and 2008 did commercialize them.

Biotechnology companies active during 2005 to 2008 involved in data collection process are represented in Table 4. In agreement with low adopted innovation which is considered as less than two, seven companies were high in innovation adoption while 39 companies were low in this process. 1.50 was the median value rate, standard deviation was 0.75. The mean of rating was 1.32.

Innovation commercialized by Biotechnology companies in 2005 to 2008 totaled 126 can be seen in Table 5. Distribution in following years is indicated: 46.0% in year 2008, 21.5% in 2007, 17.5 and 15.0% in 2006 and 2005, respectively.

The results of data collection analysis which has been done by logistic regression are presented in Table 6; collected data refers to 46 biotechnology companies and 88 questionnaires returned from university biotechnology academics. Explanation about the details of analysis is indicated below the table.

In Table 6 in the case procedure, no absence of values can be seen and all 88 questionnaires returned and replied by university biotechnology academics; they are utilized via logistic model analysis. 46 questionnaires which have been answered by biotechnology companies are included in analysis. Therefore in Table 6, throughout case procedure no missing value is seen. It is considered to utilize performed conversion of variables value to binary values and attempt to fit them in logit model. Five values are designed according to Likert scale (strongly disagree, disagree, somewhat agree, agree, strongly agree). Positive values (somewhat agree, agree and strongly agree) were equal to the value 1 while the nega-

Table 7. Analysis of maximum likelihood estimates.

Variables		B	S.E.	Wald	Df	Significance	Exp (B)
Academic researchers							
Step 1[a]	Level of knowledge (Avr.B)	0.018	1.518	0.000	1	0.990	1.018
	Amount of fund (Avr.C)	2.686	1.229	4.777	1	0.029	14.678
	Level of acceptance (Avr.D)	0.810	0.753	1.157	1	0.282	2.248
	Level of cooperation (Avr.E)	2.577	1.676	2.364	1	0.124	13.157
	Level of transfer of technology (Avr.F)	3.812	1.239	9.463	1	0.002	45.253
	Constant	-28.620	11.497	6.197	1	0.013	0.000
Biotechnology companies							
Step 1[a]	Level of knowledge (Avr.B)	2.406	4.064	0.351	1	0.554	11.094
	Amount of fund (Avr.C)	16.554	9.000	3.383	1	0.066	1.546E7
	Level of acceptance (Avr.D)	0.620	2.500	0.062	1	0.804	1.860
	Level of cooperation (Avr.E)	-13.478	10.557	1.630	1	0.202	0.000
	Level of transfer of technology (Avr.F)	9.760	4.697	4.317	1	0.038	1.733E4
	Constant	-39.435	20.222	3.803	1	0.051	0.000

a. Variable(s) entered on step 1: Avr.B, Avr.C, Avr.D, Avr.E, Avr.F.

tive values (strongly disagree and disagree) were equal to the value, both questionnaire variables are converted into binary variables.

Explanation of results importance for academic researchers is shown in the first section of Table 7. In this table, Wald statistic and all corresponding significance level are indicated. Significance of covariate and dummy independents have been tested and examined and the result is exhibited in the table. To test the significance of statistic of each coefficient (B), the Wald test is used. The ratio of the logistic coefficient B to its standard error (S.E.), squared, equals the Wald statistic. Sig is less than 0.05 and model possesses significant parameter if the Wald statistic is significant.

"Exp (B)" is appointed in exponentiation of the coefficients and explained and clarified them as odds-ratios. It is the anticipated change in odds for any single unit goes up in the independent variable correspondent. It is considered that odds ratios which are less than 1.0 correspond will be reduced and odds ratios more than 1.0 correspond will increase in odds. Odds ratios near to 1.0 exhibit that changes of unit in that independent variable do not impact and affect the dependent variable. If *p*-value of independent variables, level of cooperation (Avr.E), amount of fund (Avr. C), level of transfer of technology (Avr.F), level of knowledge (Avr.B) and level of acceptance (Avr. D) is 0.05 or lesser; the null hypothesis, no difference between the coefficients (B) of independent variables can be refused. Table 7 illustrates that the *p*-value of independent variables (Avr. C and Avr.F) are less than 0.05, therefore the null hypothesis, that there is no difference between the coefficients (B) of independent variables, is rejected for academic researchers. Also first part of Table 7 that shows academic researchers' data demonstrates that Avr.C (amount of fund) and Avr.F (level of transfer of technology) are statistically significant with *p*-values of 0.029 and 0.002, respectively while, Avr.B (level of knowledge), Avr.D (level of acceptance) and Avr.E (level of cooperation) are not. Exp (B) (odds ratio) is used for logical interpretation. It can be said that for a one unit change in Avr.C and Avr.F, the Exp(B) of *effect of MOSTI programs on accelerating biotechnology innovation* changes by a factor of 14.678 and 45.253, respectively for academic researchers.

The estimated model is used to predict probability of effect of MOSTI programs on accelerating biotechnology innovation from academic researchers' viewpoint:

$$Logit(p_i) = Ln\left(\frac{p_i}{1-p_i}\right) = -28.620 + 2.686AvrC + 3.812AvrF \quad (6)$$

In this study, 5 units are considered for predictors, then the level of possibility of adoption and acceptance of biotechnology companies are calculated as follows:

$$Logit(p_i) = -28.620 + 2.686AvrC + 3.812AvrF = -28.620 + 2.686 \times 5 + 3.812 \times 5 = 3.87 \quad (7)$$

$$Chance\ of\ adoption = p_i = \frac{e^{Logit\ (p_i)}}{1+e^{Logit\ (p_i)}} = 0.97 \quad (8)$$

Percentage of chance based on MOSTI program support dedication to biotechnology innovation to speed up this

Table 8. Effect of MOSTI programs on accelerating biotechnology innovation.

Test	Unit	Result
Logistic regression	Academic researchers	Amount of fund (Avr.C) Level of transfer of technology (Avr.F)
	Biotechnology companies	Level of transfer of technology (Avr.F)

process from point of view of university academics is 97%; while all remaining factors are constant and stable and just 5 units are dedicated to predictors.

The second part of Table 7 belong to biotechnology companies' data that illustrates the p-value of independent variables (Avr.F) is less than 0.05, therefore the null hypothesis, that there is no difference between the coefficients (B) of independent variables, is rejected for biotechnology companies. In addition, this table shows that Avr.F (level of transfer of technology) is statistically significant with p-values of 0.038, while Avr.B (level of knowledge), Avr.C (amount of fund), Avr.D (level of acceptance) and Avr.E (level of cooperation) are not. Exp (B) (odds ratio) is used for logical interpretation. It can be said that for a one unit increase in Avr.F, the exp (B) of ***effect of MOSTI programs on accelerating biotechnology innovation*** increases by a factor of 1.733E4 for biotechnology companies.

Probability of the effects of MOSTI programs on accelerating biotechnology innovation is calculated by the following formula for biotechnology companies:

$$Logit(p_i) = Ln\left(\frac{p_i}{1-p_i}\right) = -39.435 + 9.76AvrF \qquad (9)$$

When 5 assigned units are available for predictors, the possibility of a company's acceptance and adoption refer to biotechnology innovation is computed as follow:

$$Logit(p_i) = -39.435 + 9.76AvrF = -39.435 + 9.76 \times 5 = 9.365 \qquad (10)$$

$$Chance\ of\ adoption = p_i = \frac{e^{Logit\ (p_i)}}{1+e^{Logit\ (p_i)}} = 0.99 \qquad (11)$$

According to MOSTI program 99% chance for company to adopt and accept biotechnology innovation is possible based on obtained results, when all other thing is constant and stable. More detail can be found in Table 9.

Totally dependent variable is impacted by every single independent variable; in above calculation average of response for dependent variable is the reason for this influence. Understanding and comparing of outcomes is easy by Table 8, it indicates gained outcomes and results of collected questionnaire which are responded by companies of biotechnology and academic researches.

These variables which have great effect on MOSTI programs are level of transfer of technology and amount of fund. It has come from the point of view of university researchers. Database of company assists the understanding that the only thing affects on accelerating of biotechnology innovation which is offered by MOSTI program is the level of transfer of technology. The common exists between perspective of companies of biotechnology and researchers of universities about the variable of technology transformation level according to the consequences of this study.

DISCUSSION

Adoption rate is computed and measurement of possibility of biotechnology innovation according to main factors of logistic regression is conducted. It is explained in the following discussion about university and company-related data. Predicting innovation adoption possibility by companies is one of the major advantages of logistic regression. Economic justification and strategies of empirical model in Malaysia has been drawn and improved by biotechnology innovation based on agreement of universities researchers. Each unit possibility is anticipated by logistic regression model and it has been done for predictors. Graph of adoption possibility is designed when every single unit is assigned to predictors and change of percentage representation in biotechnology adoption chances by mentioned companies is so clear through this graph. All graph codes are run with MATLAB 7.0 software and all algorithms are done on a PC with Core DUA CPU. Table 9 and Graphs 1 and 2 exhibit chances for different allocated units.

The possibility of biotechnology innovations acceptance is represented obviously in the graph. In Figures 1 and 2, unit values for predictors is indicated by X axis and Y axis possibility in effect of MOSTI programs on accelerating biotechnology innovation adoption is shown while other factors are stable.

As can be seen in Figure 1, the acceptance possibility of effect of MOSTI programs on accelerating biotechnology innovation will occur by companies and it is 100% if allocated units are a bit more than 5 for predictors. The following graph exhibits chance of effect of MOSTI programs on accelerating biotechnology innovation for each unit value which is allocated to predictors. It is interpreted that adoption chance is not raised up in a

Table 9. Chance percent for accelerating biotechnology innovation based on each unit.

Parameter	Value						
Academic researchers							
x	0	1	2	3	4	5	6
Logit (pi)	-28.620	-22.122	-15.624	-9.126	-2.628	3.870	10.368
Pi	0.000	0.000	0.000	0.0001	0.0674	0.9796	1.000
Biotechnology companies							
X	0	1	2	3	4	5	6
Logit (pi)	-39.435	-29.675	-19.915	-10.155	-0.395	9.365	19.125
Pi	0.000	0.000	0.000	0.000	0.4025	0.9999	1.000

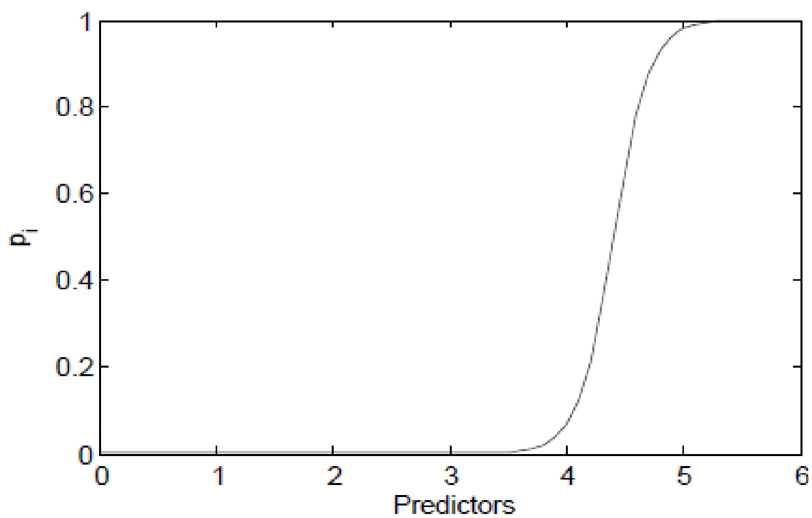

Figure 1. Chance of effect of MOSTI programs on accelerating biotechnology innovation based on academic researchers' data.

monotonous way. To have the chance more than 0%, around 4 allocated units should exist for predictors. It means that when the selected number for units is between (0, 4), adoption chance Is still 0% as view of academic researchers. The slope, interval [4, 6) is the most important and effective interval to speed up the chance of adoption, as it rises up very fast from near 0 to 100%.

As represented, in Figure 2 the possibility of acceptance by companies is 100% if the allocated units for predictor are 5 and the possibility of acceptance can be 0% if allocated units are less than 3. It means that the consequence of one unit in interval (3.5, 4.5) is most impressive and effective, and can rise up adoption chance from 0 to 100%.

Conclusion

Based on university researches, economic growth and benefits in Malaysia can be achieved by biotechnology innovation and it is a powerful tool which represents environmental, economical and social vantages. Creation of new products, new innovation and new companies are big issues in Malaysia. Based on assessment and data collection analysis need for biotechnology can be sensed and wide efforts are being performed by Malaysian government to have comprehensive and measured framework.

Technological innovation in competitive world has great role in science, research and investment of technology; investment at the beginning of research stage leads to find its potential. To utilize and control these opportunities it is important to find effective, leveraged and scalable way to bridge them from MOSTI programs to research centers of universities.

The results of this study show that only the factor of level of transfer of technology is known as a common effective factor both for academic researchers and biotechnology companies. This shows that these very important sectors do not have sufficient understanding about each other's needs and therefore are not able to

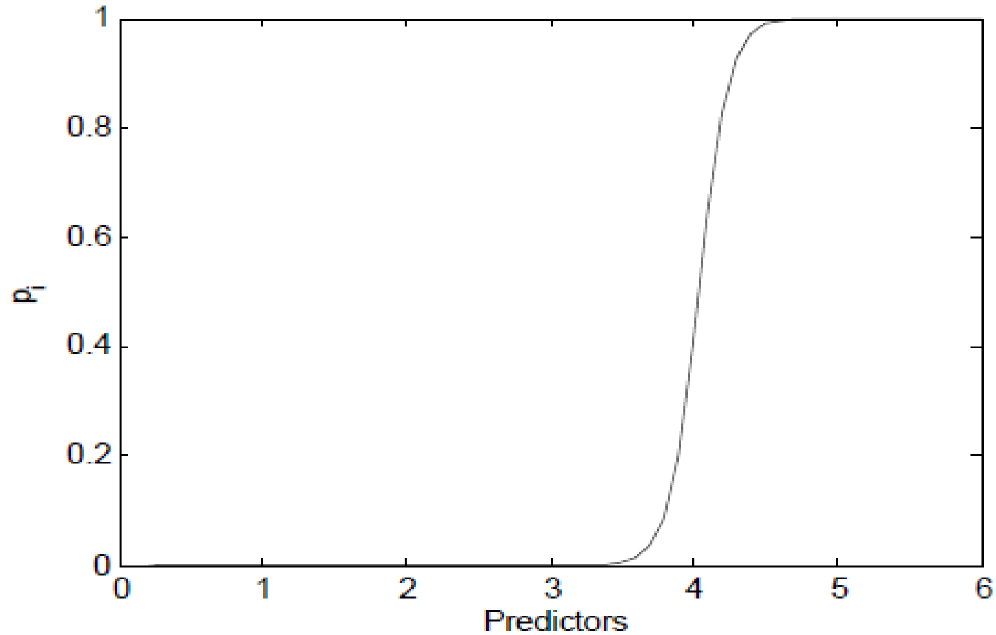

Figure 2. Chance of effect of MOSTI programs on accelerating Biotechnology Innovation by using biotechnology companies' data.

collaborate effectively. The government should pay more attention to provide researchers with sufficient information about the companies' needs and demands and on the other hand, companies should be informed about the innovations made by university researchers. This collaborative work among government, researchers and companies are inevitable if policy makers are interested in accelerating the rate of biotechnology innovation adoption and use biotechnology as an engine of growth in economical and scientific aspects.

Innovative process depends on sufficient fund and budget and also technology transformation level from the perspective of researchers. More concentration on these aspects is needed to accelerate biotechnology innovation as one of the important goals to form a technology transformation by MOSTI. By allocating sufficient funds and restricting providing the funds to those companies and researchers who are more interested in collaborating, MOSTI may be able to achieve its goals with regard to accelerating the rate of biotechnology innovation creation and adoption in biotechnology companies and academic research centers.

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