

Effects of Social Media on Religious Belief: Causal Machine Learning Approach

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Outline

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Introduction

- Causal relationships are very common in both life and science.
- Studies using solid causal methods are lacking in religious research.
- This work explores the relationships between social media and religious belief.

On the Thich Minh Tue (TMT) monk:

- Thich Minh Tue is a well-known Buddhist devotee and “wandering monk” (or itinerant monk) in Vietnam in recent years.
- He walked from the South to the North of Vietnam and back many times.
- Currently he is walking from Vietnam to India and now is in Thailand.

Social media in Vietnam:

- Over 72.7 million users (around 73.3% of the population).
- In Vietnam, social media scene is not dominated solely by global giants.
- While Facebook, YouTube, and TikTok hold strong positions, a homegrown platform called Zalo has emerged as a major player, particularly in the messaging domain.

Social media and religious practice:

- Social media platforms have emerged as new arenas for religious expression and practice.
- Social media, in particular, provides a platform for observing spontaneous interactions among believers, as well as between believers and non-believers, free from the mediation of institutions such as mass media, religious leaders, or researchers (Coman and Coman, 2017).
- Online communities facilitate the formation of new kinds of religious networks, which can be particularly important for diasporic populations (Stanton, 2019).

Treatment effect estimations:

- Average treatment effect (ATE)

$$ATE := E[Y|T = 1] - E[Y|T = 0].$$

- Conditional Average treatment effect (CATE)

$$CATE := E[Y|T = 1, X] - E[Y|T = 0, X].$$

Treatment effect estimation methods

- Linear regression (LR)
- Propensity score methods
 - Propensity score matching (PSM)
 - Propensity score stratification (PSS)
 - Propensity score distance matching (PSDM)
 - Propensity score weighting (PSW)
- Causal forests (CF)
- Double machine learning (DML)
- Meta-learners
 - S-Learner
 - T-Learner
 - X-Learner
 - R-Learner

Causal graph:

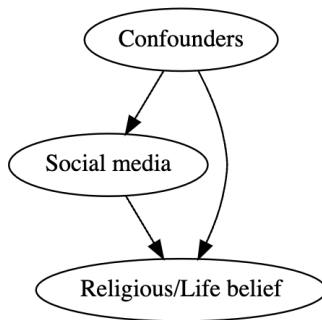


Figure 1: The causal graph

Sample Collection

- Observational data obtained from surveying.
- Surveying period: May 28 to June 7, 2024.
- Sample size: 1,885 observations.

Table 1: Number of observations by country

Country	n	Country	n
Vietnam	1,673	Singapore	2
USA	88	Poland	2
Australia	19	Europe	2
Japan	19	Belgium	2
Korea	14	Czech	2
Canada	10	Norway	2
Germany	10	UAE	1
UK	7	Thailand	1
Taiwan	7	Indonesia	1
France	6	Spain	1
Finland	5	Colombia	1
Italy	3	Malaysia	1
China	3	Laos	1
Netherlands	2	Total	1,885

Table 2: The variables and their definitions

Variable	Definition
Gender	Male (1), Female (0), Other (2), Did not answer (3)
Age	Age (in years)
Vietnam	Currently living in Vietnam (1), foreign (0)
Urban	Currently live living in urban area (1), rural (0)
Marriage	Marital status
Ethnicity	Ethnicity: Kinh (1), others (0)
Education	Educational attainment
Education (parents)	Educational attainment of parents
Income	Income range in Vietnam Dong currency (ordinal variable)
Job	Working industry (categorical variable)
SM_Time	Number of hours using social media per day
Interested	Interested in social issues
Aware	Aware of the TMT phenomenon
Platform_Know	First platform to know about TMT phenomenon: Social media (1), Others (0)
Platform_Follow	Main platform to follow TMT phenomenon: Social media (1), Others (0)
HanhDauDa	A group of austerities or ascetic practices taught in Buddhism
TMT	Perception on TMT
TMT_Followers	Perception on TMT's followers
Belief_Buddhism	Change in belief in Buddhism after TMT phenomenon (5-point Likert scale)
Belief_Life	Change in life perception after TMT phenomenon (5-point Likert scale)
Motivation	Change in motivation to uphold five Precepts of Buddhism (5-point Likert scale)

Table 3: Descriptive statistics

	Mean	Std	Min	Median	Max
Gender	0.6259	0.5250	0	1	3
Age	38.9209	11.3948	17	38	99
Vietnam	0.8859	0.3179	0	1	1
Urban	0.9442	0.2294	0	1	1
Marriage	0.7878	0.6314	0	1	4
Ethnicity	0.9714	0.1669	0	1	1
Education	3.9406	1.1439	-1	4	5
EducationP	2.3841	1.7415	-1	2	5
Income	2.9846	1.8901	-1	3	5
Job	4.0504	3.0959	0	4	10
SM_Time	2.1682	0.6400	0	2	3
Interested	3.7199	1.0043	1	4	5
Aware	0.9671	0.1784	0	1	1
Platform_Know	2.0387	2.1328	0	1	10
Platform_Follow	2.3003	2.5470	0	1	11
HanhDauDa	1.2525	0.4798	0	1	2
TMT	1.8599	0.4849	0	2	2
TMT_Followers	1.1883	0.8094	0	1	2
Belief_Buddhism	2.5039	0.7202	0	3	3
Belief_Life	2.5819	0.6420	0	3	3
Motivation	2.5156	0.7303	0	3	3

Causal effect of (first) social media on Buddhism belief

Table 4: Causal effect estimations of social media on Buddhism belief

Method	ATE	CI
LR	0.1141	[0.0345, 0.1936]
PSM	0.0419	[-0.0467, 0.1135]
PSS	0.0989	[-0.0089, 0.2134]
PSDM	0.0833	[-0.0069, 0.1708]
PSW	0.0908	[-0.0035, 0.1782]
DML	0.0995	[0.0171, 0.1818]
CF	0.1107	[-0.0475, 0.269]
S-Learner	0.0843	[0.0617, 0.1068]
T-Learner	0.0675	[0.0445, 0.0905]
X-Learner	0.0666	[0.0489, 0.0842]
R-Learner	0.1229	[0.1209, 0.1249]

Causal effect of (first) social media on Buddhism belief

Table 5: Meta-learners with different supervised ML models

	DT	RF	LGBM	XGB
S-Learner	0.0398	0.0619	0.0759	0.0843
T-Learner	0.1125	0.0769	0.0677	0.0675
X-Learner	0.0002	0.0758	0.0741	0.0666
R-Learner	0.4087	0.3269	0.0871	0.1229

Causal effect of (first) social media on Buddhism belief

Table 6: Refute tests for models using linear regression

Refuter	Est effect	New effect
Placebo refuter	0.1141	0.0113
Subset refuter (20%)	0.1141	0.1094
Subset refuter (50%)	0.1141	0.1044
Subset refuter (70%)	0.1141	0.1312
Subset refuter (90%)	0.1141	0.1142

Causal effect of (main) social media on Buddhism belief

Table 7: Causal effect estimations of social media on Buddhism belief

Method	ATE	CI
LR	0.3424	[0.2695, 0.4153]
PSM	0.3958	[0.3056, 0.5369]
PSS	0.3303	[0.2515, 0.4103]
PSDM	0.3459	[0.2525, 0.3989]
PSW	0.3713	[0.2838, 0.4452]
DML	0.3256	[0.2432, 0.4081]
CF	0.3324	[0.1977, 0.4671]
S-Learner	0.2772	[0.2568, 0.2977]
T-Learner	0.2798	[0.2559, 0.3037]
X-Learner	0.2721	[0.2536, 0.2907]
R-Learner	0.3001	[0.2983, 0.3019]

Causal effect of (main) social media on Buddhism belief

Table 8: Meta-learners with different supervised ML models

	DT	RF	LGBM	XGB
S-Learner	0.2438	0.2993	0.3232	0.2772
T-Learner	0.2512	0.2966	0.3032	0.2798
X-Learner	0.2203	0.2729	0.3034	0.2721
R-Learner	0.6997	0.6028	0.2417	0.3001

Causal effect of (main) social media on Buddhism belief

Table 9: Refute tests for models using linear regression

Refuter	Est effect	New effect
Placebo refuter	0.3424	0.0178
Subset refuter (20%)	0.3424	0.3205
Subset refuter (50%)	0.3424	0.3517
Subset refuter (70%)	0.3424	0.3489
Subset refuter (90%)	0.3424	0.3432

- **Placebo refuter:** The new effect almost disappears (close to 0) when we replace the treatment by a random variable (generated by the software) → Our treatment is **reliable**.
- **Subset refuter:** Run models on subsets of data rather than all data. The results are good if *new effects* are close to *est effects* even though we run the models on subsets of the data → Our results are **robust**.

Conclusion

- The magnitudes of causal effects of social media as the *main* platforms to follow the TMT phenomenon on Buddhism belief are remarkably greater than those of social media as the *first* platform that people know about the TMT phenomenon.
- All of the causal effect estimations of both *first* and *main* social media platforms are **consistent** in terms of sign, magnitude, and precision (i.e. small arrow of confidence intervals).
- This implies that our causal estimations are **reliable** in all cases.
- Our causal estimations are not only consistent but also **robust** under several refute tests.
- In conclusion, our work quantifies the role of social media in the recent viral of the TMT phenomenon in Vietnam (and beyond).

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- Stanton, A. L. (2019). Hashtag Islam: How cyber-Islamic environments are transforming religious authority.