

# Envelope culture in the healthcare system: happy poison for the vulnerable

Quan-Hoang Vuong <sup>1</sup>, Viet-Phuong La <sup>1,2</sup>, Giang Hoang <sup>3</sup>, Quang-Loc Nguyen <sup>4</sup>, Thu-Trang  
Vuong <sup>5</sup>, Minh-Hoang Nguyen <sup>1,\*</sup>

<sup>1</sup> Centre for Interdisciplinary Social Research, Phenikaa University, Yen Nghia Ward, Ha  
Dong District, Hanoi 100803, Vietnam

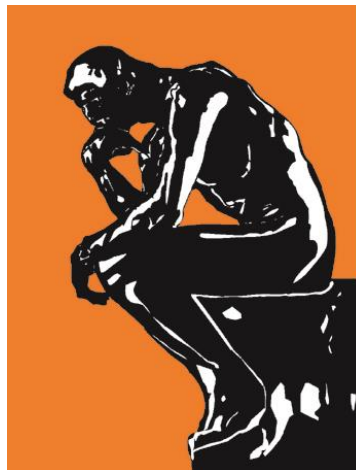
<sup>2</sup> A.I. for Social Data Lab (AISDL), Vuong & Associates, Hanoi 100000, Vietnam

<sup>3</sup> Monash Business School, Monash University, Victoria 3145, Australia

<sup>4</sup> SP Jain School of Global Management, Lidcombe, NSW 2141, Australia

<sup>5</sup> Sciences Po Paris, 75007 Paris, France

\* Corresponding: Minh-Hoang Nguyen; Email: [hoang.nguyenminh@phenikaa-uni.edu.vn](mailto:hoang.nguyenminh@phenikaa-uni.edu.vn)



Date: May 14, 2024 (v5)

\*\*\*\*\*

“— How insolent! I catch fish in style and am a principled eater! This has been a royal family legacy, unlike those gluttonous beings that have no manners and just prey on food wherever...”

from “Family Legacy” in the  
*Kingfisher Story Collection* (2022)

## **Abstract**

Bribing doctors for preferential treatment is rampant in the healthcare system of developing countries like Vietnam. Although bribery raises the out-of-pocket expenditures of patients, it is so common to be deemed an “envelope culture.” Given the little understanding of the underlying mechanism of the culture, this study employed the mindsponge theory for reasoning the mental processes of both patients and doctors for why they embrace the “envelope culture” and used the Bayesian Mindsponge Framework (BMF) analytics to validate our reasoning. Analyzing responses from 1042 Vietnamese patients, we discovered that bribing doctors can help patients reduce the destitution risk induced by treatment. Such effect of doctor bribery remains consistent among patients that have to pay high daily costs (e.g., accommodation and subsistence fees) regardless of their employment status. Nevertheless, for patients with no or unstable jobs, their risks of destitution increase if they have to pay more thank-you money. These findings suggest that doctor bribery is an adaptive strategy for patients in an environment where the healthcare supply cannot meet the actual demand. Moreover, healthcare equity is greatly exacerbated due to the envelope culture, as vulnerable individuals are exposed to a greater threat of poverty. At the same time, those with good economic conditions get preferential treatment by paying a higher amount of thank-you money. Healthcare workers’ ethics must be the top priority for an equitable and proper healthcare system.

**Keywords:** morality; medical ethics; social survival; financial risk; near-suicide phenomenon; corruption; health economics

## **1. Introduction**

On June 7, 2022, Vietnam’s Minister of Health, doctor Nguyen Thanh Long, was arrested for his abuse of power and corruption associated with Viet A Technologies JSC, which colluded with high-profile officials and hospital leaders to raise the price of RT-PCR COVID-19 test kits during the Covid-19 pandemic (Vu & Nguyen, 2022). Besides him, dozens of Centers for Disease Control and Prevention (CDC) directors across Vietnam were also dismissed, arrested, and prosecuted (Hoang & Trong, 2022). The despair is that many involved people adhered to the Hippocratic Oath before they could officially work as doctors. However, they decided to capitalize on the crisis, causing tens of thousands of Vietnamese deaths for their interest gain. The arrestment of the Minister of Health, CDC directors, and hospital leaders has reflected deteriorating medical ethics in Vietnam’s healthcare system. If the current paper had been published three years earlier, it would be the predictor for the Viet A case. For now, it will be research shedding light into the underlying mechanism of a culture that

degrades virtues of medicine, which are established on integrity, humility, honesty and compassion.

The healthcare system in Vietnam has gone through a series of neoliberal health policy reform measures since 1989, which substantially affects the delivery and financing of health services. Apart from the efficiency, access, and equity problems, there is a shift toward reduced government support and greater reliance on patients' private, out-of-pocket (OOP) expenditures (Sepehri et al., 2003; Vuong, 2015). It was estimated the average total out-of-pocket medical care costs paid by patients during hospitalization in 2010 were over US\$ 270, with surgery (almost 25 percent), diagnostic tests/examinations (24 percent), and medicines (23 percent) being the key cost drivers (Nguyen et al., 2017). Given that the Vietnamese average annual income was 1,684 USD in 2010, it was more than 16% of the yearly income, which can drive patients into poverty. Evidently, seriously ill low-income patients who face increased healthcare costs will likely discontinue treatment. Meanwhile, patients who are not locals, are poor, and lack access to adequate health insurance face an exceptionally high probability of falling into destitution (about 70%) (Vuong, 2015).

In Vietnam, OOP payment includes a “thank you money” envelope bribing doctors, nurses, and hospital staff (Vuong, 2015). Vietnamese people use the term “*phong bì*” (or “envelop”) to imply money sealed in envelopes to bribe professionals, which is analogous to the use of red envelopes to build and maintain *guanxi* in China (Ma, 2012). There is a plethora of views on giving informal payment to doctors. In one instance, Taiwanese culture perceives high-status persons as having a choice about performing services for those of lower status (Hwang, 1987). As such, should the service be performed, the recipient is seen as being in debt and obliged to respond in a way that demonstrates gratitude (Chiu et al., 2007). Since physicians are seen as socialites (Tsai, 1996), when they offer treatment to patients, they are supposed to receive recognition, which often takes the form of a gift of cash placed in a red envelope. However, this view has not found fertile soil where its healthcare sector is severely underfunded, physicians are underpaid, and accepting bribes is usually seen as a way for doctors to generate more income, which impacts their priority of offering treatment to patients (Moldovan & Van de Walle, 2013). In some cases, accepting informal payment carries a sense of entitlement because many physicians and surgeons consider kickbacks and bribes from drug companies or patients as compensation for their high training costs and high professional risks (Chan et al., 2018).

Although bribing professionals is prohibited by Vietnamese law and associated with patients' health outcomes (Matsushima & Yamada, 2016), it has gradually been considered standard practice for patients in exchange for preferential treatment, like faster or better service (Mi, 2013; Vian et al., 2012). In other instances, doctors also solicit envelopes by displaying a negative attitude toward patients, exaggerating health concerns, or providing verbal signs of solicitation. Perceiving bribery as an unspoken “standard” is not exceptional in the healthcare sector. Still, it is also prevalent in various social aspects, such as during

transportation, in the workplace, and public services. Given that more than fifty percent of surveyed Vietnamese reported that a government official receiving a 'small gift or money after performing duties' was not corruption or felt unsure about it (Vian et al., 2012; World Bank, 2010), it is reasonable to say "thank you money" giving has grown to become an "envelope culture" in Vietnam.

Despite the pervasiveness of envelop culture in the healthcare sector, little has been known about the underlying mechanism of the culture, how it affects patients' risks of destitution under different scenarios of expenditures and employment, and how it can drive ethical degradation within the Vietnamese healthcare system. To fill in this gap, we employed the mindsponge theory for reasoning the mental processes of both patients and doctors for why they embrace the "envelope culture" and used the Bayesian Mindsponge Framework (BMF) analytics to validate our reasoning.

## **2. Methodology**

### **2.1. Theoretical foundation**

This subsection uses the mindsponge theory to explain the mechanism underpinning the envelope culture in Vietnam. The mindsponge concept was originally established as a dynamic process or mechanism that describes how a mindset absorbs new cultural values and discards waning ones dependent on context (Vuong & Napier, 2015). Vuong and Napier (2015) used the metaphor "the mind as a sponge that squeezes out inappropriate values and absorbs new ones that fit or complement the context" to describe the mindsponge mechanism. The mechanism is the result of the combination of prominent theories and models from the past, such as the self-affirmation theory (Correll et al., 2004), multi-filtering process (Vuong & Napier, 2014), information processing model (Daft & Weick, 1984; Levy et al., 2007), trust (Paliszkiewicz, 2011), inductive attitude (Pólya, 1954), etc. Nevertheless, because the human body is a complex system made up of trillions of cells, each with its own structure and function, a concept derived from the observation of psychological and social phenomena is insufficient for comprehending human psychology and behavior.

Thus, the mindsponge mechanism is expanded into the mindsponge theory incorporating the most recent findings in brain and life sciences (Vuong, 2023). The mindsponge theory is a theory of how the mind processes information. In this view, the human mind is defined as a collection-cum-processor that has the following main properties:

- 1) It reflects the natural patterns of systems in the biosphere.
- 2) It is a dynamic process that is dynamically balanced.
- 3) It involves cost-benefit evaluation, which aims to increase the perceived benefit and reduce the perceived cost of the system.
- 4) It consumes energy and thus follows the principle of energy saving.
- 5) It has a goal(s) and priority, depending on the demand of the system

- 6) Its fundamental purpose is to prolong the system's existence in one way or another, including survival, growth, and reproduction.

Based on these properties, we assumed that patients are likely to think, decide, and behave to maximize perceived benefits and minimize perceived costs to prolong their existence. Following the usual logic, giving thank-you money will increase patients' OOP expenditures and eventually the risk of destitution. However, why do Vietnamese patients still bribe doctors?

It needs to consider the socio-cultural environments to answer this question. In the mindsponge theory, the mind and environment are two major components. The environment refers to all external information outside the mind or the individual's information-processing system. The environment has crucial impacts on the changes and evolution of any species' information-processing systems that exist within it, and those of Vietnamese patients are not exceptional. This notion is aligned with Darwinism's "natural selection" or "survival of the fittest" notion (Darwin, 2003; Rogers, 1972).

Despite remarkable achievements, Vietnam's healthcare system still faces many problems, which keep nurturing the "envelope culture." The healthcare facilities in Vietnam have been unevenly distributed for a long time (*Chất lượng khám chữa bệnh chưa đồng đều giữa các vùng, tuyến*, Van, Thanh). There are three primary levels in the public hospital system in Vietnam: district hospitals (684 facilities), provincial hospitals (419 facilities), and central/national hospitals (47 facilities) (World Health Organization, 2023). In contrast to metropolitan regions with a concentration of high-quality healthcare facilities and medical staff, rural provincial hospitals generally lack advanced infrastructure and well-trained human resources to meet staffing norms and clinical demands (Ministry of Health, 2016). Most private hospitals (182 facilities) are also in urban areas (World Health Organization, 2023). Due to this disparity and skepticism about treatment quality in the commune and provincial hospitals, patients tend to go to cities for medical care, leading to overcrowding in central hospitals.

Such movement of patients from rural to urban areas does not only affect patients but also affects healthcare workers. As for patients, overcrowding significantly increases patients' waiting time and reduces their satisfaction with healthcare services (Quyen et al., 2021; Sawang et al., 2019). The longer waiting time also results in higher OOC payments for accommodations and food if the patients are non-residents, raising the destitution risk of patients (Vuong, 2015). These facts might affect the patients' information-processing mechanism, motivating them to find alternatives to reduce the waiting time. From this perspective, patients might consider bribing the doctor for prioritized treatment as a helpful alternative.

Healthcare workers are often overworked due to overcrowding in central healthcare facilities but underpaid (Phuong & An, 2022). The "thank-you money" from the patients will

help boost their motivation in the stressful working environment, which improves the treatment effectiveness (Ministry of Health, 2016). When patients see the reciprocity between health improvement and “thank-you money” payment, the benefits of the envelope culture will be reinforced in their minds. This feedback loop gradually generates a collective mindset in which patients and healthcare providers prefer the temporary benefits induced by the envelope culture. Based on this reasoning, we proposed the following hypothesis (H):

**H1:** The amount of thank-you money is negatively associated with the risk of destitution due to treatment.

During the treatment, patients are subject to many types of costs besides the treatment cost. Those costs can be grouped into three main kinds that are not covered by health insurance: 1) the daily cost (including accommodation and subsistence fees), 2) thank-you money, and 3) discontinued-income cost. Patients must balance these costs to minimize their perceived costs or avoid being financially destitute. For patients not residing in the same regions with the hospitals, their daily costs will be much higher than those living in the same areas as the hospitals. Nguyen (2017) estimated that non-residing patients have to pay about 15 million Vietnam Dong (approximately 750 USD) more than residing patients, leading to a higher risk of destitution for non-residing patients (Vuong, La, et al., 2021). For this reason, we expected that the alleviation effect of thank-you money on patients’ destitution risk would be stronger among those spending higher daily costs. We hypothesized that:

**H2:** The association between the amount of thank-you money and destitution risk is conditional on (or moderated by) the amount of daily cost.

A stable job will give the patients a sustainable source of income, lowering their risk of poverty due to treatment. However, if the treatment cost is lengthened, they might bear the income loss due to discontinuity or even the risk of losing jobs. Having a stable source of income and perceiving the discontinued cost and risk of lengthy treatment are two motivations that simultaneously drive patients to give doctors a large amount of thank-you money for favorable treatment to reduce their loss of discontinued income and the risk of losing their job. We hypothesized that:

**H3:** The association between the amount of thank-you money and destitution risk is conditional on (or moderated by) the patients’ employment stability.

Although the alleviation effect of thank-you money on patients’ destitution risk is more substantial among those spending higher daily costs, it will not be applicable in scenarios where patients have no or unstable jobs because they have less income to sustain the positive effect of thank-you money on treatment effectiveness. If patients with no or unstable jobs still have to pay high thank-you money to the healthcare workers when their daily expense is not high, their risk of destitution will increase. We hypothesized that:

**H4:** The moderation effect of daily cost on the relationship between the amount of thank-you money and destitution risk is conditional on the patients' employment stability.

## 2.2. Model construction

### 2.2.1. Variable selection and rationale

The data used in this study were retrieved from a dataset containing 1042 records obtained from patients in northern Vietnam (Ho et al., 2019). This dataset was the outcome of a prolonged survey spanning 20 months from August 2014 to March 2016. It yielded a comprehensive set of records of patients' financial situations, healthcare, health insurance information, and perspectives on hospital treatment services. The survey strictly conformed to the ethical standards of the International Committee of Medical Journal Editors (ICMJE) Recommendations, the World Medical Association (WMA) Declaration of Helsinki, and Decision 460/QD-BYT by the Vietnamese Ministry of Health.

Not only does the survey provides an exhaustive description of patients in the context of Vietnam, but it also stands distinctive as it explores some dark sides of the doctor-patient relationship by asking patients and/or their families about sensitive matters related to their financial situation, attitudes, and behaviors regarding the hospital and treatment process, such as bribery or length of stay. Smaller subsets derived from the current dataset have been used to explore health insurance issues (Vuong et al., 2017), healthcare payments, financial destitution (Pekerti et al., 2017), and satisfaction with healthcare services (Vuong, 2018b). The complete description and validation can be viewed in the article "Health Care, Medical Insurance, and Economic Destitution: A Dataset of 1042 Stories" (Ho et al., 2019).

One question is whether survey data can be used for studying the dynamic underlying mechanism of the envelope culture in Vietnam's healthcare system. The answer is positive. To complete the questionnaire, respondents must use the knowledge they already possess and provide us with their ideas, emotions, and memories. The mindsponge mechanism assists in understanding the psychological and behavioral processes that lead to the respondents' thoughts, feelings, and memories at the time of answering. In other words, the mindsponge mechanism offers an analytic framework that supports creating and imagining a psychological process retrospectively using cross-sectional data.

Following the theoretical foundation discussed in Subsection 2.1, we generated four variables for Bayesian analysis and presented their description in Table 1 below.

**Table 1:** Variable description

Variable (Coded name)	Meaning	Category	Value
-----------------------	---------	----------	-------

<i>Burden</i>	Self-reported evaluation of the patient's and family's financial situation after paying treatment fees.	Minimally affected (A), adversely affected (B), destitute (C), adversely destitute (D).	minimally affected: 1; adversely: 2; destitute: 3; adversely destitute: 4.
<i>EnvL</i>	The portion of "extra thank-you money" that the patient had to include in the medical fees.	Nil (0) Low (<7%) Medium (7%-15%) High (>15%)	Nil: 1; Low: 2; Medium: 3; High: 4.
<i>AvgCost</i>	The average cost that the patient spent daily during treatment. Unit: million VND (Vietnamese Dong).	Low ( $\leq 1.5$ ) Medium (1.5 to 5.4) High ( $> 5.4$ )	Low: 1; Medium: 2; High: 3.
<i>Jcond</i>	Condition of the patient's employment.	Unemployed Unstable Stable	Unemployed: 1; Unstable: 2; Stable: 3.

The outcome variable, *Burden*, was measured using a question that was asked to demonstrate a self-reported evaluation of the financial situation of patients and their families after paying treatment fees. Respondents selected one of the four choices: minimally affected (A), adversely affected (B), destitute (C), and adversely destitute (D). The variable's values were then converted to numbers from 1 to 4, where 1 is minimally affected, 2 is adversely affected, 3 is destitute, and 4 is adversely destitute.

The *EnvL* variable was created by asking patients about the portion of funds used for "extra thank-you money" or for bribing doctor/staff. The answer is selected from four choices: Nil (0), Low (<7%), Medium (7%-15%), to High (>15%). It was then transmuted to a respective value ranging from 1 to 4.



The *AvgCost* variable measures the average cost in millions of Vietnamese Dong (VND) the patient spent daily during treatment. The answer was classified into three categories: Low ( $\leq 1.5$ ), Medium (1.5 to 5.4), and High ( $> 5.4$ ), to which the values are given 1, 2, and 3, respectively. The answers were then translated into an equivalent range of values from 1 to 3.

The *Jcond* variable was constructed to identify the condition of the patient's employment. The answer falls into three categories: Unemployed, Unstable, and Stable. The responses were also transmuted into an equivalent range of values from 1 to 3.

### 2.2.2. Statistical models

To test the proposed hypotheses in Subsection 2.1, we employed the four multiple linear regression models, starting with the simplest. Specifically, we constructed Model 1 to examine Hypothesis 1:

$$Burden \sim normal(\mu, \sigma) \quad (1.1)$$

$$\mu_i = \beta_0 + \beta_{EnvL} * EnvL_i \quad (1.2)$$

$$\beta \sim normal(M, S) \quad (1.3)$$

The probability around  $\mu$  is determined by the form of the normal distribution, whose width is specified by the standard deviation  $\sigma$ .  $\mu_i$  indicates the evaluated level of patient  $i$ 's financial situation after paying treatment fees;  $EnvL_i$  indicates the portion of "extra thank-you money" that the patient  $i$  had to include in the medical fees. Model 1 has three parameters: the coefficient,  $\beta_{EnvL}$ , the intercept,  $\beta_0$ , and the standard deviation of the "noise",  $\sigma$ . The coefficient of the variable  $EnvL_i$  is distributed as a normal distribution around the mean denoted  $M$  and with the standard deviation denoted  $S$ .

We tested Hypothesis 2 by incorporating variable  $AvgCost_i$  and its interaction with variable  $EnvL_i$  into Model 1:

$$Burden \sim normal(\mu, \sigma) \quad (2.1)$$

$$\mu_i = \beta_0 + \beta_{EnvL} * EnvL_i + \beta_{AvgCost} * AvgCost_i + \beta_{EnvL*AvgCost} * EnvL_i * AvgCost_i \quad (2.2)$$

$$\beta \sim normal(M, S) \quad (2.3)$$

$AvgCost_i$  indicates the average cost that the patient  $i$  spent daily during treatment;  $\beta_{EnvL*AvgCost}$  indicates the coefficient of the non-additive effect of  $EnvL_i$  and  $AvgCost_i$  on

*Burden*. If the coefficient  $\beta_{EnvL*AvgCost}$ 's distribution is significant, and the association between the amount of thank-you money and destitution risk is considered conditional on the amount of daily cost.

Model 3 was used to test Hypothesis 3 by adding variable  $Jcond_i$  and its interaction with variable  $EnvL_i$  into Model 2.

$$Burden \sim normal(\mu, \sigma) \quad (3.1)$$

$$\mu_i = \beta_0 + \beta_{EnvL} * EnvL_i + \beta_{AvgCost} * AvgCost_i + \beta_{EnvL*AvgCost} * EnvL_i * AvgCost_i + \beta_{Jcond} * Jcond_i + \beta_{EnvL*Jcond} * EnvL_i * Jcond_i \quad (3.2)$$

$$\beta \sim normal(M, S) \quad (3.3)$$

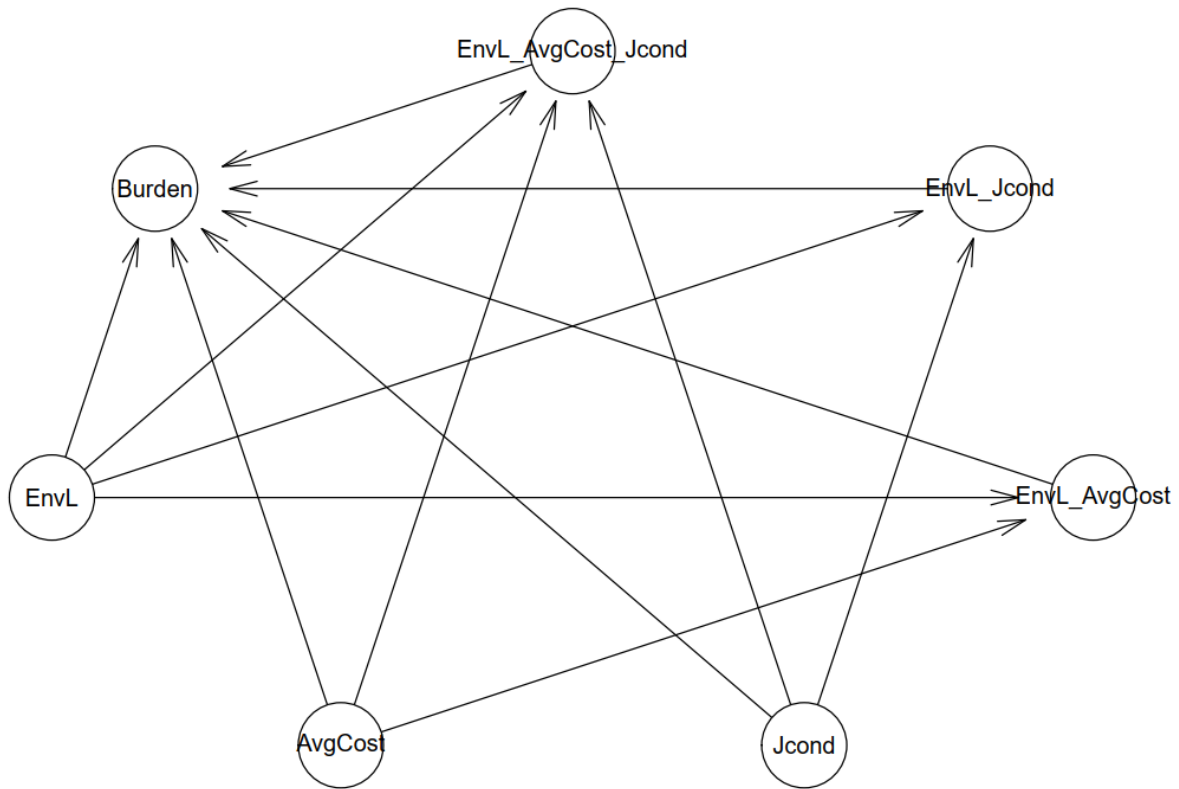
Finally, for testing Hypothesis 4, we constructed Model 4 to include the interaction variable between  $EnvL_i$ ,  $AvgCost_i$ , and  $Jcond_i$ :

$$Burden \sim normal(\mu, \sigma) \quad (4.1)$$

$$\mu_i = \beta_0 + \beta_{EnvL} * EnvL_i + \beta_{AvgCost} * AvgCost_i + \beta_{EnvL*AvgCost} * EnvL_i * AvgCost_i + \beta_{Jcond} * Jcond_i + \beta_{EnvL*Jcond} * EnvL_i * Jcond_i + \beta_{EnvL*AvgCost*Jcond} * EnvL_i * AvgCost_i * Jcond_i \quad (4.2)$$

$$\beta \sim normal(M, S) \quad (4.3)$$

$\beta_{EnvL*AvgCost*Jcond}$  indicates the coefficient of the non-additive effect of  $EnvL_i * AvgCost_i$  and  $Jcond_i$  on *Burden*. The logical model of Model 4 can be plotted in Figure 1.



**Figure 1: Model 4's logical model**

### 2.3. Analysis and validation

This study employs the reasoning and analytical approach of the Mindsponge Theory to explore mechanisms behind offering envelop money by patients to doctors in the context of Vietnam (Vuong, 2023). The statistical analysis method used in our study is based on the Bayesian Mindsponge Framework (BMF), aided by the Markov Chain Monte Carlo (MCMC) technique (Nguyen et al., 2022a, 2022b; Vuong, Nguyen, et al., 2022a). The BMF is employed in this study for it possesses multiple advantages. First, there is strong compatibility between the mindsponge mechanism and Bayesian inference (Nguyen et al., 2022a). Second, the Bayesian inference measures all the properties probabilistically (Csilléry et al., 2010; Gill, 2014), allowing for accurate prediction with parsimonious models. By incorporating the power of the MCMC technique, Bayesian methods can fit a wide variety of models, like multi-level correlation structures and non-linear regression frameworks, making flexibility a significant advantage (Dunson, 2001). Third, the Bayesian inference has several strengths compared to its frequentist-approach counterpart. Specifically, although it does not rely on  $p$ -value, it still enables users to create credible intervals (Wagenmakers et al., 2018). In addition, the Bayesian inference presents a potential solution for the reproducibility crisis,

which has been singled out as a problem associated with the frequentist approach (Halsey et al., 2015).

Because this study is exploratory research, the models were constructed using uninformative priors specifying a flat prior distribution to provide the least amount of prior information possible to the model estimation. Although the prior information still exists, it is so small that it can be negligible (Diaconis & Ylvisaker, 1985). We also use the “prior-tweaking” technique with priors reflecting our disbelief to check the model’s robustness.

Once the models are constructed, the models’ goodness-of-fit is checked using Pareto-smoothed importance sampling leave-one-out (PSIS-LOO) diagnostics (Vehtari & Gabry, 2019; Vehtari et al., 2017). A model is considered to have acceptable goodness of fit when  $k$  values are below 0.5. Secondly, the convergence of Markov chains can be validated visually through trace plots, Gelman-Rubin-Brooks plots, and autocorrelation plots, and statistically through the effective sample size ( $n_{eff}$ ) and the Gelman-Rubin shrink factor ( $Rhat$ ). During stochastic simulation, the  $n_{eff}$  value represents the number of iterative samples that are not autocorrelated. If  $n_{eff}$  is bigger than 1000, it is generally considered that the Markov chains are convergent, and the effective samples are sufficient for reliable inference (McElreath, 2018). The  $Rhat$  value, often referred to as the Gelman-Rubin shrink factor and the potential scale reduction factor, is used to evaluate the convergence of the Markov chains (Brooks & Gelman, 1998). If the value exceeds 1.1, the model does not converge. Typically, if  $Rhat = 1$ , the model is considered convergent. According to Lynch (2007), the  $Rhat$  value is computed by this mathematical formula:

$$\hat{R} = \sqrt{\frac{\hat{V}}{W}}$$

where  $\hat{R}$  represents the  $Rhat$  value,  $\hat{V}$  is the estimated posterior variance, and  $W$  is the within-sequence variance.

Then, we employed weight comparison to select the most predictive model for the data. To compare models’ weights, we employed the Pseudo-Bayesian model averaging (BMA) with Bayesian bootstrap, Pseudo-BMA without Bayesian bootstrap, and Bayesian stacking to choose the optimal predictive one. We also utilized Akaike weights to help rescale all of these statistics. Specifically, the weight for a model  $i$  in a set of  $K$  models is given by:

$$w_i = \frac{\exp(LPD_i - \max_j(LPD_j))}{\sum_{k=1}^K \exp(LPD_k - \max_j(LPD_j))}$$

Where  $LPD_j$  is the log pointwise predictive density of model  $i$ ;  $\max_j(LPD_j)$  is the maximum log pointwise predictive density over all models  $j$ ;  $K$  is the total number of models being compared. This formula was also applied for other types of information criteria above. Each

weight,  $w_i$ , will be a number between 0 and 1, and the total of all weights will always equal 1. Thus, the model with a greater weight value is preferable (McElreath, 2018).

The **bayesvl** R package is employed to perform Bayesian analysis because of its advantages, such as good visualization power, openness, and streamlined operation (La & Vuong, 2019; Vuong, Nguyen, et al., 2022b). The MCMC setups for all models are 5000 iterations, which contain 2000 warm-up iterations and four chains. For transparency and cost-effectiveness (Vuong, 2018a, 2020), all the code and data used for this study’s analysis are deposited on the Open Science Framework: <https://osf.io/hgpby/>.

### 3. Results

#### 3.1. Model comparison

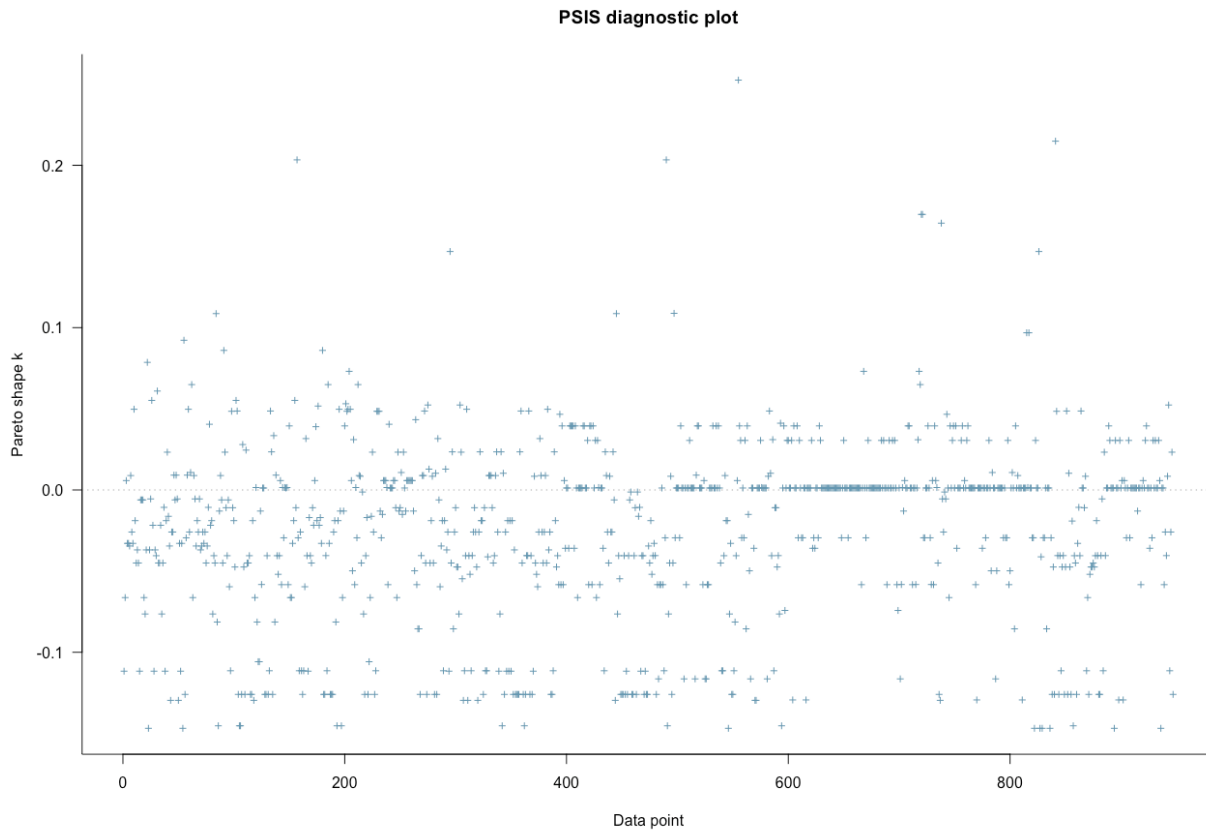
The weight comparison using the Pseudo-BMA without Bayesian bootstrap, Pseudo-BMA without Bayesian bootstrap, and Bayesian stacking was conducted to assess the predictive weight of each model. As can be seen from Table 2, Model 4 outperforms other models in the categories of Pseudo-BMA without Bayesian bootstrap and Pseudo-BMA without Bayesian bootstrap. Therefore, it was chosen for subsequent analysis.

**Table 2: Model weights comparison and model ranking**

Weights	Pseudo-BMA without Bayesian bootstrap	Pseudo-BMA without Bayesian bootstrap	Bayesian stacking
Model 1	0.0000	0.000	0.0254
Model 2	0.0000	0.000	0.0361
Model 3	0.0918	0.296	0.4641
Model 4	0.9082	0.704	0.4745
Most predictive model	Model 4	Model 4	Model 4

The models’ goodness-of-fit can be validated by categorizing them into four levels: (i) ‘good’: its  $k$ -values are all below 0.5; (ii) ‘OK’: its  $k$ -values range from 0.5 to 0.7; (iii) ‘bad’: its  $k$ -values are more than 0.7 and below 1; (iv) ‘very bad’: its  $k$ -values are all more than 1. Here, we only present the PSIS diagnostic plot of Model 4. The plots of other models are shown in

Figures S1-S3 in the Supplementary. Figure 2 demonstrates that all Pareto  $k$ -values are below the threshold of 0.5, suggesting that the model fits the data well.

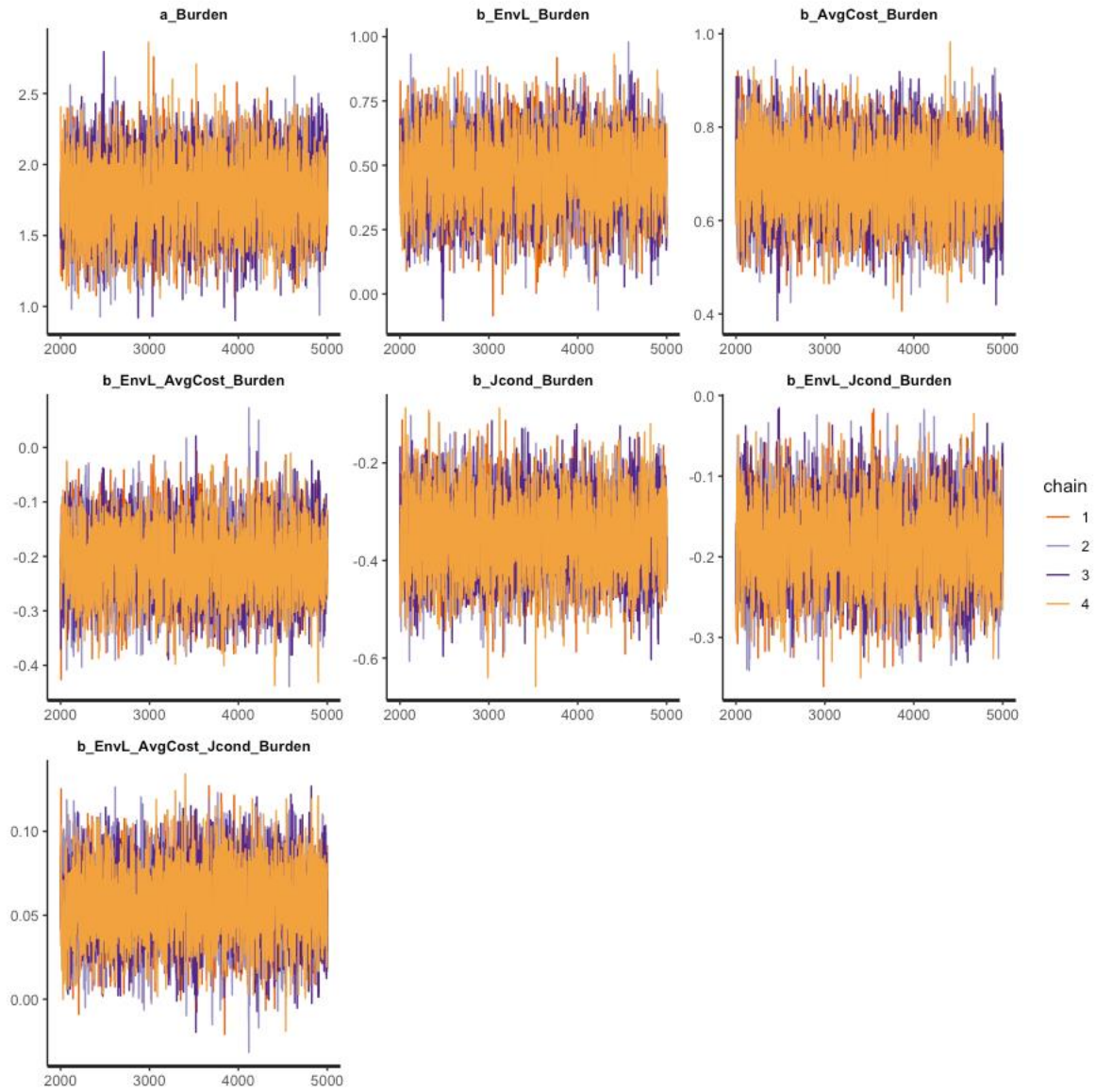


**Figure 2:** Model 1's PSIS-LOO diagnosis with uninformative priors

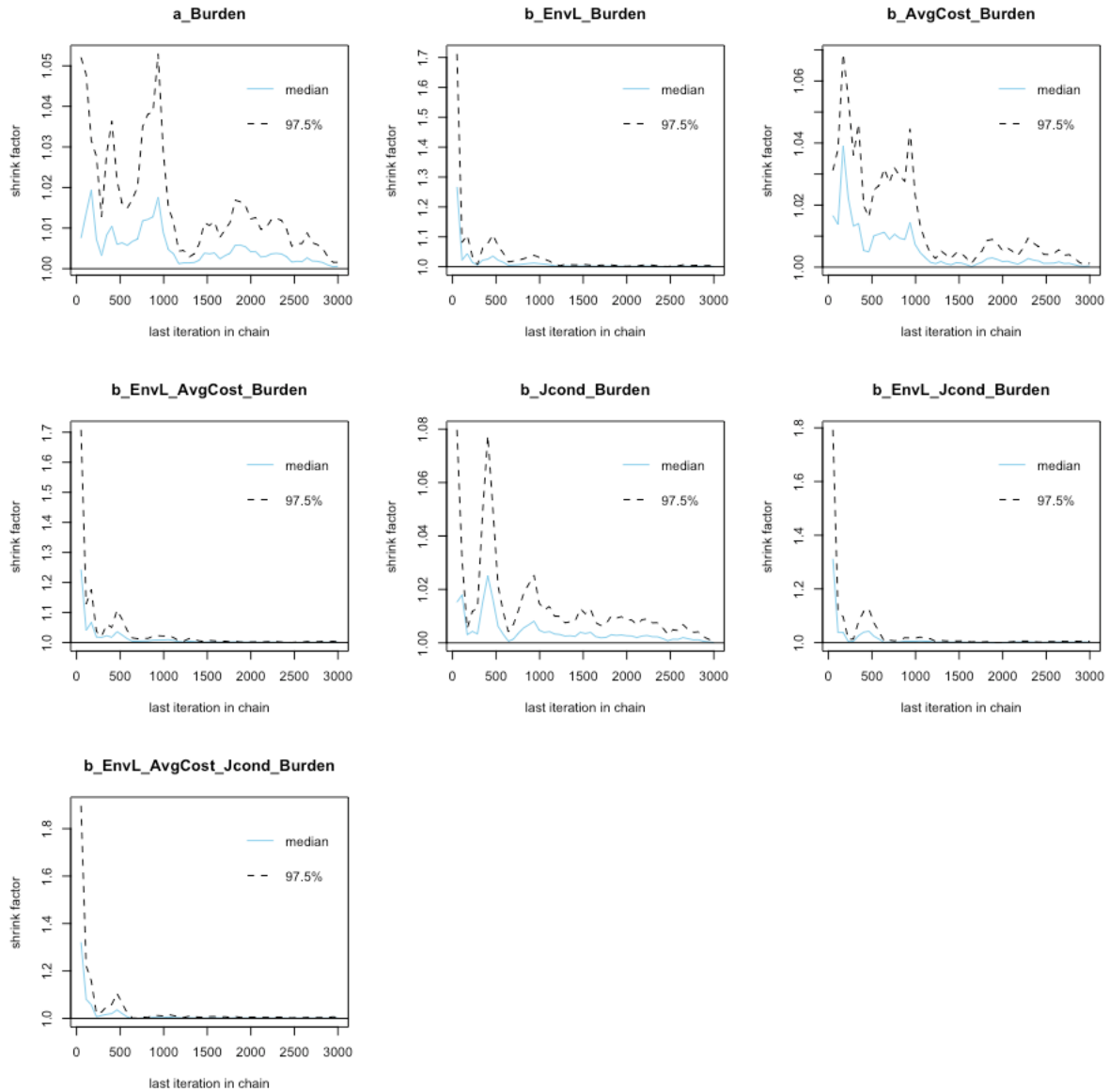
### 3.2. Convergence diagnostics

The simulation of all four models can be deemed well-convergent based on convergent indicators. Specifically, the effective sample size ( $n_{eff}$ ) values of all models' parameters are above the standard threshold of 1000, and all  $Rhat$  values are equal to 1 (see Table 3 and Tables S1-S3). Since the main model of the current study is Model 4, we only display the model's estimated diagnostic statistics and visualizations in the main text. Other models' convergence diagnosis plots are presented in Figures S4-S6 (for trace plots), Figures S7-S9 (for Gelman-Rubin-Brooks plots), and Figures S10-S12 (for autocorrelation plots).

In the trace plot, when Markov chains are good-mixing and stationary around an equilibrium, they are considered well-convergent. The healthy fluctuation of Model 4's Markov chains around a central equilibrium in Figure 3 shows a good signal of convergence. The decline of the shrink factors to 1 after the warm-up phases further supports the convergence (see Figure 4).



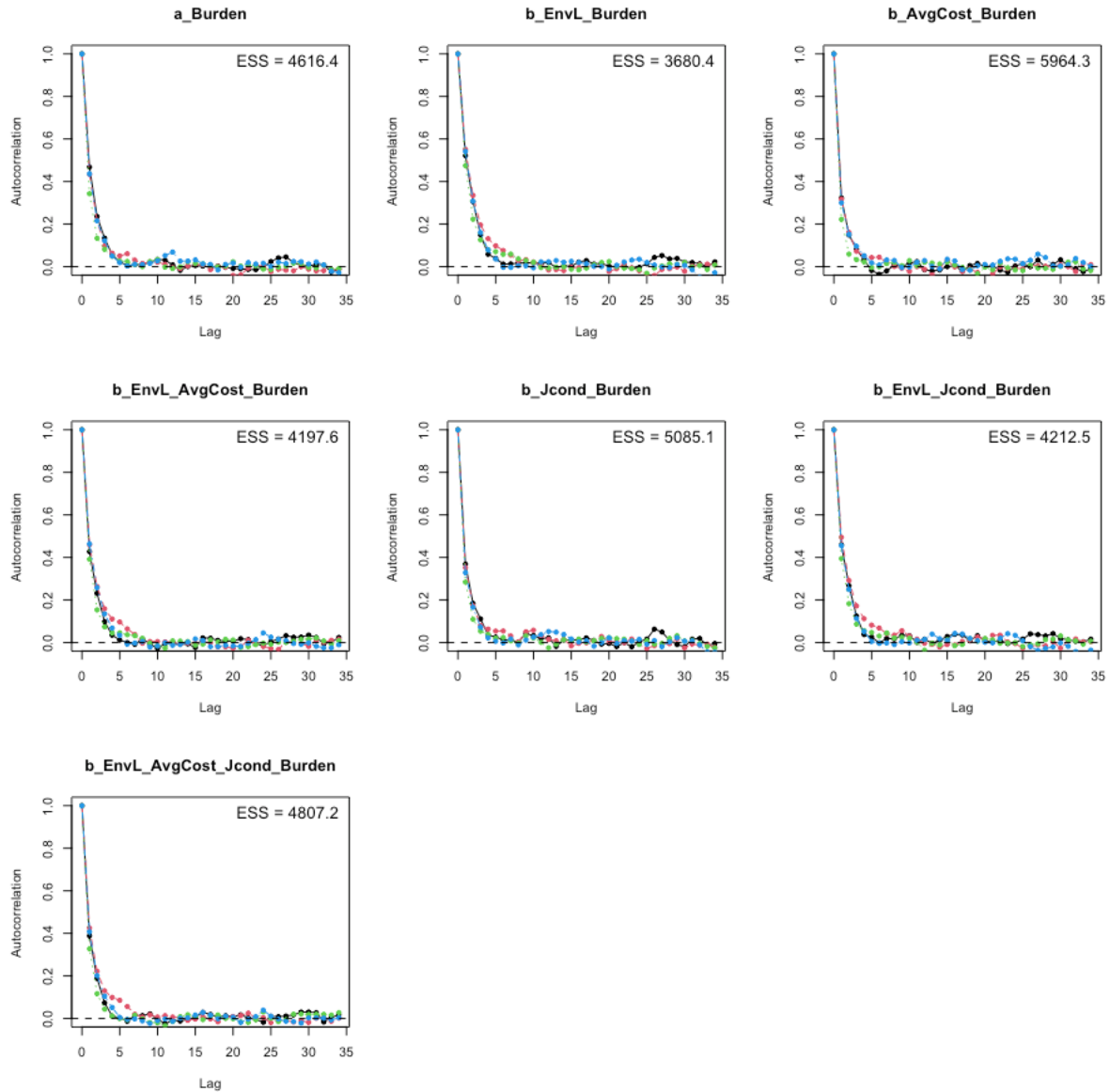
**Figure 3:** Model 4's trace plots with uninformative priors



**Figure 4:** Model 4's Gelman–Rubin–Brooks plots with uninformative priors

The autocorrelation plots in Figure 5 also aid the validation of the convergence of Markov chains. The quick elimination of autocorrelation levels to 0 after a certain number of lags suggests that iterative samples in the stochastic simulation process are memoryless, which is a strong signal of convergence.





**Figure 5:** Model 4's autocorrelation plots with uninformative priors

### 3.3. Result interpretation

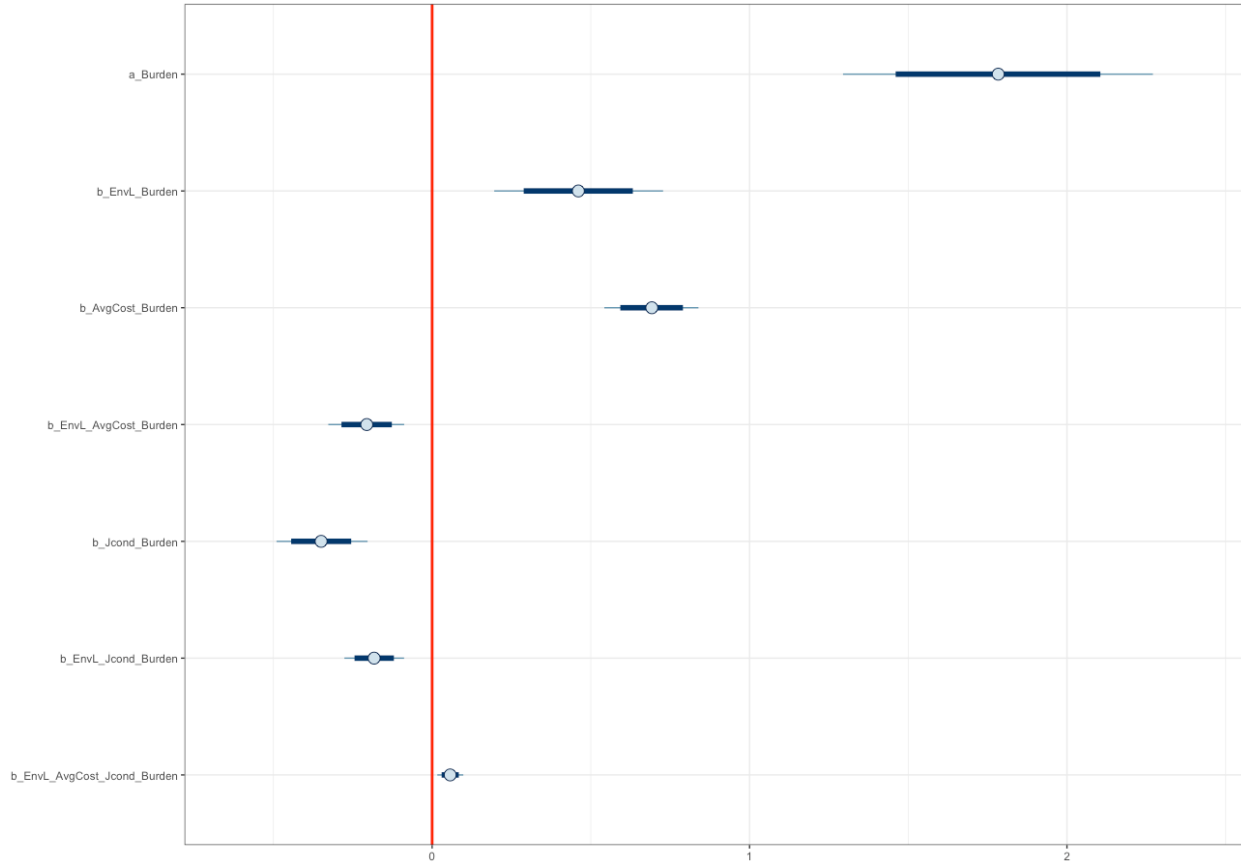
The estimated posterior distributions of Model 4 are presented in Table 3 and visualized in Figure 6 accordingly. Because Model 4 is highly complex, it is better to visualize the results for interpretation. However, before interpreting the results, it is necessary to check the results' reliability and robustness.

**Table 3:** Results of Model 4 analysis.

Parameters	Informative priors	Informative priors (belief on effect)
------------	--------------------	---------------------------------------

	Mean	SD	n_eff	Rhat	Mean	SD	n_eff	Rhat
<i>Constant</i>	1.78	0.25	4137	1	2.03	0.22	4784	1
<i>EnvL_Burden</i>	0.46	0.13	3378	1	0.29	0.11	4676	1
<i>AvgCost_Burden</i>	0.69	0.08	5560	1	0.58	0.07	6517	1
<i>EnvL_AvgCost_Burden</i>	-0.21	0.06	4193	1	-0.12	0.05	5257	1
<i>Jcond_Burden</i>	-0.35	0.07	4484	1	-0.37	0.07	5584	1
<i>EnvL_Jcond_Burden</i>	-0.18	0.05	3790	1	-0.15	0.04	5131	1
<i>EnvL_AvgCost_Jcond_Burden</i>	0.06	0.02	4794	1	0.04	0.02	5647	1

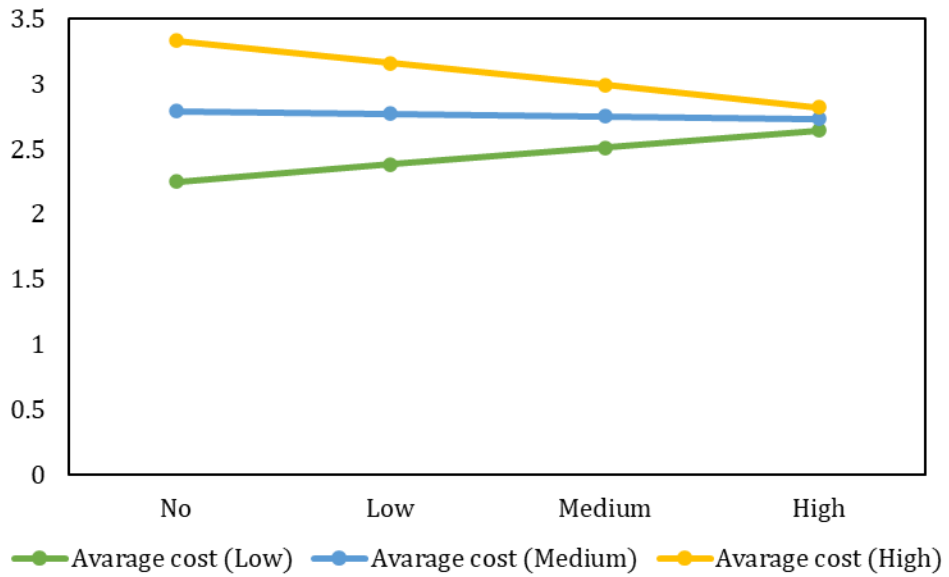
Figure 6 illustrates the posterior distributions of Model 4 on an interval plot. The red straight line in the Figure denotes the division between the negative and positive zones. The probability mass outside of the highest credible zone is represented by the thin blue lines, whereas the probability mass inside of the 89% Highest Posterior Density Intervals (HPDI) is represented by the thick blue lines. As can be seen from Figure 6, all the posterior distributions' 89% HPDI are located entirely on either the positive or negative side of the axis. This hints at the high reliability of the estimated results. Even when we applied the "prior-tweaking" technique, the magnitudes of the parameters only changed slightly, while their tendencies remained consistent. Thus, the estimated results are robust regardless of our disbelief in the estimated relationships.



**Figure 6:** Interval plots of posterior distributions of Model 4

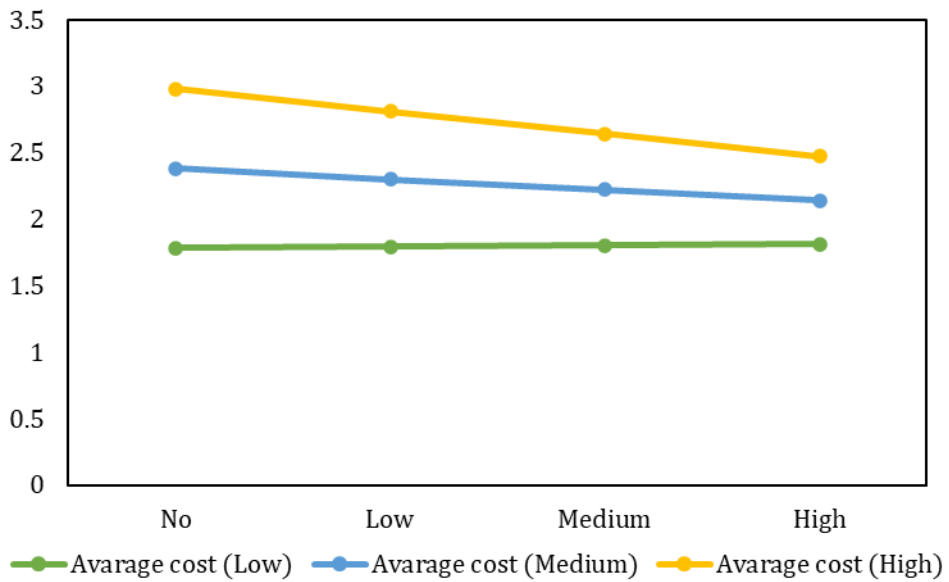
Employing Equation 4.2 and the estimated mean values of parameters in Table 3, we calculated the evaluated level of patients' financial situation after paying treatment fees. The calculated numbers are plotted in Figures 7A-7C. The amount of thank-you money generally helps reduce the risk of destitution induced by treatment among patients. However, the alleviation effect of thank-you money on destitution risk is lessened in groups of patients with unstable or no job. For patients having no or unstable jobs, their risks of destitution even increase if their average daily costs are low. These results validate the theoretical reasoning provided in Section 2.

### Unemployed

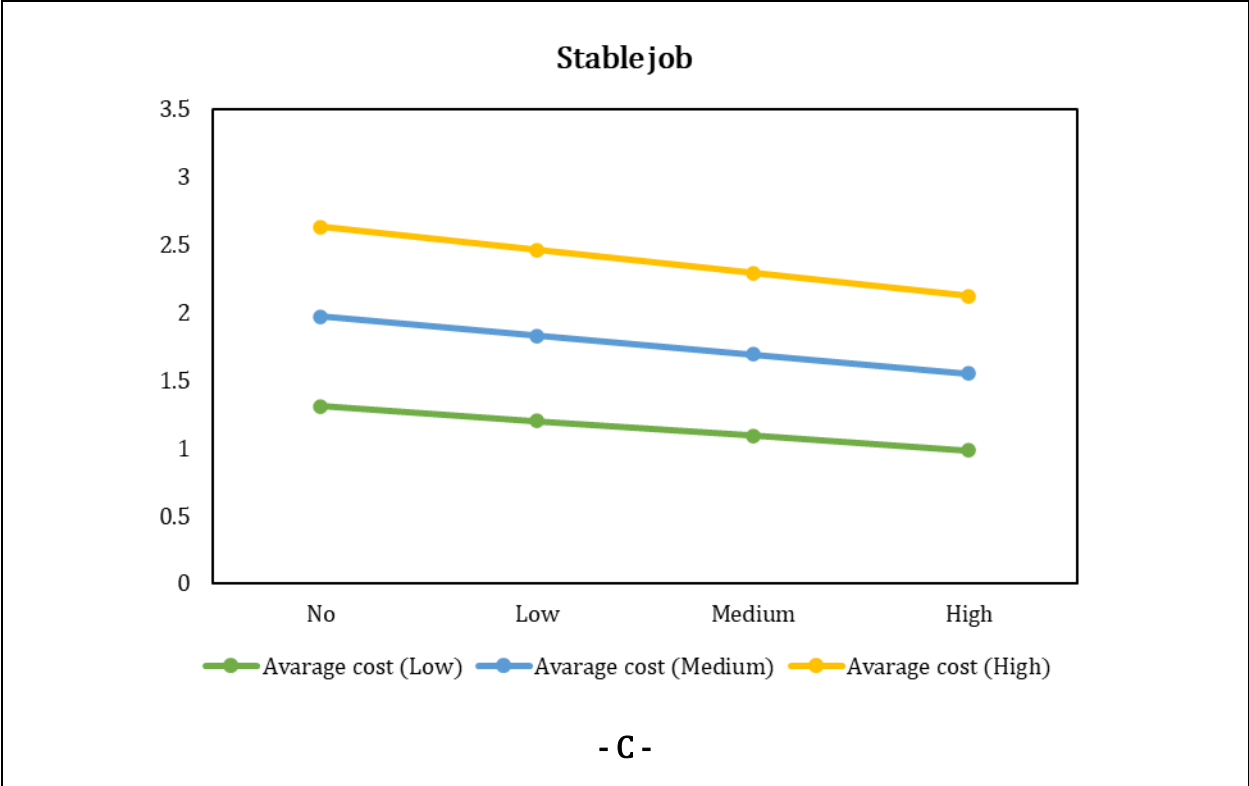


- A -

### Unstable job



- B -



**Figure 7:** Financial destitution level of patients according to job stability, daily spent cost during treatment and amount of given envelope money

**4. Discussion**

The current study employed the Mindsponge Theory to explain the underlying mechanism of envelope culture’s persistence in Vietnam’s healthcare system. Analyzing the dataset of 1042 patients using BMF analytics helps validate the explanation. In particular, we found that paying thank-you money is a strategy to reduce the financial burden due to the treatment of patients, especially for those that have to pay high daily costs (including accommodation and subsistence fees).

The finding, at first glance, might seem logically contradicting because paying thank-you money is costly. Nevertheless, due to the healthcare system’s situation in Vietnam, such an act has become a beneficial alternative for those with good economic conditions. By giving envelope money to doctors, patients can enjoy prioritization on the waiting list for treatment, resulting in a shorter length of hospital stay and, subsequently, lowering their total costs. The thank-you money is also a good incentive for healthcare workers to care for the patients better, increasing the chance of treatment success and reducing incurred costs during treatment. From the healthcare workers’ perspectives, receiving thank-you money is not only a means to improve livelihood but also a way to feel justice. Students going to medical schools in Vietnam are those not only obtaining the highest scores in the University entrance

exams but also undergoing prolonged and rigorous training before becoming healthcare workers. Poor working conditions and low salaries can make them feel unfair and gradually perceive thank-you money as compensation.

The envelope culture can be analogously metaphorized as “happy poison” for the whole healthcare system. Despite meeting the demand for better treatment of patients and the desire for the improved livelihood of healthcare workers, it can lead to severe consequences due to healthcare workers’ addiction to the “envelope.” The Minister of Health and other leaders of the healthcare system took use of the Covid-19 crisis, which has killed thousands of people, to make money is a prime example. At the healthcare facility level, addiction to “envelope” reduces the quality of service provision. It is evident that some healthcare workers even actively solicit envelopes from patients by displaying a negative attitude toward patients, exaggerating health concerns, or providing verbal signs of solicitation (An, 2022; Giang, 2016). Such negative attitudes can significantly reduce public trust in the healthcare system, alleviating future cooperation effectiveness between the public and healthcare workers (Vuong, Le, et al., 2021).

Moreover, the envelope culture can also exacerbate inequality in healthcare. Our findings show that patients being unemployed or having unstable jobs are most negatively affected by this culture. In other words, economically vulnerable people have to bear a higher risk of destitution to incentivize healthcare workers to do the works that are their duty. In contrast, those with good economic conditions enjoy the preferential treatment the thank-you money provides. Perhaps, this is one of the reasons driving many patients with serious health issues to choose the “near-suicide” option (Vuong, Le, et al., 2022). While unlikely, we should not rule out the worst-case scenario in which the envelope culture drives the whole society to the point of “collective suicide,” preventing vulnerable individuals from receiving treatment due to the failure to give extra “thank-you money” to healthcare workers (Nguyen et al., 2021).

From the mindsponge theory’s viewpoint, bribing the doctor can be deemed an adaptive strategy in an environment where the healthcare supply cannot meet the actual demand. This leads to social competition for the priority to be cured. This strategy is analogous to the case of cotton plants that accept low-impact insects, such as aphids, consuming a small number of leaves if these pests can attract predators (e.g., fire ants) to avoid more harmful herbivores like caterpillars (Kaplan & Eubanks, 2005). Like cotton plants, patients have to choose to bribe to minimize the overall treatment cost. Hence, a sound healthcare system should be a setup that pledges to the Hippocratic Oath and does not impel patients to make such kind of tradeoff.

Based on the study’s results, we propose two main implications. First, healthcare workers need to remind the Hippocratic Oath daily. Second, doctor bribery must be seriously considered in policymaking and scientific discourse, as it is only the tip of the iceberg.

Although doctor bribery is small-scale, it might cause the “butterfly effect” on myriad unobserved bribery phenomena. For example, doctors bribe hospital directors for promotion; hospital directors bribe the Ministry of Health for more subsidies; pharmaceutical companies bribe the government to manipulate drug prices. Such things are not only possible but have actually occurred. Vietnam’s Minister of Health was arrested and accused of overstating medical equipment prices, including COVID-19 test kits (Vu & Nguyen, 2022). Apart from that, his peers, Deputy Ministers of Health – Truong Quoc Cuong and Cao Minh Quang – were also arrested for their involvement in Vietnam Pharma JSC’s (VN Pharma) fake cancer drug import and trade (Du, 2022; SGT, 2022).

### Supplementary

**Table S1: Estimated posteriors of Model 1**

Parameters	Mean	SD	n_eff	Rhat
<i>Constant</i>	2.22	0.07	4426	1
<i>EnvL_Burden</i>	-0.16	0.03	4468	1

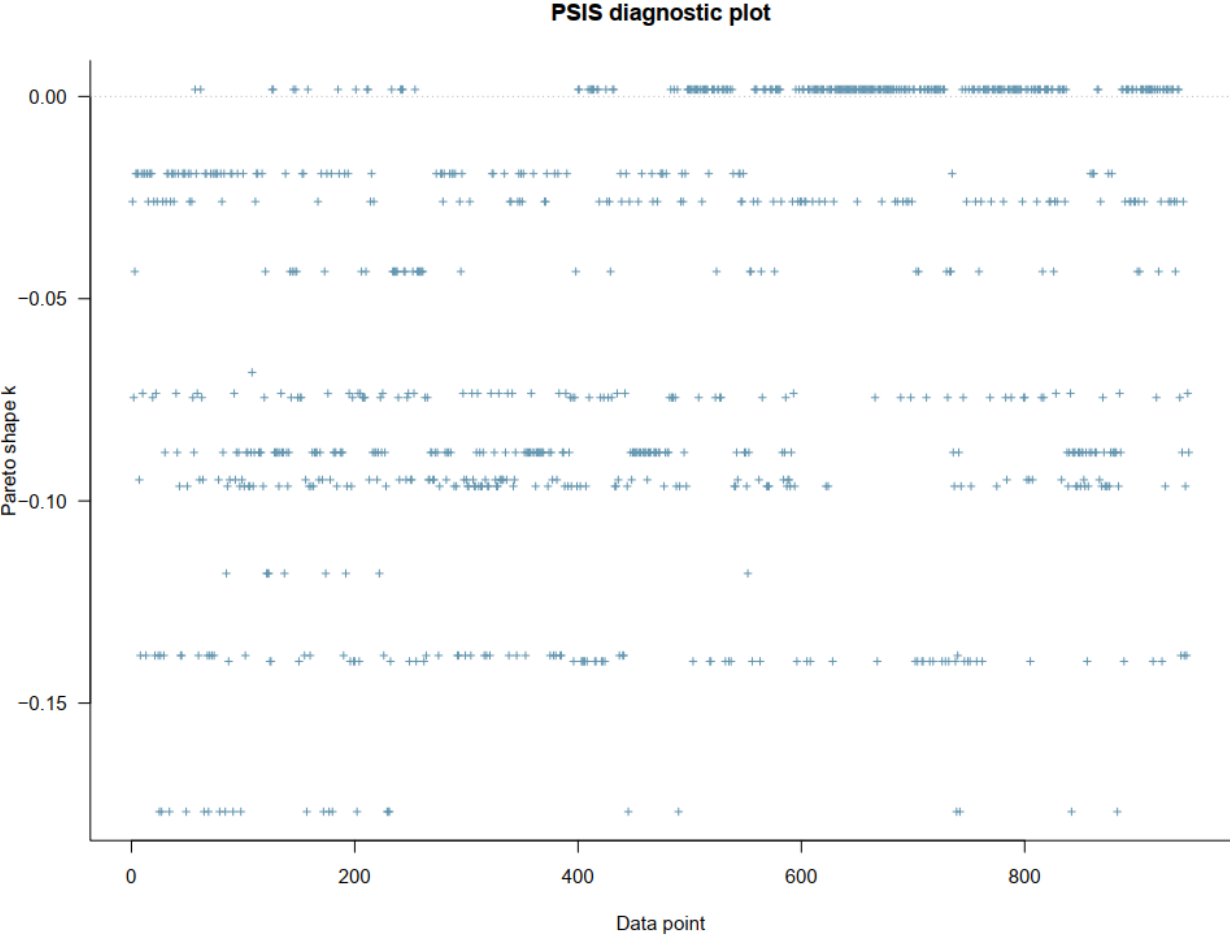
**Table S2: Estimated posteriors of Model 2**

Parameters	Mean	SD	n_eff	Rhat
<i>Constant</i>	0.40	0.17	2625	1
<i>EnvL_Burden</i>	0.12	0.08	2590	1
<i>AvgCost_Burden</i>	0.99	0.08	2679	1
<i>EnvL_AvgCost_Burden</i>	-0.13	0.04	2674	1

**Table S3: Estimated posteriors of Model 3**

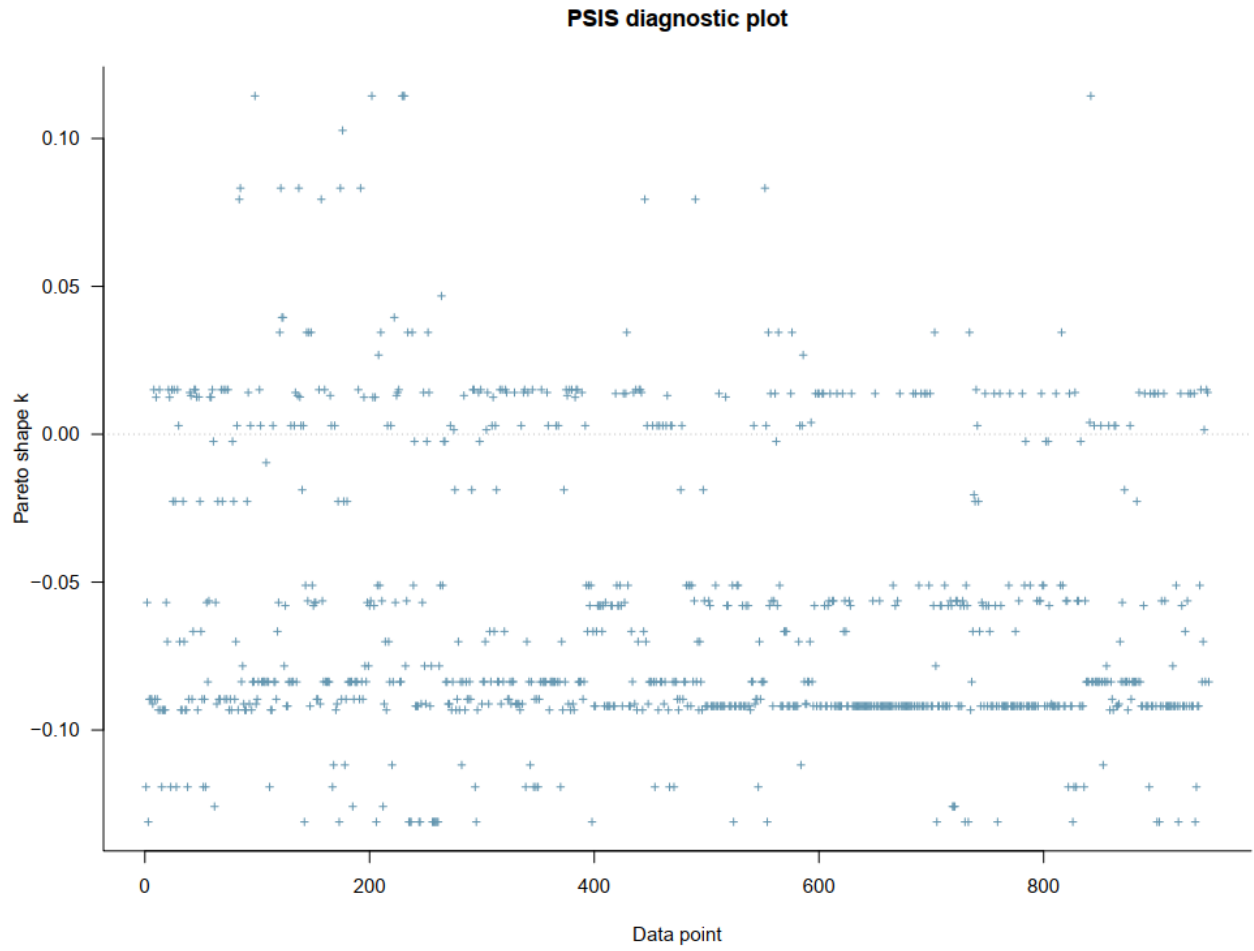
Parameters	Mean	SD	n_eff	Rhat
<i>Constant</i>	1.76	0.25	3549	1
<i>EnvL_Burden</i>	0.22	0.10	3561	1
<i>AvgCost_Burden</i>	0.70	0.08	4134	1

<i>EnvL_AvgCost_Burden</i>	-0.07	0.04	4265	1
<i>Jcond_Burden</i>	-0.36	0.07	3859	1
<i>EnvL_Jcond_Burden</i>	-0.08	0.03	3909	1

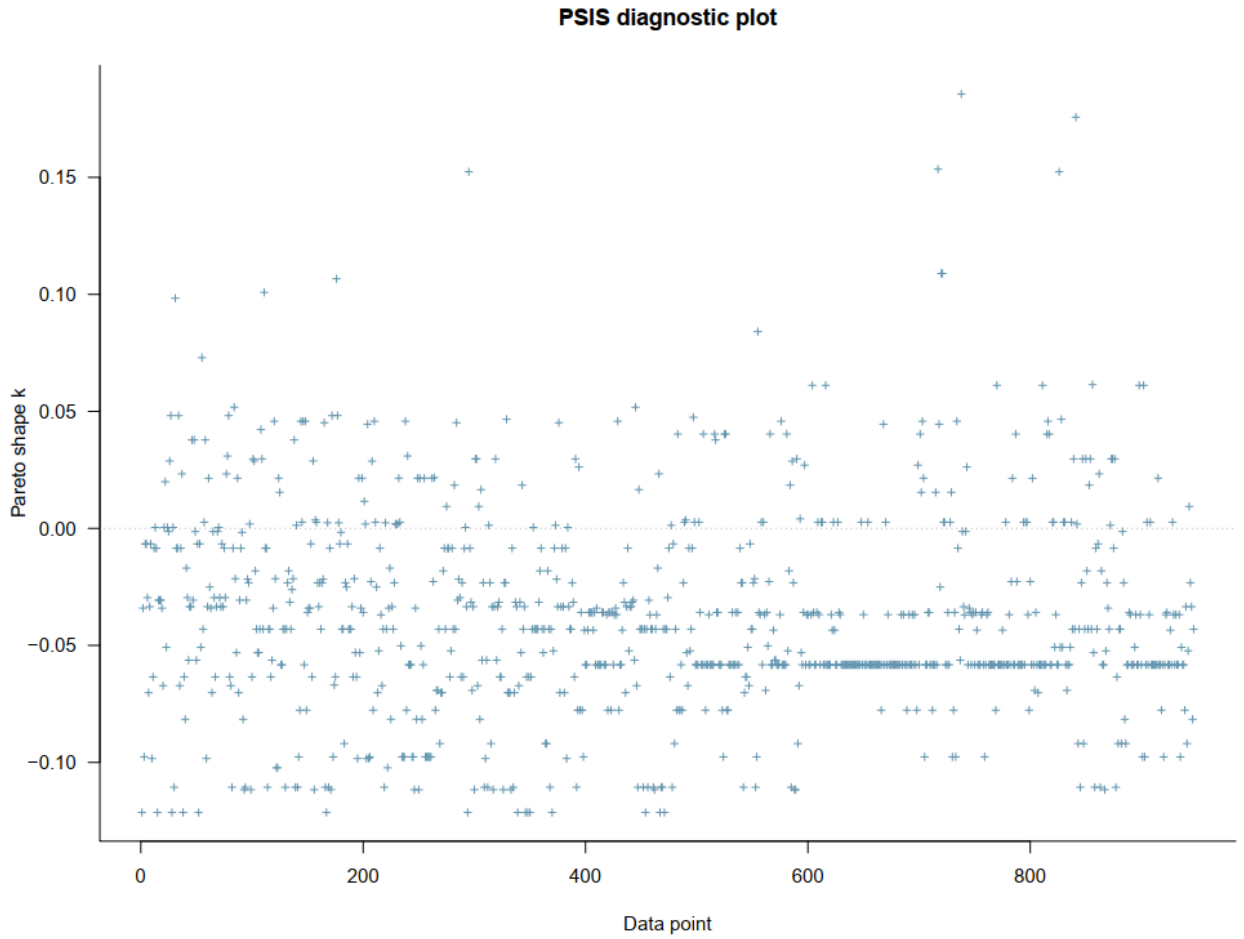


**Figure S1:** Model 1's PSIS-LOO diagnosis with uninformative priors

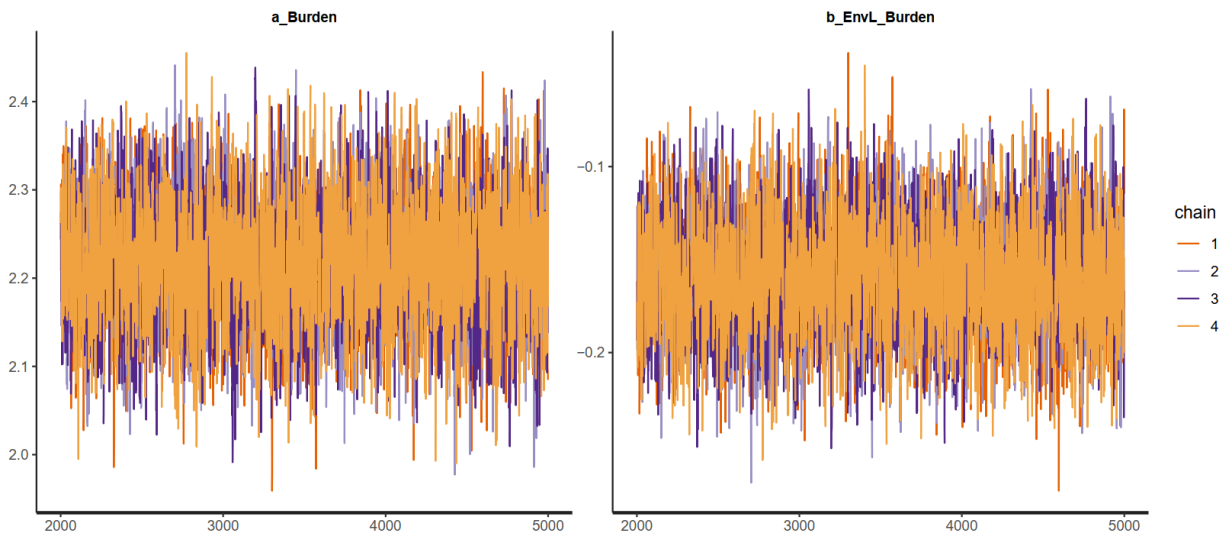




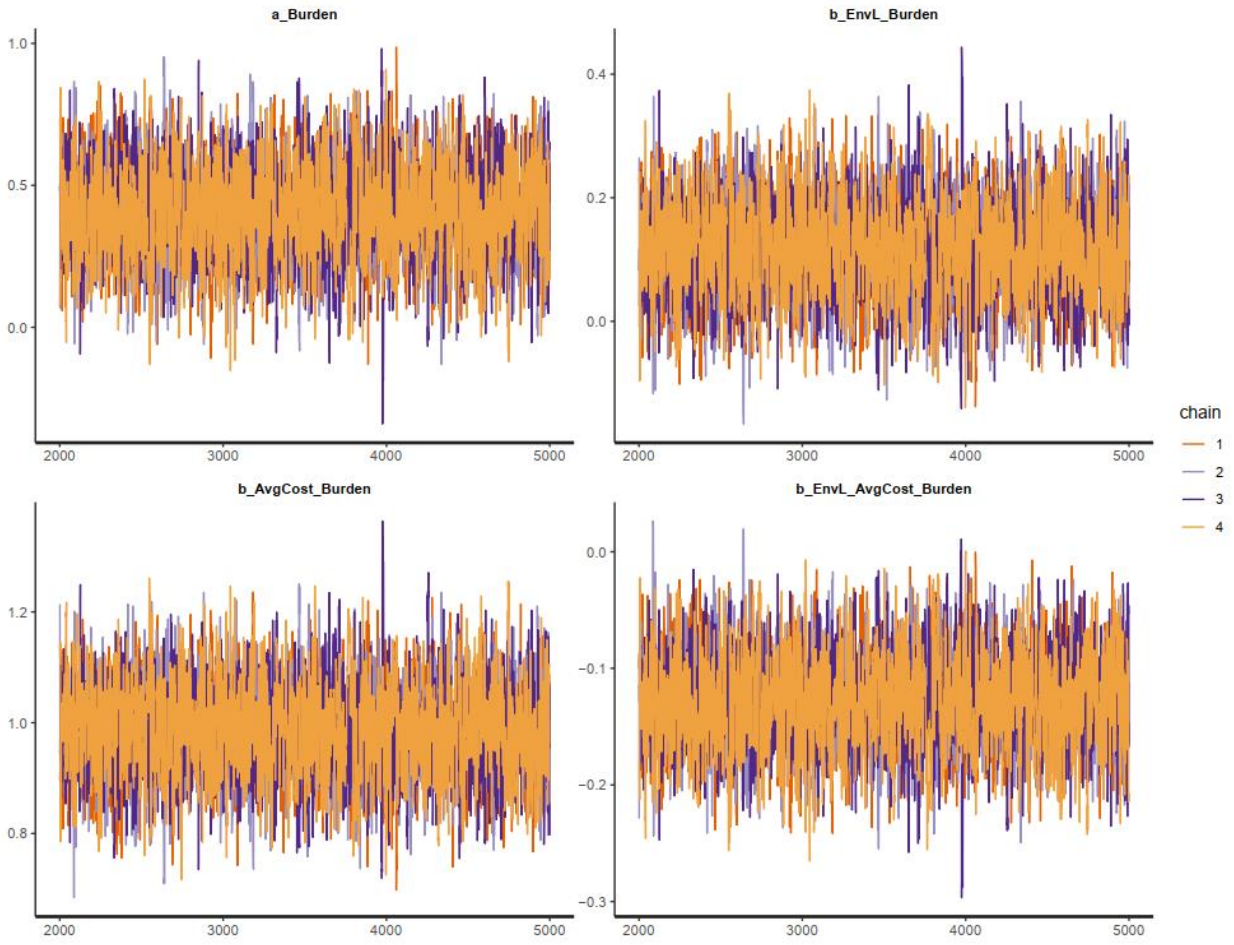
**Figure S2:** Model 2's PSIS-LOO diagnosis with uninformative priors



**Figure S3:** Model 3's PSIS-LOO diagnosis with uninformative priors



**Figure S4:** Model 1's trace plots with uninformative priors



**Figure S5: Model 2's trace plots with uninformative priors**

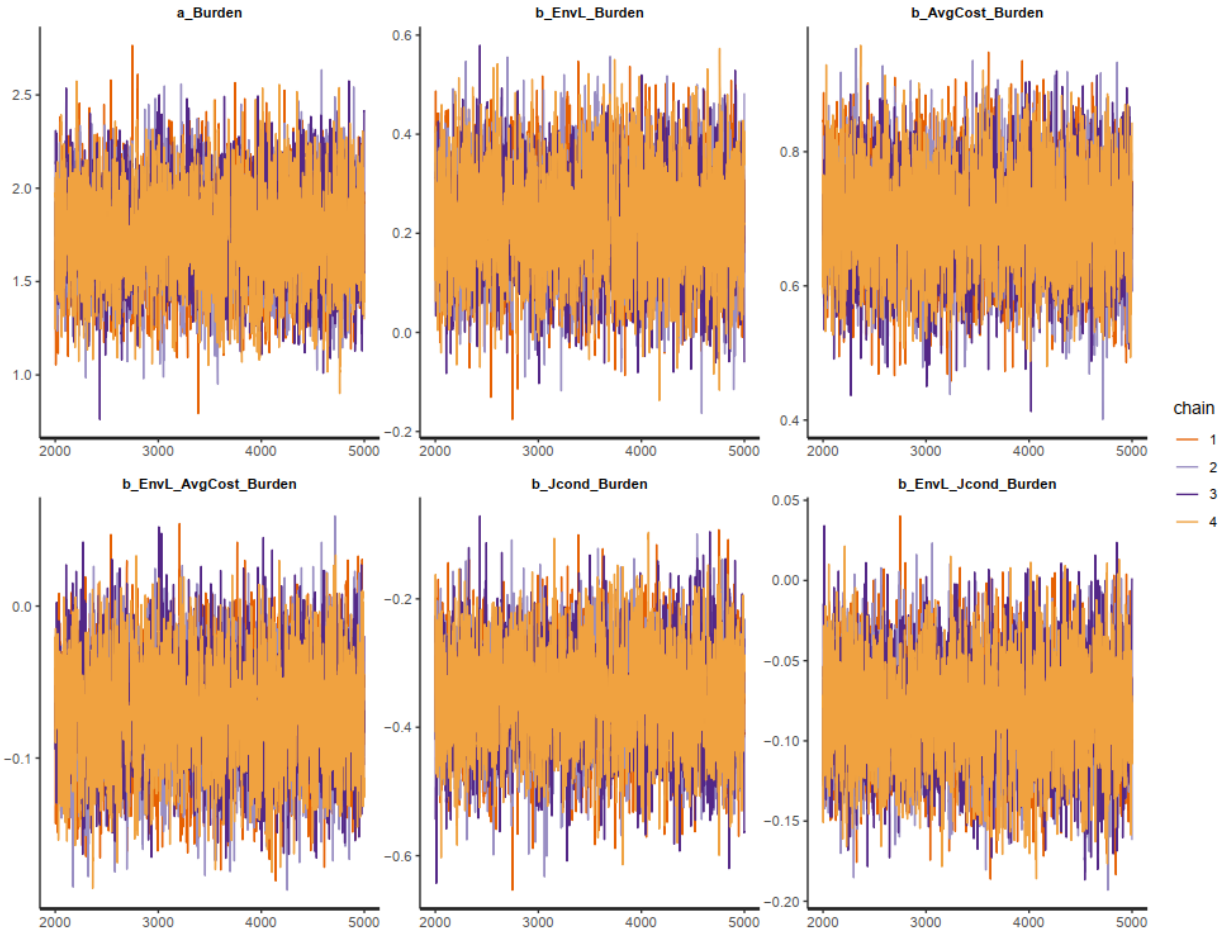
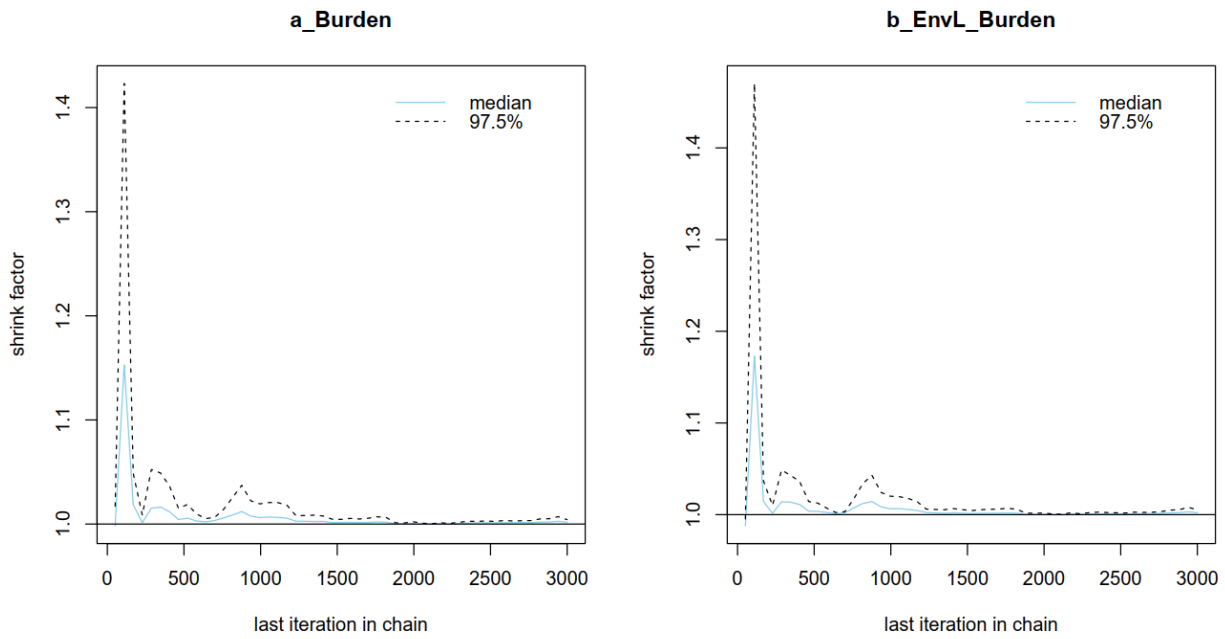
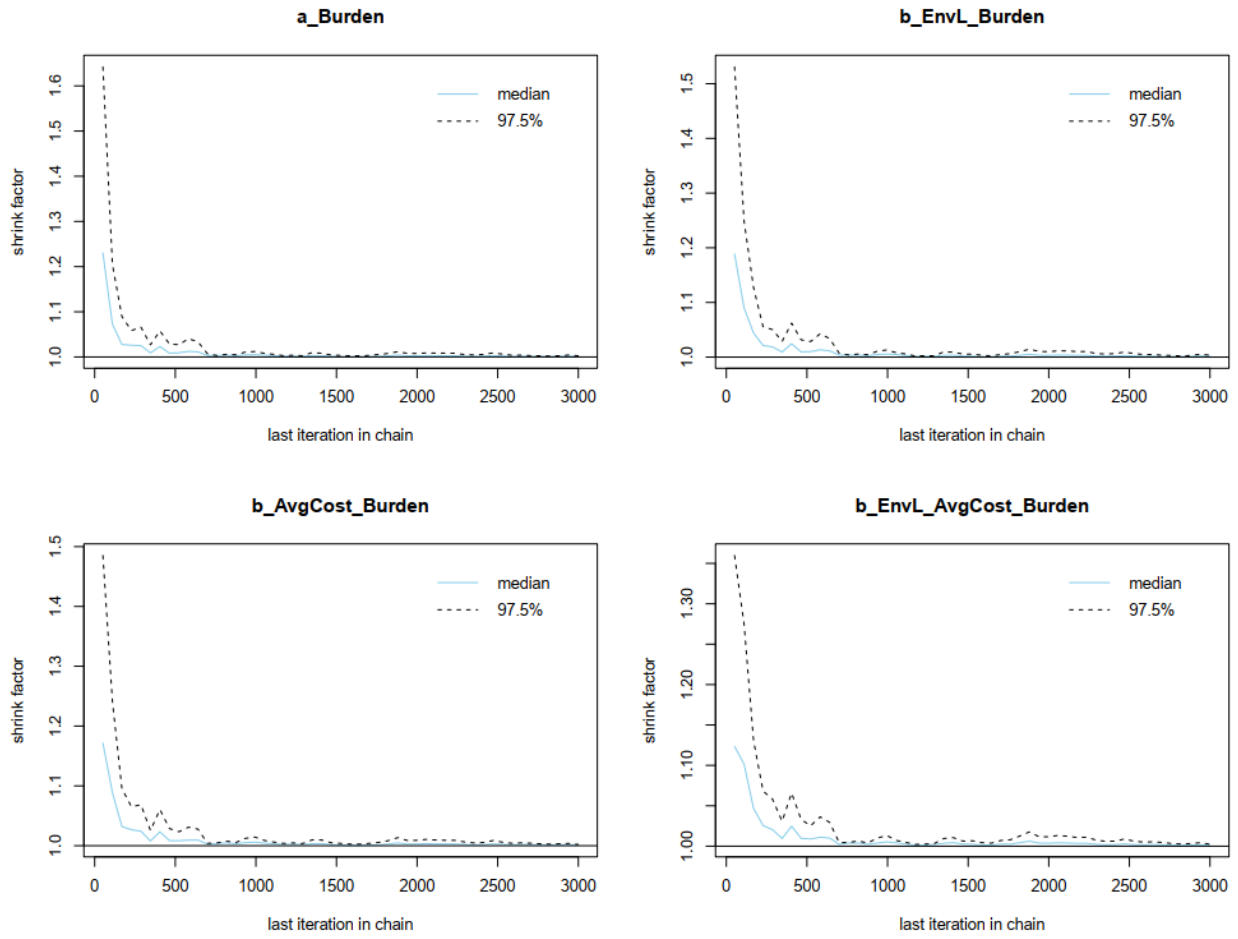


Figure S6: Model 3's trace plots with uninformative priors



**Figure S7:** Model 1's Gelman–Rubin–Brooks plots with uninformative priors



**Figure S8:** Model 2's Gelman–Rubin–Brooks plots with uninformative priors

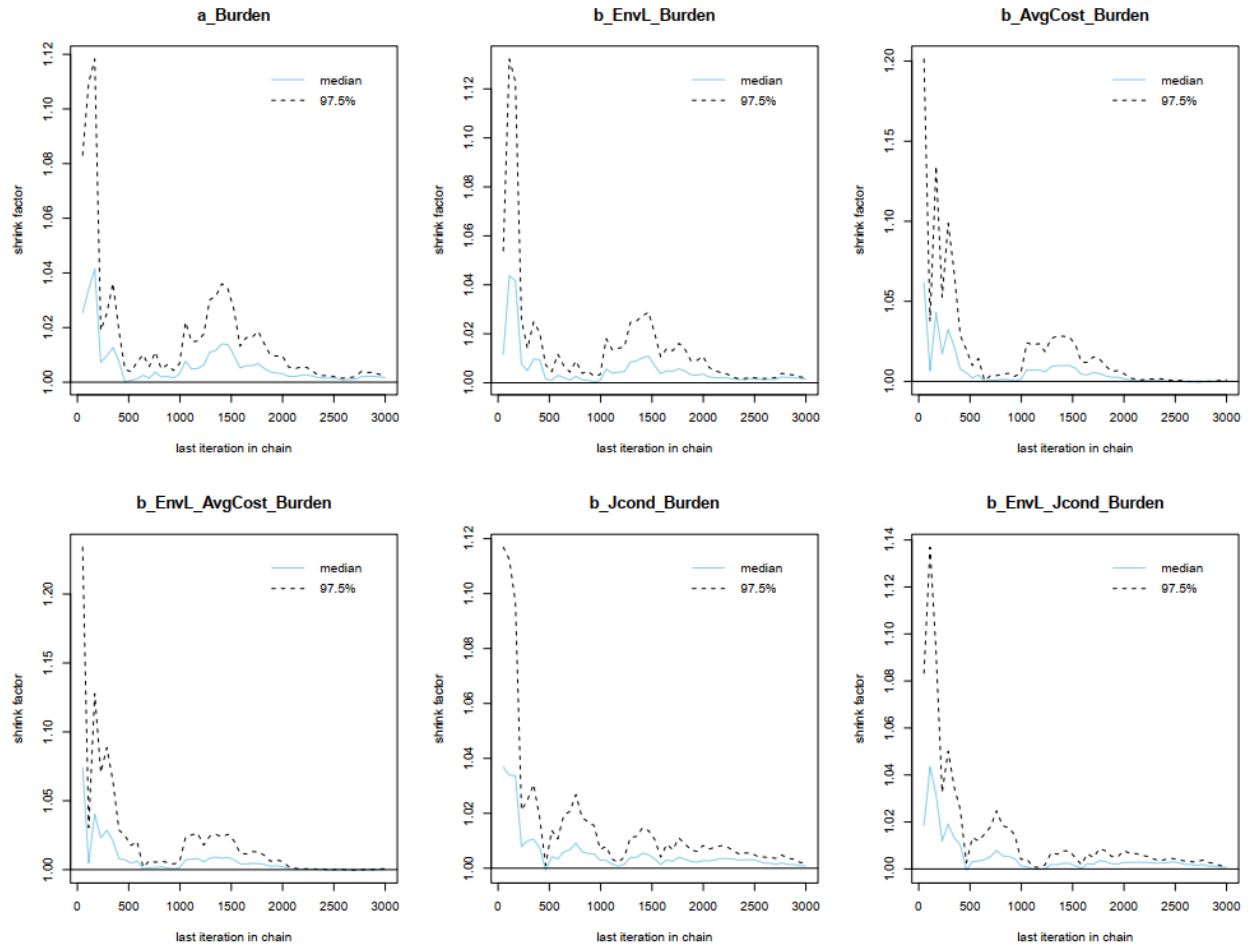
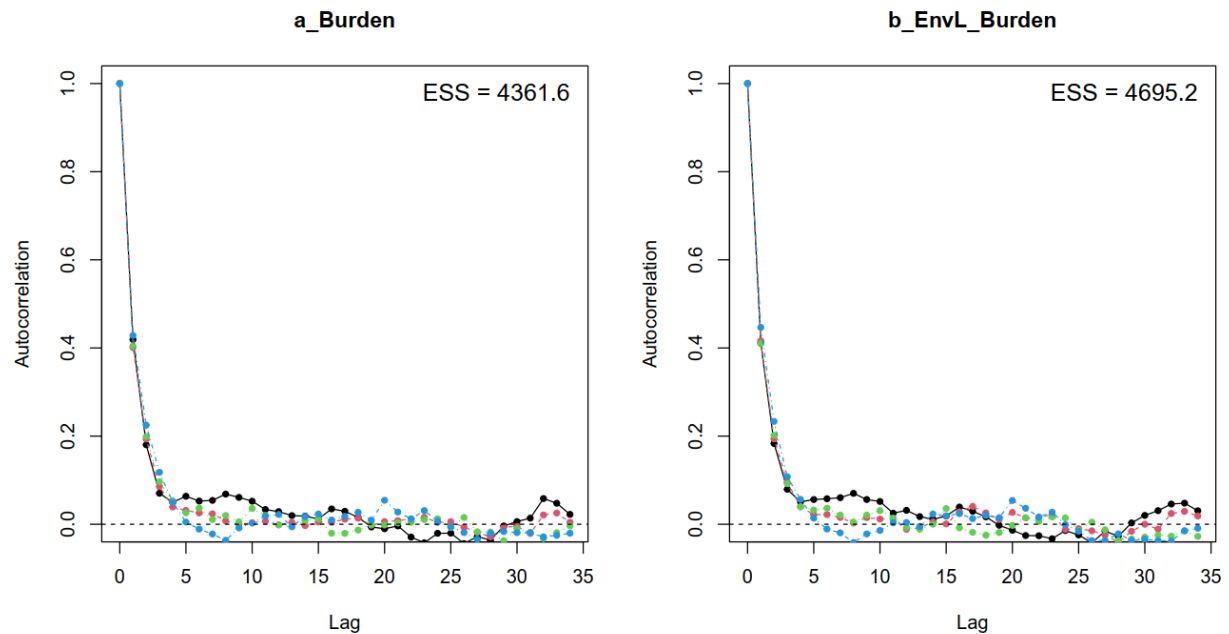
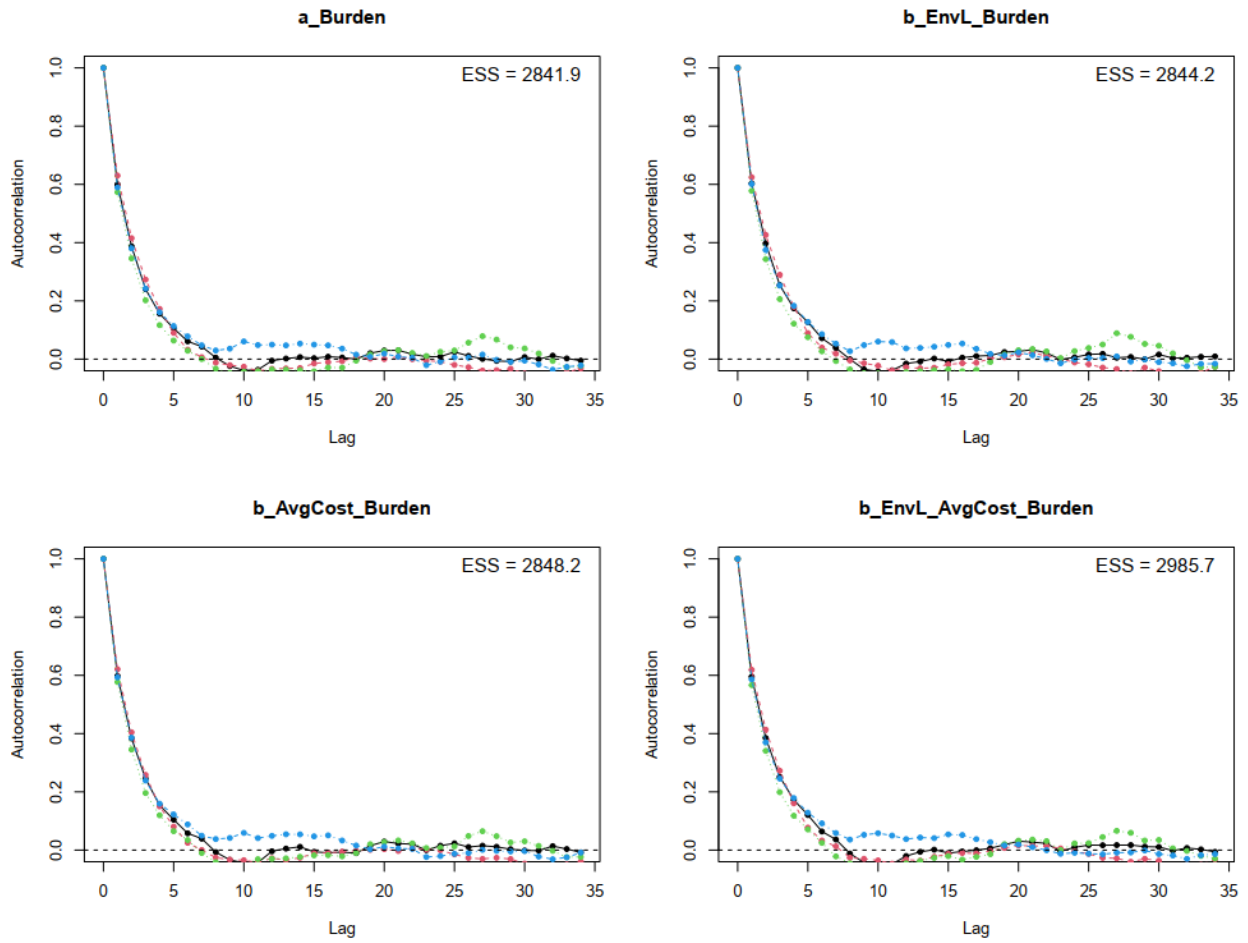


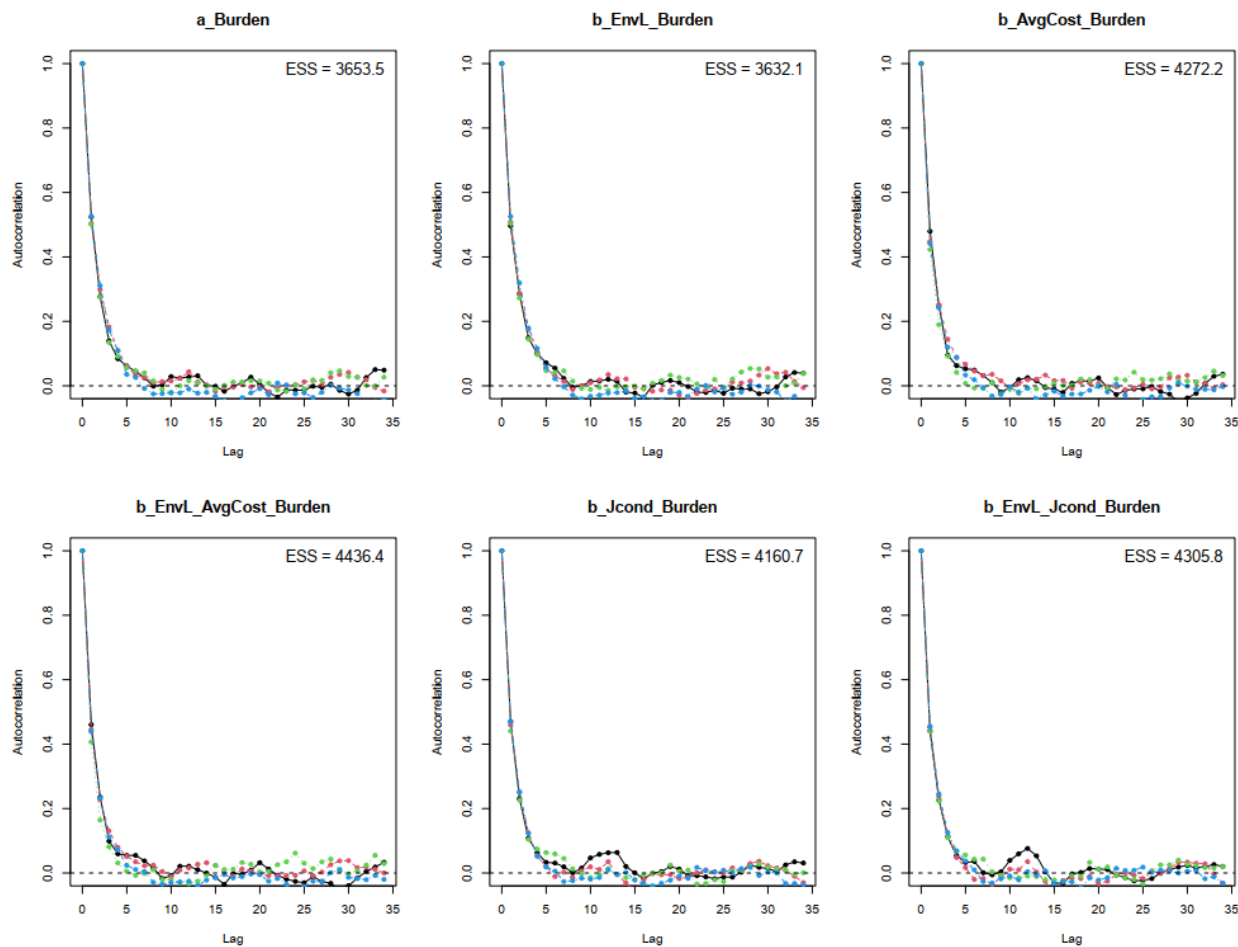
Figure S9: Model 3's Gelman-Rubin-Brooks plots with uninformative priors



**Figure S10: Model 1's autocorrelation plots with uninformative priors**



**Figure S11: Model 2's autocorrelation plots with uninformative priors**



**Figure S12:** Model 3's autocorrelation plots with uninformative priors

## References

- An, T. T. H. (2022). *Phong bì cho bác sĩ: "Có mỗi mấy đồng!"*. Vietnam Net. <https://vietnamnet.vn/phong-bi-cho-bac-si-co-moi-may-dong-2063864.html>
- Brooks, S. P., & Gelman, A. (1998). General methods for monitoring convergence of iterative simulations. *Journal of computational and graphical statistics*, 7(4), 434-455.
- Chan, C. S.-c., Yao, Z. J. T., & Society. (2018). A market of distrust: toward a cultural sociology of unofficial exchanges between patients and doctors in China. *Theory and Society*, 47, 737-772.
- Chất lượng khám chữa bệnh chưa đồng đều giữa các vùng, tuyến.* (Van, Thanh). Đảng Bộ Thành Phố Hồ Chí Minh. Retrieved 21 February from <https://www.hcmcpv.org.vn/tin-tuc/chat-luong-kham-chua-benh-chua-dong-deu-giua-cac-vung-tuyen-1491858388>



- Chiu, Y.-C., Smith, K. C., Morlock, L., & Wissow, L. (2007). Gifts, bribes and solicitations: print media and the social construction of informal payments to doctors in Taiwan. *Social Science and Medicine*, 64(3), 521-530.
- Correll, J., Spencer, S. J., & Zanna, M. P. (2004). An affirmed self and an open mind: Self-affirmation and sensitivity to argument strength. *Journal of Experimental Social Psychology*, 40(3), 350-356.
- Csilléry, K., Blum, M. G., Gaggiotti, O. E., & François, O. (2010). Approximate Bayesian computation (ABC) in practice. *Trends in Ecology and Evolution*, 25(7), 410-418. <https://doi.org/10.1016/j.tree.2010.04.001>
- Daft, R. L., & Weick, K. E. (1984). Toward a model of organizations as interpretation systems. *Academy of Management Review*, 9(2), 284-295.
- Darwin, C. (2003). *On the origin of species* (D. Knight, Ed. Reprint ed.). Routledge.
- Diaconis, P., & Ylvisaker, D. (1985). Quantifying prior opinion. In J. M. Bernardo, M. H. DeGroot, D. V. Lindley, & A. F. M. Smith (Eds.), *Bayesian Statistics* (Vol. 2, pp. 133-156). North Holland Press.
- Du, P. (2022). *Former deputy health minister arrested for negligence*. VNExpress International. Retrieved 21 February from <https://e.vnexpress.net/news/news/former-deputy-health-minister-arrested-for-negligence-4437588.html>
- Dunson, D. B. (2001). Commentary: practical advantages of Bayesian analysis of epidemiologic data. *American journal of Epidemiology*, 153(12), 1222-1226. <https://doi.org/10.1093/aje/153.12.1222>
- Giang, H. (2016). *Còn hiện tượng vòi vĩnh người bệnh ở BV K Trung ương*. Pháp Luật. Retrieved 21 February from <https://plo.vn/con-hien-tuong-voi-vinh-nguoi-benh-o-bv-k-trung-uong-post416960.html>
- Gill, J. (2014). *Bayesian methods: A social and behavioral sciences approach* (Vol. 20). CRC press.
- Halsey, L. G., Curran-Everett, D., Vowler, S. L., & Drummond, G. B. (2015). The fickle P value generates irreproducible results. *Nature methods*, 12(3), 179-185.
- Ho, M.-T., La, V.-P., Nguyen, M.-H., Vuong, T.-T., Nghiem, K.-C. P., Tran, T., & Vuong, Q.-H. (2019). Health care, medical insurance, and economic destitution: A dataset of 1042 stories. *Data*, 4(2), 57. <https://doi.org/10.3390/data4020057>
- Hoang, T., & Trong, D. (2022). *Vụ Việt Á: Đã khởi tố 29 vụ án, 102 bị can liên quan ‘thối giá’ kit xét nghiệm*. Tuổi Trẻ Online. Retrieved 21 February 2022 from

<https://tuoitre.vn/vu-viet-a-da-khoi-to-29-vu-an-102-bi-can-lien-quan-thoi-gia-kit-xet-nghiem-20221219161337237.htm>

- Hwang, K.-k. (1987). Face and favor: The Chinese power game. *American Journal of Sociology*, 92(4), 944-974.
- Kaplan, I., & Eubanks, M. D. (2005). Aphids alter the community-wide impact of fire ants. *Ecology*, 86(6), 1640-1649.
- La, V.-P., & Vuong, Q.-H. (2019). bayesvl: Visually learning the graphical structure of Bayesian networks and performing MCMC with 'Stan'. *The Comprehensive R Archive Network (CRAN)*. <https://cran.r-project.org/web/packages/bayesvl/index.html>
- Levy, O., Beechler, S., Taylor, S., & Boyacigiller, N. A. (2007). What we talk about when we talk about 'global mindset': Managerial cognition in multinational corporations. *Journal of International Business Studies*, 38(2), 231-258. <https://doi.org/10.1057/palgrave.jibs.8400265>
- Lynch, S. M. (2007). *Introduction to applied Bayesian statistics and estimation for social scientists*. Springer Science & Business Media.
- Ma, S. K. (2012). "Policing the police": A perennial challenge for China's anticorruption agencies. In T. Gong & S. K. Ma (Eds.), *Preventing Corruption in Asia* (pp. 81-96). Routledge.
- Matsushima, M., & Yamada, H. (2016). Impacts of bribery in healthcare in Vietnam. *The Journal of Development Studies*, 52(10), 1479-1498.
- McElreath, R. (2018). *Statistical rethinking: A Bayesian course with examples in R and Stan*. Chapman and Hall/CRC Press.
- Mi, H. (2013). *Why do Vietnam's patients bribe their doctors?* BBC. Retrieved 21 February from <https://www.bbc.com/news/world-asia-23237285>
- Ministry of Health. (2016). *For people's health protection, care and promotion 2016-2020*. <https://faolex.fao.org/docs/pdf/vie179587.pdf>
- Moldovan, A., & Van de Walle, S. (2013). Gifts or bribes? Attitudes on informal payments in Romanian health care. *Public Integrity*, 15(4), 385-402.
- Nguyen, H., Ivers, R., Jan, S., & Pham, C. (2017). Analysis of out-of-pocket costs associated with hospitalised injuries in Vietnam. *BMJ Global Health*, 2(1), e000082.
- Nguyen, H. M. (2017). Inequality in healthcare costs between residing and non-residing patients: evidence from Vietnam. *International Journal for Equity in Health*, 16, 1-9.
- Nguyen, M.-H., La, V.-P., Le, T.-T., & Vuong, Q.-H. (2022a). Bayesian Mindsponge Framework analytics: a novel methodological approach for social sciences and humanities. In Q.-

- H. Vuong, M.-H. Nguyen, & V.-P. La (Eds.), *The mindsponge and BMF analytics for innovative thinking in social sciences and humanities* (pp. 87-116). De Gruyter. <https://doi.org/10.2478/9788367405119-010>
- Nguyen, M.-H., La, V.-P., Le, T.-T., & Vuong, Q.-H. (2022b). Introduction to Bayesian Mindsponge Framework analytics: an innovative method for social and psychological research. *MethodsX*, 9, 101808. <https://doi.org/10.1016/j.mex.2022.101808>
- Nguyen, M.-H., Le, T.-T., Nguyen, H.-K. T., Ho, M.-T., Nguyen, H. T. T., & Vuong, Q.-H. (2021). Alice in Suicideland: Exploring the Suicidal Ideation Mechanism through the Sense of Connectedness and Help-Seeking Behaviors. *International Journal of Environmental Research and Public Health*, 18(7), 3681. <https://doi.org/10.3390/ijerph18073681>
- Paliszkiwicz, J. O. (2011). Trust management: Literature review. *Management*, 6(4), 315-331.
- Pekerti, A., Vuong, Q.-H., Ho, T. M., & Vuong, T.-T. (2017). Health care payments in Vietnam: patients' quagmire of caring for health versus economic destitution. *International Journal of Environmental Research and Public Health*, 14(10), 1118.
- Phuong, L., & An, T. (2022). *Nurses unable to nurse enthusiasm for stressful, underpaid job*. VNExpress International. Retrieved 21 February from <https://e.vnexpress.net/news/news/nurses-unable-to-nurse-enthusiasm-for-stressful-underpaid-job-4515987.html>
- Pólya, G. (1954). *Induction and analogy in mathematics: Mathematics and plausible reasoning*. Princeton University Press.
- Quyen, B. T. T., Ha, N. T., & Van Minh, H. (2021). Outpatient satisfaction with primary health care services in Vietnam: Multilevel analysis results from The Vietnam Health Facilities Assessment 2015. *Health Psychology Open*, 8(1), 20551029211015117.
- Rogers, J. A. (1972). Darwinism and Social Darwinism. *Journal of the History of Ideas*, 33(2), 265. <https://doi.org/10.2307/2708873>
- Sawang, S., Chou, C. Y., & Truong-Dinh, B. Q. (2019). The perception of crowding, quality and well-being: a study of Vietnamese public health services. *Journal of Health Organization and Management*, 33(4), 460-477.
- Sepehri, A., Chernomas, R., & Akram-Lodhi, A. H. (2003). If they get sick, they are in trouble: health care restructuring, user charges, and equity in Vietnam. *International Journal of Health Services*, 33(1), 137-161.

- SGT. (2022). *Deputy Minister of Health Truong Quoc Cuong gets the sack*. VietnamNet. Retrieved 21 February from <https://vietnamnet.vn/en/deputy-minister-of-health-truong-quoc-cuong-gets-the-sack-814672.html>
- Tsai, D. (1996). *Transformation of physicians' public identities in Taiwan and the United States: A comparative and historical study of ambivalence, public policy and civil society* [University of Michigan]. <https://deepblue.lib.umich.edu/handle/2027.42/130146>
- Vehtari, A., & Gabry, J. (2019). *Bayesian Stacking and Pseudo-BMA weights using the loo package*. In (Version loo 2.2.0) <https://mc-stan.org/loo/articles/loo2-weights.html>
- Vehtari, A., Gelman, A., & Gabry, J. (2017). Practical Bayesian model evaluation using leave-one-out cross-validation and WAIC. *Statistics and computing*, 27(5), 1413-1432. <https://doi.org/10.1007/s11222-016-9696-4>
- Vian, T., Brinkerhoff, D. W., Feeley, F. G., Salomon, M., & Vien, N. T. K. (2012). Confronting corruption in the health sector in Vietnam: patterns and prospects. *Public Administration and Development*, 32(1), 49-63.
- Vu, K., & Nguyen, P. (2022). *Vietnam's health minister, Hanoi city chief arrested amid anti-graft drive*. Reuters. Retrieved 21 February from <https://www.reuters.com/world/asia-pacific/vietnam-sacks-health-minister-amid-anti-graft-drive-2022-06-07/>
- Vuong, Q.-H. (2018a). The (ir)rational consideration of the cost of science in transition economies. *Nature Human Behaviour*, 2, 5. <https://doi.org/10.1038/s41562-017-0281-4>
- Vuong, Q.-H. (2018b). Sociodemographic factors influencing Vietnamese patient satisfaction with healthcare services and some meaningful empirical thresholds. *Iranian Journal of Public Health*, 47(1), 119.
- Vuong, Q.-H. (2020). Reform retractions to make them more transparent. *Nature*, 582, 149. <https://doi.org/10.1038/d41586-020-01694-x>
- Vuong, Q.-H. (2022). *The kingfisher story collection*. <https://www.amazon.com/Kingfisher-Story-Collection-Quan-Hoang-Vuong-ebook/dp/B0BG2NNHY6>
- Vuong, Q.-H. (2023). *Mindsponge Theory*. De Gruyter. <https://books.google.com/books?id=OSiGEAAAQBAJ>
- Vuong, Q.-H., La, V.-P., Nguyen, M.-H., Nguyen, T.-H. T., & Ho, M.-T. (2021). Good budget or good care: The dilemma of social health insurance in Vietnam. *SAGE Open Medicine*, 9, 20503121211042512. <https://doi.org/10.1177/20503121211042512>

- Vuong, Q.-H., Le, T.-T., La, V.-P., & Nguyen, M.-H. (2021). *The psychological mechanism of Internet information processing for post-treatment evaluation: implications for healthcare system development*. <https://osf.io/qnywu/>
- Vuong, Q.-H., Le, T.-T., Ruining, J., Nguyen, H.-S., Vuong, T.-T., & Nguyen, M.-H. (2022). Near-suicide: A mindsponge-based investigation into the psychology of patients with serious illnesses withdrawing from treatment. *OSF Preprints*. <https://osf.io/rsptq>
- Vuong, Q.-H., & Napier, N. K. (2014). Making creativity: the value of multiple filters in the innovation process. *International Journal of Transitions and Innovation Systems*, 3(4), 294-327.
- Vuong, Q.-H., & Napier, N. K. (2015). Acculturation and global mindsponge: an emerging market perspective. *International Journal of Intercultural Relations*, 49, 354-367.
- Vuong, Q.-H., Nguyen, M.-H., & La, V.-P. (2022a). *The mindsponge and BMF analytics for innovative thinking in social sciences and humanities*. De Gruyter. <https://books.google.com/books?id=EGeEEAAAQBAJ>
- Vuong, Q.-H., Nguyen, M.-H., & La, V.-P. (2022b). Updated protocol for performing BMF analytics using bayesvl. In Q.-H. Vuong, M.-H. Nguyen, & V.-P. La (Eds.), *The mindsponge and BMF analytics for innovative thinking in social sciences and humanities* (pp. 301-370). De Gruyter. <https://doi.org/10.2478/9788367405119-015>
- Vuong, Q. H. (2015). Be rich or don't be sick: estimating Vietnamese patients' risk of falling into destitution. *SpringerPlus*, 4(1), 529.
- Vuong, Q. H., Nguyen, H., & Vuong, T.-T. (2017). Health insurance thresholds and policy implications: a Vietnamese medical survey in 2015. *Biomedical Research*, 28(6), 2432-2438.
- Wagenmakers, E.-J., Marsman, M., Jamil, T., Ly, A., Verhagen, J., Love, J., . . . Epskamp, S. (2018). Bayesian inference for psychology. Part I: Theoretical advantages and practical ramifications. *Psychonomic bulletin review*, 25(1), 35-57. <https://doi.org/10.3758/s13423-017-1343-3>
- World Bank. (2010). *Vietnam development report (VDR) 2010: Modern institutions*.
- World Health Organization. (2023). *Hospitals in Viet Nam*. World Health Organization. Retrieved 21 February from <https://www.who.int/vietnam/health-topics/hospitals>