



Understanding Information Operations and Economic Impacts in the Digital Era

Varin Pulpol, Tanpat Kraiwanit* and Narong Petprasert

Faculty of Economics, Rangsit University, Pathum Thani, Thailand

* Corresponding author, e-mail: tanpat.k@rsu.ac.th

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Abstract

This research aimed to investigate whether demographic factors and the knowledge and understanding of information operations (IOs) affect the attitudes of Thai people towards economic impacts. Data were collected from 602 Thai Internet users, aged 18 years or over, via an online survey. Then, the data were analysed through ordered logistic regression to test the hypotheses. The dependent variables consist of three directions: positive attitude, uncertain attitude, and negative attitude. The set of independent variables includes gender, education level, occupation, average monthly income, average monthly savings and social media tools. The value of the knowledge and understanding of information operations is a covariate variable in this study. The analysis shows that the respondents' education level is the only factor that has significance for their attitude towards economic impacts. The paper suggests that the knowledge and understanding of IOs can help society to recognize better the need to scrutinize news and whether news should be trusted. Meanwhile, education levels contribute to the understanding of IOs and predictions of economic impacts; therefore, the competent authorities should widely the information operations disseminate at all levels of education to create a better society, eliminate distorted news and contribute to economic growth.

Keywords: *Knowledge and understanding of information operations, IOs, Attitude towards economic impacts, Ordered logistic regression, Digital era*

1. Introduction

Information influences people's attitudes in many respects, such as their attitudes towards the dimensions of economics, politics, investment or psychology. Nowadays, even though the rapid development of information technology enables quick and boundless information consumption, the potentiality of information operations is still increasing because information operations are not just used in battles or wars but are weapons that anybody can create. For example, in the case of the US presidential election of 2016 between Donald Trump and Hilary Clinton, Cambridge Analytica harvested profile data from 87 million Facebook users, without their permission, and used those data to exploit Donald Trump's campaign for the Republican Party. Many people believe that this basic information was used to conduct information operations in support of Donald Trump. Therefore, it can be said that, if anyone has the ability or "skill" to use different types of media better or more effectively, they will be able to use information operations better than another party. The purpose of this research is to perform a case study of information operations (IOs) (Workpointtoday, 2019).

Information operations (IOs) could be a category of coordinated and backhanded bolster operations for the United States military. They are the integrated businesses of electronic warfare (EW), computer network operations (CNOs), psychological operations (PSYOPs), military deception (MILDEC) and operations security (OPSEC), in concert with indicated supporting and related capabilities. Information operations (IOs) are used to affect, disturb, degenerate, or wrest the antagonists, by using human or robotized choice making, whereas securing the security of themselves. It can be said that IOs are activities undertaken to influence one's adversary's data and data frameworks while protecting one's own data and data frameworks (Command, 2012).

As mentioned above, as a rough indication, to use the most efficient IOs, it is necessary to rely on all media, through word of mouth or proclamation or through an intermediary, such as newspapers and television. In the past, the government made the most effective use of IOs because of its role and power to

communicate and reach most people. Nowadays, most people have access to various social media, and everyone can produce their own media, so the most efficient use of IOs is not just made by governments, as can be seen from the case of Cambridge Analytica and Facebook, which are both private companies. IOs are not used just for one's own benefit or for attacking an opponent. They can also be used for development in various fields, for example to raise the popularity of someone or something without causing any harm to others (Puengnetr, 2020).

2. Literature review

Economic impacts stem from any economic events that occur in a specific area and can influence a single neighbourhood or affect the whole world. For example, the economic impacts of COVID-19 might be a dramatic decrease of national GDPs globally, a reduction of household consumption and a decrease of business revenues and profits (Chetty, Friedman, Hendren, Stepner & The Opportunity Insights Team, 2020).

Attitudes can be defined as the feelings and thoughts of an individual, both negative and positive, such as perspective, fear, belief and bias regarding a particular topic. Attitudes are usually presented through personal opinions; hence, the opinions of an individual are representations of personal attitudes (Zunick, Teeny & Fazio, 2017). Phalusuk and Ponghanyut (2002) divided attitudes into three types: positive, negative and passive. A positive attitude is having positive feelings or being satisfied with something, while a negative attitude means having negative or unpleasant feelings towards something. A passive attitude involves feeling neutral towards something, which might be caused by a lack of knowledge and understanding of that issue.

The dependent variable in this study is the attitudes of Thai people towards economic impacts; therefore, the definition of this dependent variable is the personal feelings of Thai people about economic impacts, which might be affected by the independent variables in this study, together with the covariance, the level of knowledge and the understanding of information operations.

There are many factors that can influence individuals' attitudes, for example demographic factors such as education level and income. Boonsri (2013) produced a study titled "The Media Effect on Political Participation: The Case Study of Ratchadamnoen Political Rallies, 2013". The results of this study indicate that participants with different education backgrounds and monthly incomes were exposed to the media differently and participated in politics differently.

Cordero, Muniz and Polo (2016) aimed to extend the literature about the role played by socio-economic and family backgrounds in educational outcomes by comparing the determinants of two different dimensions of educational output: academic achievement and non-cognitive traits. They explored the information provided by a self-reported survey developed specifically for the purpose of their research. This provided an innovative measure of non-cognitive performance based on particular personal traits, such as responsibility, effort, motivation and critical capacity, as well as a common measure of cognitive proficiency. They used a Bayesian approach to estimate the potential influence of multiple individual and family variables on both dimensions of educational output. From the results, they found that, despite some similarities, there are several important divergences with regard to some socio-economic variables that have traditionally been considered to be the most influential determinants of academic achievement, which do not appear to have a significant impact on non-cognitive outcomes.

Vaarmets, Liivamagi and Talpsepp (2019) assessed how different types of learning affect the disposition effect by using the NASDAQ OMX Tallinn data set. They employed survival analysis to show that intelligence and potentiality of learning based on education levels and types of education can reduce the disposition effect. Investors who are smarter or have obtained higher education are able to learn faster by trading. The findings showed that mathematical abilities are beneficial for overcoming the limitations of management skills and learning abilities are an important factor for intelligence, affecting management skills.

3. Objectives

- 1) To study and analyse people's understanding and knowledge of information operations.
- 2) To study the variables affecting economic predictions in the digital era.

4. Materials and methods

For this survey research, the population is Thai citizens aged 18 years or above from six regions of Thailand (north, northeast, west, central, east and south), who access social media regularly. People aged 18 years or above are assumed to have sufficient psychosocial maturity, base knowledge and cognitive skills to engage in critical thinking and independent decision making. Meanwhile, internet users who usually access social media such as Facebook and Twitter are more likely to perceive a larger amount of online information created by information operations (IOs) than those who do not use social media regularly. Through convenience sampling, 602 people were selected as samples. To decrease the bias of the data and to represent the population in each region, 100 samples from each region of Thailand were selected; therefore, 602 samples are adequate to represent the population of the whole country. The data were collected via an online survey created by Google Form and were then analysed using ordered logistic regression (OLR) since the dependent variable is ordinal. The independent variables are demographic factors, including gender, education level, occupation, average monthly income, average monthly savings and social media platforms. The dependent variable is people's attitudes towards economic impacts, measured with a covariate variable, the score of the knowledge and understanding of information operations.

5. Results and discussion

5.1 Results

Table 1 Determination of score values for demographic factors

Demographic factors	Chi-square	Percentage weight
Age	241.211	20.70
Education level	87.243	7.49
Occupation	204.356	17.54
Status	66.842	5.74
Average monthly income	204.347	17.54
Average monthly savings	192.65	16.54
Social media platforms	168.369	14.45
Total	1165.018	100

From Table 1, it is apparent that the most significant factor is age, which has the largest weight value of 20.70%, followed by occupation and average monthly income, which present the same weight values of 17.54%. Status shows the lowest percentage weight of 5.74%.

Table 2 Percentage weight of individual variables in each group of dependent variables

Variable	Weight	Sub-weighted
Age (years)	100	20.70
18–24	48.84	10.11
25–31	23.09	4.78
32–38	5.98	1.24
39–45	7.14	1.48
46–52	8.47	1.75
53 or over	6.48	1.34
Education level	100	7.48
Lower than bachelor's degree	20.10	1.51
Bachelor's degree	71.93	5.39
Master's degree or higher	7.97	0.60

Variable	Weight	Sub-weighted
Occupation	100	17.54
Student	47.67	8.36
Government officials/state enterprises	10.80	1.89
Private employee	13.95	2.45
Employee	5.15	0.90
Self-employed	18.94	3.32
House husband/housewife	2.49	0.44
Others	1.00	0.17
Status	100	5.74
Single	75.25	4.32
Married	21.76	1.25
Widowed/divorced	2.99	0.17
Average monthly income	100	17.54
15,000 baht and lower	50.00	8.77
15,001–30,000 baht	27.41	4.81
30,001–45,000 baht	9.47	1.66
45,001–60,000 baht	5.81	1.02
60,001–75,000 baht	2.16	0.38
75,001 baht and over	5.15	0.90
Savings	100	16.54
5,000 baht and lower	55.32	9.15
5,001–10,000 baht	27.41	4.53
10,001–15,000 baht	8.47	1.40
15,001–20,000 baht	3.49	0.58
20,001–25,000 baht	1.50	0.25
25,001 baht and over	3.82	0.63
Social media platforms	100	14.45
LINE	17.28	2.50
Facebook	53.49	7.73
Twitter	16.45	2.38
Instagram	11.46	1.66
Others	1.33	0.19

Table 2 shows the percentage weight of individual variables in each group of dependent variables. The variables 18–24 years old, bachelor's degree, student, single, average monthly income of 15,000 baht and lower, savings of 15,000 baht and lower, and Facebook have the greatest weights of 48.84, 71.93, 47.67, 75.25, 50, 55.32 and 53.49, respectively.

Table 3 Test of the data distribution and adjusting the values for normality

		Before adjusting*	After adjusting*	Formula for adjusting data
Age	Skewness	-2.27	0.29	Cubic
	Kurtosis	-8.487	-9.965	Cubic
Education	Skewness	-10.26	-0.28	Square root
	Kurtosis	-4.387	-9.62	Square root
Occupation	Skewness	-0.56	Constant	
	Kurtosis	-9.020	Constant	
Status	Skewness	-12.37	-11.77	Square root
	Kurtosis	-1.7234	-3.065	Square root
Average monthly income	Skewness	-5.05	-1.62	Square root
	Kurtosis	-6.442	-8.9598	Square root
Savings	Skewness	-6.31	-3.12	Square root
	Kurtosis	-5.683	-8.93467	Square root
Social media Platforms	Skewness	-1.87	Constant	
	Kurtosis	-9.512	Constant	

* Statistic/std error normality test.

In Table 3, the data are not normally distributed (negatively skewed) and need to be adjusted to the most normal distribution by using the square root (education level), square root (status), square root (income) and square root (savings). The results after adjustment do not provide a perfectly normal distribution, and they indicate that age is highly *negatively skewed*, so the cubic (age) formula was used.

Table 4 Attitudes of Thai citizens towards economic impacts

Predicted impact	Frequency	Percentage
Negative	171	28.4
Uncertain	221	36.7
Positive	210	34.9
Total	602	100.0

In Table 4, the economic impacts estimated by 602 participants show that 34.9% of the participants assessed economic impacts with a positive attitude, while 36.7% viewed them with uncertainty. In addition, 28.4% of the samples estimated negative impacts on the economy.

Table 5 Model-fitting information of attitude towards economic impacts

Model	Model-fitting criteria		Likelihood ratio tests	
	-2 log-likelihood	Chi-square	df	Sig.
Intercept only	959.802			
Final	902.441	57.361	42	0.047

Table 5 shows the model-fitting criteria test statistics. The intercept only of the -2 log-likelihood equals 959.802, and the final of the -2 log-likelihood equals 902.441. In the likelihood ratio test, the final has a Chi-square equal to 57.361 and a significance of 0.047, indicating the significance level of 0.05. Therefore, the test indicates that the model can explain the dependent variables.

Table 6 Pseudo R-square of attitude towards economic impacts

Cox and Snell	0.091
Nagelkerke	0.102
McFadden	0.044

Table 6 shows that the pseudo R-square coefficient of Cox and Snell equals 0.091, the Nagelkerke R-square equals 0.102 and the McFadden R-square equals 0.044. These results indicate that the model can explain the dependent variables.

Table 7 Likelihood ratio tests of attitude towards economic impacts

Effect	Model-fitting criteria	Likelihood ratio tests		
	-2 log-likelihood of reduced model	Chi-square	df	Sig.
Intercept	902.441 ^a	.000	0	0.000
SCORE	907.303	4.861	2	0.088
sqrt_ed	916.001	13.560	4	0.009
sqrt_status	908.131	5.689	4	0.224
sqrt_income	915.793	13.352	10	0.205
sqrt_savings	908.907	6.466	10	0.775
cub_age	908.803	6.362	10	0.784
GENDER	903.445	1.004	2	0.605

Note: The Chi-square statistic is the difference in the -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all the parameters of that effect are 0.

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

From Table 7, it can be seen that the only factor that affected the attitude towards economic impacts was the level of education (sqrt_ed), which resulted in a -2 log-likelihood of 916.001, a Chi-square of 13.560 and a sig. value of less than 0.05; therefore, this means that the education level is suitable for use as a predictor of the knowledge and understanding of information operations and attitudes towards economic impacts.

Table 8 Model-fitting information on the education level

Model	Model-fitting criteria	Likelihood ratio tests		
	-2 log-likelihood	Chi-square	df	Sig.
Intercept only	211.778			
Final	195.234	16.544	6	.011

In Table 8, the model-fitting criteria test statistics show that the intercept only of the -2 log-likelihood is equal to 211.788 and the final is equal to 195.234. In the likelihood ratio test, the final Chi-square is equal to 16.544 and the sig. value is equal to 0.011 at the significance level of 0.05. Therefore, the statistics indicate that the attitude towards economic impacts depends on the respondents' education and understanding of information operations.

Table 9 Pseudo R-square of the education level

Cox and Snell	0.027
Nagelkerke	0.031
McFadden	0.013

Table 9 shows that the pseudo R-square coefficient of the Nagelkerke R-square equals 0.031, which indicates that the dependent variable can be described as scoring 3.1%.

Table 10 Likelihood ratio tests of the education level

Effect	Model-fitting criteria	Likelihood ratio tests		
	-2 log-likelihood of reduced model	Chi-square	df	Sig.
Intercept	195.234 ^a	0.000	0	0.000
SCORE	202.364	7.130	2	0.028
sqrt_ed	206.003	10.769	4	0.029

Note: The Chi-square statistic is the difference in the -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all the parameters of that effect are 0.

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

Table 10 shows that the factors influencing the knowledge and understanding of information operations and attitude towards economic impacts are education (sqrt_ed) with the sig. value of less than 0.05. These results show that independent variables are appropriate for forecasting people's attitudes towards economic impacts at the significance level of 0.05.

Table 11 Coefficient of variables in the ordered logistic regression of education level

EXPECT ^a	B	Std error	Wald	df	Sig.	Exp(B)	95% confidence interval for Exp(B)	
							Lower bound	Upper bound
Negative	Intercept	-1.039	0.379	7.501	1	0.006		
	SCORE	0.119	0.058	4.239	1	0.040	1.127	1.006 1.263
	[sqrt_ed=0.36]	0.413	0.430	0.921	1	0.337	1.511	0.650 3.513
	[sqrt_ed=2.28]	0.429	0.269	2.554	1	0.110	1.536	0.907 2.601
Uncertain	Intercept	-0.949	0.358	7.017	1	0.008		
	SCORE	0.133	0.055	5.964	1	0.015	1.143	1.027 1.272
	[sqrt_ed=0.36]	0.939	0.377	6.190	1	0.013	2.557	1.220 5.358
	[sqrt_ed=2.28]	0.572	0.252	5.149	1	0.023	1.772	1.081 2.904

a. The reference category is positive.

b. This parameter is set to zero because it is redundant.

Table 12 Predictor coefficients of the education level by the ordered logistic regression model

Variables	Negative vs positive		Uncertain vs positive		Uncertain vs negative	
	B	Exp(B)	B	Exp(B)	B	Exp(B)
Education group (reference = master's degree and higher)						
Lower than undergraduate	0.413	1.511	0.939	2.557*	-0.939	0.391*
Undergraduate	0.429	1.536	0.572	1.772*	-0.572	0.564*

It can be seen from Table 12 that, when comparing a positive attitude with a negative attitude, if the education level is lower than a bachelor's degree, there is a negative attitude score of 1.511. If the education level is a bachelor's degree rather than a master's degree or higher, there is a negative attitude towards economic impacts of 1.536. This means that groups with lower education levels have a lower likelihood of having negative attitudes than higher educated groups.

When comparing an uncertain attitude with a negative attitude, people with an education level lower than a bachelor's degree show an uncertain attitude towards economic impacts of 0.391. Meanwhile, people

who have obtained a bachelor's degree show an uncertain attitude towards economic impacts of 0.564. This means that people with lower education have a lower likelihood of having an uncertain attitude than more educated groups.

The ordered logistic regression analysis shows that the factor that influences the knowledge and understanding of information operations and attitudes towards economic impacts in the digital era is education (*sqrt_ed*), which can be described in the two following points:

1. If the knowledge scores increase by 1 point, the negative attitude will be increased by 0.119 (Table 11). If people have reached an education level lower than a bachelor's degree, it tends to increase the chance of having a negative attitude towards economic impacts by 0.413 (Table 12). Meanwhile, when the population has education higher than a bachelor's degree, there is no significant difference in the attitude towards economic impacts.

2. If the knowledge scores increase by 1 point, the estimation of an uncertain impact will increase by 0.133 (Table 11). If people have attained a lower education level than a bachelor's degree, the chances of having a negative attitude towards economic impacts will increase by 0.939 (Table 12), while, when the population has an education level higher than a bachelor's degree, there is no significant difference in the attitude towards economic impacts.

5.2 Discussion

The personal attitudes towards economic impacts of 602 respondents show that 65.1% of Thai citizens have uncertain and negative attitudes towards economic impacts; this may be because of anxiety about the economic conditions, politics or pandemics, especially COVID-19, which is a current global problem. The Thai economy depends on the economies of foreign countries; therefore, it has shrunk severely during the COVID-19 pandemic as the COVID-19 virus is affecting the global economy heavily (Siam Commercial Bank, 2020). The tourism sector, which contributes 15% of the Thai GDP, has been extremely badly affected due to the complete lack of foreign tourists since March 2020. Moreover, exports and private consumption in Thailand were projected to decline by 6.3% and 3.2%, respectively, in 2020 as the COVID-19 pandemic is ongoing and countries have not recovered from the world economic crisis yet (The World Bank, 2020). Therefore, the perception of all these crises might lead people to have uncertain and negative attitudes towards the economic impacts in Thailand.

In this study, the education level is the only variable affecting the attitude of Thai citizens towards economic impacts. The findings indicate that participants in higher education groups have a greater likelihood of holding a negative attitude towards economic impacts than people with lower education levels. Highly educated people tend to engage in more critical thinking, which is the skill that allows people to trust, reject or be sceptical about the information received (Cooke, 2017; Yue, Zhang, Zhang & Jin, 2017). Therefore, it is hard to assess this group of people quickly as they will consider an issue from all perspectives and this might affect the adoption of economic measures and policies specified by the government. For example, when the government launches a measure to stimulate the domestic economy during the COVID-19 crisis, such as a half-price co-payment campaign, people with higher education might be sceptical about this campaign and tend to research and analyze the pros and cons using many sources before adopting it. Recognizing the attitude of people with higher education based on this study can help to create a strategy for acceptance of government campaigns. In this case, the government should provide sufficient and reliable information to enhance the adoption of economic campaigns among people with higher education. When the campaign is conducted and participated in quickly, there will be a larger cash flow in the local economic system, leading to an increase in private consumption and the recovery of the domestic economy.

Other variables that were not significant in this study, including the score of the knowledge and understanding of information operations, have not been tested for multicollinearity yet as this is not the assumption of ordered logistic regression. Therefore, for further studies, these factors should be tested for multicollinearity by using other statistical methods, such as a correlation plot, to ensure that they are really uncorrelated with people's attitudes towards economic impacts. In addition, the insignificance of variables might be caused by an abnormal distribution of dependent variables. Even though the data were adjusted by using the square root, the distributions of many groups of data were still not normal, and this can be overcome by increasing the size of the samples.

6. Conclusion

The analysis showed that the education level is the only factor with significance for Thai people's attitudes towards economic impacts. If the knowledge scores increase by 1 point, the negative attitude towards economic impacts will increase by 0.119. If people have obtained a lower than a bachelor's degree, their chances of having a negative attitude towards economic impacts will increase by 0.413. In addition, if there is a shift in the education level to having a bachelor's degree, there will be no significant difference in the attitude towards economic impacts. If the knowledge scores increase by 1 point, the uncertain attitude towards economic impacts will increase by 0.133. The Nagelkerke R-square equals 0.031, and the dependent variable can be described as scoring 3.1%.

Suggestions

The knowledge and understanding of information are very important nowadays because, if people are aware of whether the information that they receive is true, it will benefit the knowledgeable and have a positive impact on others; for example, people will not be deceived or distrustful. To combat "fake news" to make society livable and to receive more truthful news by informing responsible agencies, the following recommendations are made:

- 1) The knowledge and understanding of information operations can help society to recognize better the need to scrutinize news and identify which news should be trusted or not trusted. Therefore, it is vitally important to spread the content or articles to be thoroughly informed about information operations.
- 2) At the same time, education levels contribute to the understanding of information operations, the predictions of economic impacts in the digital age and whether they are positive, uncertain or negative; therefore, the competent authorities should disseminate the information operations widely at all levels of education to create a better society, eliminate distorted news and contribute to economic growth.

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