UNIVERSITY OF COPENHAGEN

FACULTY OF SCIENCE

Evaluating Tiger Bone Glue Behavior and Consumption in Hanoi, Vietnam.

An application of choice experiments

Master Thesis

Kasper Gadbert [rpc651] & Julie Vikkelsø Nielsen [bhj279]

Supervisor: Martin Reinhardt Nielsen, Vu Hoai Nam Dang & Jette Bredahl Jacobsen

Submitted on: 20 December 2020

Abstract

Tiger glue consumption in Vietnam is a serious threat to the tiger population in and around Vietnam. There have not been many studies on this topic, thus the goal of this thesis is to describe and analyze the consumers preferences and behavior of tiger glue in Vietnam. We use choice modeling to find out if a legally controlled trade in tiger glue might reduce poaching and contribute to tiger conservation. We conducted the discrete choice experiment on 228 tiger glue consumers in Vietnam, Hanoi during the summer of 2020. We investigated the respondent's preferences to attributes of their choice to purchase tiger glue and examined the effect of legal trade to reduce illegal tiger trade. We find that consumers preferred wild over farmed tiger glue and that they were willing to pay more for this. However, when introducing a scenario with legal trade with farmed tigers, respondents will prefer to buy the farmed tiger because they trust in the quality more than tigers obtained from the wild. Hence, legalizing the international tiger trade would not necessarily stop the illegal trade but it may decrease poaching, but at least reduce the pressure on wild tiger populations.

Preface

This paper is composed as the last written project before graduating from the Masters degree in Agricultural Economics from the University of Copenhagen. The object of the master thesis is to demonstrate the abilities to work with an academic problem that is central to our study area.

We would like to thank our supervisor Martin Reinhardt Nielsen (Lector IFRO, UCPH) for his inputs and guidance throughout the project and Vu Hoai Nam Dang (Ph.D.-student IFRO, UCPH) for his continuous help with the model, execution of the choice experiment and his connections in Vietnam. We will also like to thank Jette Bredahl Jacobsen (Professor IFRO, UCPH) for her guidance throughout the construction of the choice experiment. This work was funded and supported by two scholarships, and we would like to thank the boards behind the *Hotelejer Anders Månsson og hustru Hanne Månssons Mindelegat* and *Frøken Marie Månssons Legat* for making our data collection possible. The funds have no financial interest that could have appeared to influence the work reported in this paper.

Content

1. Introduction

Illegal wildlife trade is a significant threat to biodiversity conservation and is driving species toward extinction (’t Sas-Rolfes et al. 2019; Milner-Gulland & Wright 2017). Goal 15 of the Sustainable Development Goals (SDG) focuses on Sustainable Development including protecting, restoring and promoting sustainability, and reversing biodiversity loss. This goal encompasses wildlife as well as habitat conservation. Regardless of this focus in both the preceding Millenium Development Goals and the new SDGs, the abundance of wild tigers has decreased markedly the past decades concomitantly with habitat and prey base loss. The tiger (*Panthera Tigris*) has been listed as Endangered on the IUCN Red List since 1986. However, from the 1990s to 2014, the global tiger population declined by about 50% (Goodrich et al. 2015; Seidensticker et al. 1999), and it is estimated that there are about 4,000 tigers left globally (EIA 2019; Goodrich et al. 2015). Apart from declining habitat, high demand for tiger bones in Asia’s traditional medicine markets is a major threat to the survival of the remaining wild tiger populations (Nijman & Shepherd 2014).

The demand for tigers especially, is driven by different purposes including traditional medicine, curio, decoration, wild meat, public and private display (Broad & Damatia 2010). Trading tiger products does not only limit to one or two specific parts of the tiger, anything that has a value is being sold and traded. Tiger commodities can consist of claws, bones (could either be the skull, whole skeleton or individual bones), paws, teeth, meat, whiskers, tail or the whole skin (Wong & Krishnasamy 2019), as seen on figure 1.1.

Figure 1.1: Traded tiger products (VTC News 2019; Wong & Krishnasamy 2019; TRAFFIC 2019)

Tiger bones have been used in traditional medicine in many Asian countries for centuries with perceived benefits of treating rheumatism and other ailments of the muscles and bones (Mills & Jackson 1994). Tiger bone specifically, is believed to have anti-inflammatory and pain-killing effects (Lapointe et al. 2007). Wild tiger products like the skin can be sold for 20.000 USD (Bourton 2009), while the current price of tiger bone glue in Vietnam ranges from US$6,500 to US$13,000 per kilogram depending on the proportion of tiger bone in the paste (Tiger trader, per. comm., March 28th, 2020). United Nations (2020) states that tiger bones are currently sold for 1,400 USD per kilogram. One of the products obtained from tiger bones is tiger glue.

Figure 1.2: Tiger glue process (VTC News 2019)

Traditionally, tiger bone was dried and ground into a powder, then mixed with other ingredients in concoctions prescribed by traditional medicine practitioners (Broad & Damatia 2010). Today, tiger bone is often cooked into a sticky glue known as *cao ho* that can be eaten directly or put into wine to drink, as seen in Figure 1.2 (Stoner et al. 2016; Matsangou 2019; Davis et al. 2020). In addition to the trade in tigers, other big cat species like lions are also being breaded to supply the demand for big-cat bones (Moyle 2009; Coals et al. 2020). Williams et al. (2015) states that lion parts have been legally traded to Southeast Asia since 2008, where the lion bones have been used as substitutes for tiger bones in traditional medicine and health tonics (Moyle 2009). However, due to the increasing demand, producers on the black market have also started adding bones from other animals such as antelopes and monkeys, without informing consumers (Davis et al. 2020). International trade in tigers and their parts has been prohibited since 1975 when the species was listed under Appendix I of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Abbott & Van Kooten 2011). Strengthening enforcement of regulations to prevent illegal hunting in supply countries is difficult and has had limited effect. Hence, initiatives targeting demand are required in order to make a change.

Both national and international organizations like CITES, World Wildlife Fund (WWF) and TRAFFIC have over the past several decades tried to change this demand with several initiatives. The policies issued by the General Department of Forestry in Vietnam between 1960 to 1994, have primarily focused on the protection (or prevention) of illegal hunting and exploitation of natural resources. The government in Vietnam has further developed several policies to regulate wildlife trade like the National Action Plan from 2004 that focuses on strengthening regulation of the wildlife trade towards 2010. However, due to the lack of government funds for monitoring and evaluation, the policies have not been implemented correctly, and wildlife trade keeps increasing (Nguyen et al. 2008). Current initiatives however try to cease the trade of tiger parts by strengthening law enforcement. This is done in both supply and demand countries but with mixed success. One of the strengthening law enforcements that has been implemented in China, was imposing death penalty for tiger traffickers (Conrad 2012). Vietnam has also increased legal sanctions on trade and consumptions on wildlife products (National Assembly 2015). Even though a great deal of work has been done to strengthen law enforcement, the illegal trade in tiger products shows no sign of abating (Goodrich et al. 2015). More

recently, there has been a joint effort to reduce the demand for tiger products in Asia and elsewhere, creating international campaigns against the trade with tigers (Davis et al. 2020). Five Points Trading Co., who produces *Tiger Beer,* has in 2017 made a six-year global partnership with the WWF. The campaign started with a $1 million donation to support the organization's tiger conservation efforts. The partnership between WWF and Five Points Trading Co. launched a digitally led global awareness campaign called *3890Tigers*, which aspired to increase awareness and inspire action against illegal tiger trade with the help of art and creativity (Tiger beer NA.). However, whether these initiatives have generally been effective is questioned and there is little evidence on their impact in terms of changing consumer attitudes and behavior (Mills & Jackson 1994; TRAFFIC 2012; Dang et al. 2020).

The different campaigns focus not only on wild - but also on farmed tigers. Tiger farms is a facility where tigers are kept captive with the intent of selling their parts for commercial trade (WWF 2016). A large number of tiger farms are housed in East and Southeast Asia close to the market for tiger part trade. The countries who hold the most farms are China, Thailand, Lao and Vietnam. The Environmental Investigation Agency reported more than 200 captive tiger facilities in Asia. China, Laos, Thailand and Vietnam are housing between 7,000 and 8,000 individuals, which is more than double the number of tigers left in the wild (EIA 2007). The number of seizures of tiger parts has plummeted over the past decade (Graham-Rowe 2011). Since 2010, TRAFFIC has been analyzing the illegal wildlife trade in tigers, resulting in three different reports covering the period from 2000 to 2015 (Verheij et al. 2010; Stoner & Pervushina 2013; Stoner & Krishnasamy 2016). In 2019, Wong & Krishnasamy published a new report analyzing the illegal trade in Tigers over a 19-year period from 2000 to 2018, stating that an estimated 2,359 tigers have been seized across 32 countries and territories globally during those years (Wong & Krishnasamy 2019). The density of these seizures can be split into hot zones as shown in Figure 1.3.

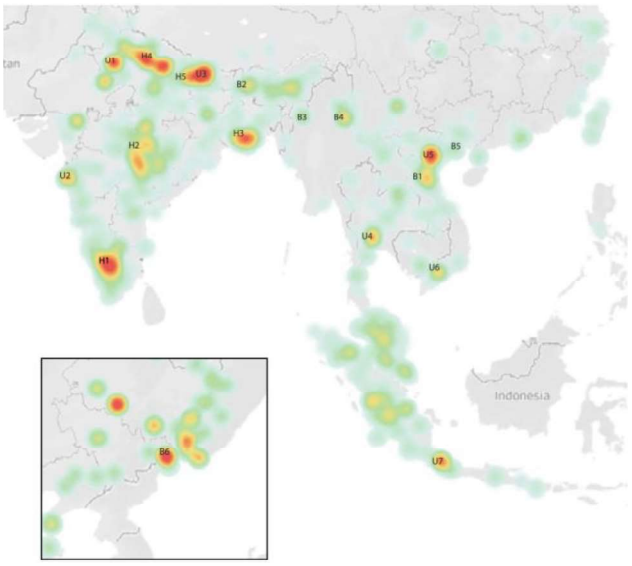


Figure 1.3: Density of tiger seizures (Wong & Krishnasamy 2019)

Note: H1: Nagarhole (India). H2: Bhander (India). H3: Sundarban Park (India, Kolkata (India) & Sundarban Forest (Bangladesh). H4: Along Sarda River (India - Nepal). H5: Chitwan Park (Nepal) & Bihar state (India). U1: New Delhi (India). U2: Mumbai (India). U3: Kathmandu (Nepal). U4: Greater Bangkok (Thailand). U5: Hanoi (Vietnam). U6: Ho Chi Minh City (Vietnam). U7: Jakarta (Indonesia). B1: Vietnam – Lao PDR. B2: Bhutan and India. B3: India and Myanmar B4: Myanmar – China. B5: Vietnam - China. B6: China – Russian Federation. The inserted map shows the border between China and Russia.

The map in Figure 1.3 shows geographically the top 20 provinces with the highest number of tigers seized. India is the country with the largest wild tiger population, and also the country with the highest number of seizure hotspots. According to Wong & Krishnasamy (2019), the data in Figure 1.3 is challenged by its size, evidence quality and the reliability of testimonies, while the politically motivated propaganda cannot be excluded. Cross-border smuggling of tigers mostly happens between countries in Asia, and rarely between Asia and Europe or Africa. There was no cross-border smuggling between Asia and the US or Middle East during this period, even though there was smuggling between the US and Mexico (Wong & Krishnasamy 2019).

To understand consumer behavior in relation to illegal wildlife trade, extensive research has been made on the topic using several different methods. The most common method is the stated preference. Stated preference studies are often used to inform decision makers, such that both governmental and nongovernmental organizations can use the recommendations (Johnston et al. 2017). The stated preference methods have previously been used less commonly in low-income countries. However, they are now so broadly used in low income countries that the majority of research conducted is used to support ongoing policy work (Whittington 2010). One of the benefits of this method is that it has shown potential to overcome problems affecting data quality when asking sensitive questions in conservation research (Moro et al. 2013; Nielsen et al. 2015). The method assumes that choices about a good can be described using a set of product attributes, and that consumers are willing to trade off having more of one desirable attribute for less of another, but also that all attributes will be traded off against the price (Hanley et al. 2018).

Coals et al. (2020) presents results from a stated preference questionnaire focusing on preference differences in bone wine products between China and Vietnam. The research was part of a larger questionnaire and did therefore not focus specifically on tiger consumption, but on traditional medicine in general. Since Coals et al. (2020) conducted their questionnaire in both China and Vietnam, the study design was challenged by the order of the questions. With cultural differences between the countries, questions about what is sensitive or not can be raised. Sensitive questions in general may, without the correct implementation, produce unreliable results. Other studies on tiger glue consumers have been conducted by TRAFFIC. However, the data in the TRAFFIC (2019) report is based on a quite small sample, corresponding to 72 respondents. The data were collected through an online questionnaire, which can be problematic when dealing with sensitive questions. Another

drawback of this study is reflected in the age distribution of the respondents, as 31% of the respondents were under the age of 44, which is low compared to the average consumer age (TRAFFIC 2008; TRAFFIC 2019b). Davis et al. (2020) aimed to analyze the motivation and behavior of consumers of tiger products in order to provide policy design recommendations. Limitation is based on the lack of income data, as this variable, along with prices of tiger products and a choice experiment, might help the understanding of the monetary role in determining consumption. Several other studies have evaluated the elasticity of demand for various wildlife products as well as wildlife viewing (Fischer 2003; Esteves & Reggiani 2014; Brennan & Kalsi 2015; Hanley et al. 2018; Walelign et al. 2019) and assessed different policy interventions ('t Sas-Rolfes 2010). Other research have studied tigers more generally and discovered tiger glue consumption in Vietnam (Nowell 2010; Drury 2011; Stoner et al. 2016), but also what tiger parts are used for and the mixture of tiger glue (Stoner et al. 2016; Coals et al. 2019) and the composition for the market on tiger parts (TRAFFIC 2019; Davis et al. 2020). However, none have estimated the demand for tiger glue specifically, and existing studies have 1) not used choice experiments on actual consumers of tiger glue and 2) not included price information which makes it possible to make predictions regarding consumer behavior. Our study focuses on Vietnam, a central marketplace for trade with tiger products and the home of many tiger glue consumers (Nguyen et al. 2008; National Assembly 2019). We also interviewed real consumers of tiger products and tiger glue, and therefore hope to have a much more relevant socio-economic profile of those users than the above mentioned (conditioned on the representative of the sample). Information on preferences and price sensitivity can be used to predict what effort in enforcement will be sufficient to reduce demand, and how to target the regulation of policy interventions more appropriately.

This project will therefore examine the demand for tiger glue in Hanoi, Vietnam, for the sake of contributing to the design of interventions and behavior modification campaigns to reduce demand for illegal trade in tigers. Specifically, we will assess preferences and trade-offs with respect to issues concerning tiger glue, as a function of the price and consumer certainty about product composition, in relation to proportion originating from tiger bone vs bone from other animals. The influence of consumer characteristics will also be assessed.

The aim is to answer the following research questions:

- What factors affect the demand of tiger glue?
- Which attribute is most important for the respondent's choices?
- What is the impact of a legally controlled trade in farmed tigers on consumer demand?

2. Methodology

2.1 Study area and context

This study is conducted in Hanoi, the capital of Vietnam, located in the northern part of the country. The population is 8 million people alone in the metro area and covers an area of 3,358 square kilometers (Central Intelligence Agency 2020). Hanoi was chosen as the study site, for two main reasons; it is one of the largest cities in Vietnam and characterized by high wildlife consumption (Davis et al. 2020).

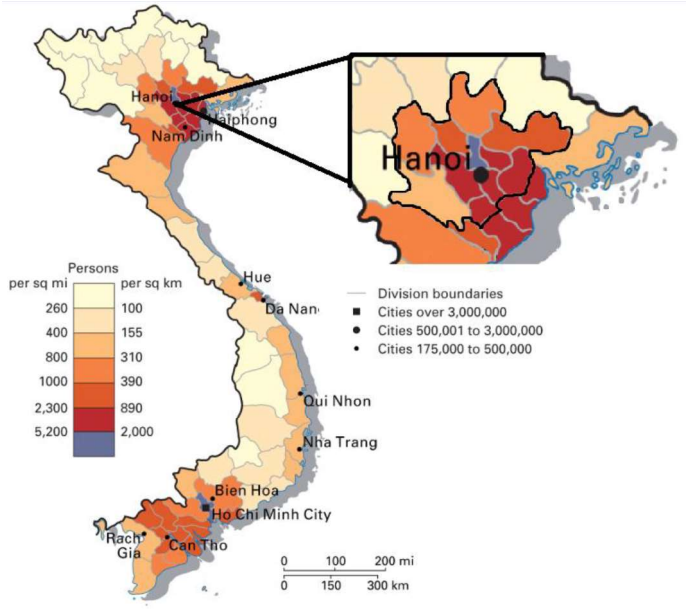


Figure 2.1: Population density in Vietnam (Encyclopædia Britannica 2019)

In recent years, Vietnam has suffered enormous biodiversity losses, where some species are close to extinction. They have therefore prioritized conservation, due to the fact that they have 1,556 endangered species (National Assembly 2019). With less than five wild tigers left (TRAFFIC 2020), Vietnam has enacted comprehensive policies on wildlife protection and is one of the earliest members of CITES (National Assembly 2019). Some of these policies include the Law on Biodiversity from 2008, Decree No.160 from 2013, the Penal Code from 2015 - amended in 2017, Directive No. 28 from 2016, and the Law on Forestry from 2017. Tigers specifically are protected under Decree 160 from 2013, Decree 64 and 06 from 2019, along with the National Program on Tiger Conservation running from 2014-2022 (National Assembly 2019). It is therefore currently illegal to hunt, kill, transport or sell tigers, trap them, keep them as pets or advertise tiger products (ENV 2019). Vietnam is also participating in many different international initiatives such as the London Declaration, the Trans-Pacific Trade Partnership Agreement (TPP), the Kasane Statement on illegal wildlife trade, the ASEAN Wildlife Enforcement Network, the Asia Pacific Economic Cooperation Summit and the Declaration of the East Asia Summit.

A number of initiatives ranging from government publicity about legal sanctions to behavior modification campaigns have been done, in order to reduce the demand for tiger products. Some NGOs have also cooperated with celebrities (Broad & Damania 2010). The TX2 initiative, for instance, was launched in 2010 and aimed to stop the illegal wildlife trade, reduce consumer demand, and double the number of wild tigers by 2022 (TRAFFIC 2020). Le Mai Hanh from ENV (2019) states that tiger glue consumers:

> "*(...) use tiger bone glue as a kind of gift to give people you want to impress as a form of status symbol. Approaching television stations is a good way to spread the message to the largest number of people,*".

Education for Nature – Vietnam therefore tried to implement a range of awareness campaigns to reduce demand for tiger products (ENV 2019). One of their campaigns was brought on national television and showed a new corporate board member giving his colleagues a gift of tiger glue during a meeting, which the recipients left on the table in disgust. The slogan for the campaign was: *"Using tiger bone paste won't impress anyone, don't embarrass yourself"*. In 2014, this type of advertising was one of the first campaigns to focus only on tiger products (Brown 2014).

2.2. Sampling strategy and data collection

2.2.1 Sampling strategy

As the study was conducted in Hanoi and due to the limited literature on the gender and ages of tiger glue consumers, no limitation on these was chosen. We wanted the highest possible sample, limited by our budget constraints, resulting in 228 interviews. The interviews were conducted face-to-face in the period between May 2020 and August 2020 and were held in cafes and conducted by local enumerators.

In questionnaires with focus on sensitive subjects, relationships play a key role. For us as foreigners, it will be hard to identify networks and create the relationships needed, due to the sensitivity of the subject and many Vietnamese people not speaking English. For this choice experiment, the snowball sampling strategy was used. Snowball sampling is often used when it is difficult to find respondents with specific target characteristics. Due to the sensitivity of the topic, all our interviewees were recruited via our two key informants' network. The enumerators first used their own network to find consumers and thereafter extended their network with those respondents they had interviewed. The enumerators asked the respondents if they knew other tiger glue users that would be willing to participate in the questionnaire. This method is a very efficient way to access consumers who, in other ways, are hard to find (Naderifar et al. 2017).

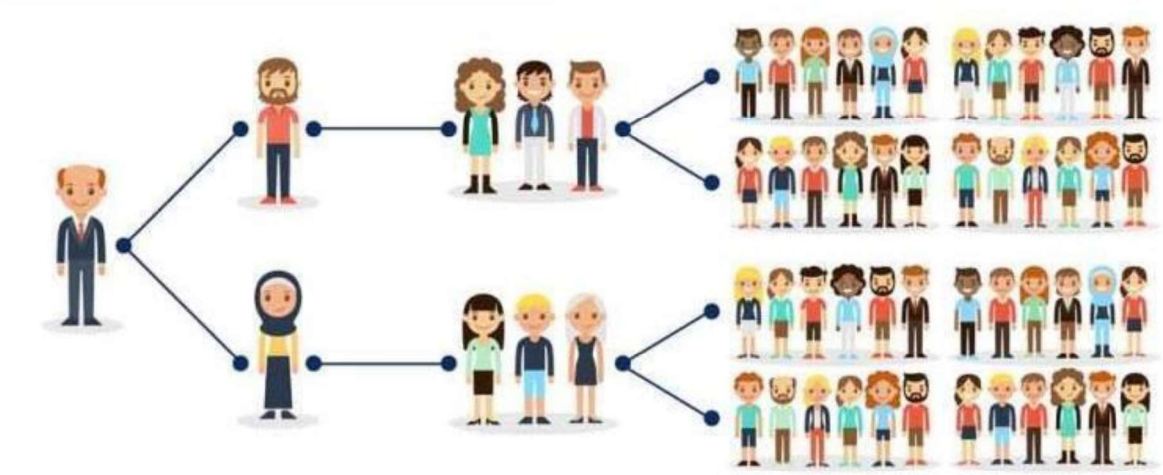


Figure 2.2: Snowball sampling (Bhat 2020)

At the end of June, the team had reached more than 130 respondents. After this period, the collection of data slowed down, as the enumerators had contacted all tiger glue users in their networks. They therefore had to expand their networks and relationships in order to find other consumers. One of the enumerators played tennis at the local tennis club and had to visit other clubs in order to find new respondents. The other enumerator established a network of key informants. For example, when one of his informants had a drink with someone outside the enumerator's network, he would call the enumerator to join and thereby make a new contact.

The target populations were current and potential tiger glue consumers, who were first identified by our enumerators and thereafter by the following question:

"*Do you expect to buy tiger glue for any purposes in the near future (1-3 years)?*
Includes all purposes such as treatment of bone- related diseases (e.g., arthritis, rheumatism), health tonics, aphrodisiacs, gifting or any other types of use".

The target sample was therefore based on a sample of qualitative interviews with confessed and expected consumers or traders of tiger glue.

2.2.2 Sample size

Orme (2019) offers a rule-of-thumb for determining the minimum sample sizes for choice-based modeling.

$$\frac{nta}{c} \geq 500 \tag{2.1}$$

Where *n* is the number of respondents, *t* is the number of tasks, *a* is the number of alternatives per task (Not including the *do not buy* alternative) and *c* is equal to the highest levels for any of the attributes. Researchers have over time been misunderstanding the rule-of-thumb by justifying sample sizes that are too small. The 500

was the minimum main-effect level, thus it would be better to have a number of 1,000 or higher according to Orme (2019). In our study the main-effect level is:

$$\frac{228 * 12 * 2}{4} \geq 1{,}000$$
$$1{,}368 \geq 1{,}000$$

This equation could be rewritten as (de Bekker-Grob et al. 2015):

$$n = \frac{500 * c}{ta} \tag{2.2}$$

Which would generate the minimum amount of respondents in our study:

$$n \geq \frac{500 * 4}{12 * 2}$$
$$n \geq 83.3$$

However, if we changed the main-effect level to 1,000, the minimum amount of respondents should be:

$$n \geq \frac{1{,}000 * 4}{12 * 2}$$
$$n \geq 166.7$$

As the sample in this study consists of 228 respondents, this exceeds both suggested main-effects levels. de Bekker-Grob et al. (2015) argued that if the interview is split up into two or more parts, *n* in each group should be higher. In our study, the choice experiment is split into two different treatments based on legality; one where trading farmed tigers is legal (hypothetical) and one where farmed tiger is illegal (current situation). Following de Bekker-Grob et al. (2015), both scenarios should contain more than 83.3 respondents with a main-level effect of 500. Following this, our study has 114 respondents per treatment corresponding well above the proposed limit.

2.2.3 Data collection

Our Choice Experiments consist of a questionnaire and a set of choice cards, that was collected through personal interviews. The main argument for choosing this data collection method is that users were identified through personal networks and that interviews conducted face-to-face had the ability to build good rapport to facilitate explanation and sharing information.

We used the software program ODK and tablets for the data collection, as the interviews were not recorded either by sound or video. This allowed us to follow the data collection in real time online, as we were not able to oversee it ourselves due to the COVID-19 situation. It also allowed us to detect any inconsistencies along with the registration of the data. The interviews typically took between 15 to 30 minutes, while some lasted only 12 minutes and others two hours. Topics included when, what and why tiger glue was used, how it was obtained, and the respondent experience with it. The respondents were also asked to reflect on the current conservation status of tigers, the illegality of consuming and owning, and trading tiger glue under Vietnamese law. Finally, the respondents were asked whether they preferred wild or farmed tigers and how much they

would be willing to pay for 100-gram tiger bone glue, made from wild or farmed tiger with 50% purity is medium. When stating their WTP, the respondents should consider their disposable income and the current context (i.e., no changes in availability of tiger glue and law enforcement).

The data collection was performed by professional enumerators by us and our co-supervisor Vu Hoai Nam Dang's supervision. Vu Hoai Nam Dang is a Vietnamese PhD student in Denmark, that was located in Vietnam during the data collection. He acted as the middleman between us and the enumerators, as they do not understand English and we do not speak Vietnamese. The enumerators have previous experience gathering data for the *Rhino horn consumer behavior project* conducted by Vu Hoai Nam Dang. They have excellent communication skills and extensive relationships with the high-income society in Hanoi, which is crucial as our data collection depends on personal relationships of the enumerators. However, we still required them to be guided and trained online, in order to obtain a basic understanding of the topic and conducted the interviews as we intended. The interview protocol that the enumerators had to follow can be seen in Appendix 3. Once the data collection was in progress, we checked the data for two main things:

- Incomplete interviews
- Illogicalities, inconsistencies or fallacies

For **incomplete interviews** we would take the average of the duration for an interview and determine if all questions had been answered. We initially assumed that any interview that lasted less than 15 minutes was incomplete. However, some interviews could last less than 15 minutes with for example younger respondents as they could keep their focus and understand the questions faster than older respondents. For **illogicalities, inconsistencies or fallacies** we would look at the responses provided by the respondents. Did they provide answers without thinking rationally or logically (i.e. just wanted to finish the interview as soon as possible)? Or did the enumerators make unintentional mistakes while using the Tablet (i.e. recording the wrong type of answer). Another thing we would also look for was illogical contexts with the answers obtained from the CE, which could occur if the enumerators had not explained the CE clearly enough to the respondents. We look at the incomplete interviews and inconsistencies to exclude non-reliable results.

In order to make sure that the enumerators were confident with the interviews, we held several meetings during the data collection to discuss any potential problems that either we or they had experienced, especially in the beginning of the data collection. When the enumerators became more experienced and familiar with the questions, and knew how to control distracting factors, they could conduct the interviews faster while minimizing any potential problems. This level of quality control procedure is very time-consuming, but it ensures the quality of the data.

The meetings with the enumerators identified several potential problems, some that even led to changes in the questionnaire. One of the things we uncovered was that interviews with senior and wealthy consumers stood out from the other interviews. Sometimes, they did not sit down and focus on the interview, and many factors distracted the enumerators. Meanwhile, it was easier to make younger respondents focus, making the interviews shorter. We discovered further that asking socio-demographic questions like income seemed to be more personal than asking questions about illegal behavior. Except for those respondents, that are government officials, they were hesitant when talking about their personal use of illegal wildlife products. To overcome this, we emphasized the government officials' anonymity further, to let them know that their responses would be 100% anonymous.

2.2.4 Ethics

Due to the sensitivity of the subject, we wanted to ensure that the respondents felt safe and were willing to participate in the interview. When the enumerators approached any potential respondent, they would always start by reading the introduction and consent form from the questionnaire. This way the research objective was introduced, along with a consent form that stated that no name or address would be recorded, such that any participation would be completely anonymous. We also made sure that the respondents were aware that the participation was voluntary and that they could terminate the interview at any point. Or if they were posed a question they did not want to answer, they were not obliged to. All respondents had the option to leave the interview if they did not want to continue, however none of the respondents did that.

This study and data collection is conducted as a supporting analysis for the PhD project *Rhino horn consumer behavior project* (https://ifro.ku.dk/english/research/projects/rhino-horn-in-vietnam/). And due to the relation between these studies, our study and data collection was conducted under the ethics- and research permit approved for the rhino horn project. The ethics advisory committee for Science and Health at the University of Copenhagen evaluated and approved the ethics guidelines (ID: GA801199). CITES Management Authority of Viet Nam supports the research proposal by Vu Hoai Nam Dang and believes that this has critical content, providing practical and scientific inputs for government agencies in managing, tackling, and preventing such legal violations as illegal trade. With this recommendation, the chair of the Ethical Review Board for Biomedical Research at Hanoi University of Public Health granted permission for implementation of the study in Hanoi from 2019 to 2022 (No 019-461/DD-YTCC).

2.3 Study design

2.3.1 Pretesting and implementation

Before the data collection, different pretesting measures were used in order to eliminate misunderstandings and to control the structure of the interview. We conducted two focus group interviews, where the Ngene software was used to create the optimal design for our choice sets. We also conducted two pilot tests on tiger glue consumers as the interview protocol stated, which helped us to revise and remove any misunderstandings.

The focus groups revealed some confusion about the purity of tiger glue, as some of the respondents were not aware that the purity could be differ in tiger glue. Compared to other traditional Chinese medicine products, tiger glue is more complex, as the consumers might not understand the cooking process. To solve this, we made a more specific explanation for those two questions such that the respondent was more enlightened about the composition of tiger glue and categorized the purity into: high = 70%, medium = 50%, and low = 30%. To verify these proportions, we talked to three different producers of tiger glue and asked them about the proportion of tiger bone in their highest-quality product, which resulted in the given purity.

The price range categories on tiger glue were obtained from local experts and traditional medicine sellers. Price levels were tested in the first focus group test. This showed us that the initial price range was not working and that it confused the respondents as it did not reflect the true market price. We came up with a new price range (15, 20, 25, 30, 35, 40), as the current retail price in the black-market ranges from 20 to 30 million VND per 100 grams. Then we ran the Ngene syntax again with the new price range and came up with another design. This design showed good results in the pilot test, but we had to define in the description of the choice experiment that all offers (tiger glue 1 and 2) are from trusted sellers, meaning that the attribute levels are correct, otherwise the respondent would not believe the shown situations.

In the second focus group interview, we had to test whether the variables income and prior use of tiger glue had any effect on respondents' choices. We also needed to check whether our design reflected the actual situation on the market and if the respondents understood them. The second focus group interview consisted of data from 12 interviews, which we used to build a model to obtain prior parameters for an efficient design.

2.3.2 Questionnaire

The questionnaire consists of three main parts: *introduction and consent*, *screening question* and *the main questionnaire*. The main questionnaire consists of 5 parts in itself: *Behaviors, beliefs and knowledge (A)*, *Choice experiment* and related questions (B), *Trust* (C), *Attitude* (D), and *Socio-demographic characteristics* (E). Here, section A is divided into A1 *use of tiger glue* and A2 *beliefs and knowledge*. The total interview consists of 34 questions in addition to the 12 choice situations in the choice experiment.

The questionnaire begins with general questions about the use of- and beliefs about tiger glue, in order to make the respondents think about their preferences and previous use. The initial questions are followed by the choice experiments and questions about their experience in this. The questionnaire is constructed such that the respondents are not affected by anything other than their own experiences and beliefs, so the answers obtained are true to their preferences. Following the choice experiment, questions about how to trust the seller and the product are introduced. These are a part of the research in order to obtain a greater knowledge about the market and how it works. Here after, the respondents are asked to consider different attitude statements on the legality status of tigers. These questions are introduced as the second last part as a control of the answers obtained earlier in the questionnaire, but also because these statements might have influenced their responses if presented earlier. We introduce the socio-demographic questions as the final part, as these types of questions for respondents in the higher social class in Hanoi might seem personal. So, in order to avoid any non-response, we introduced this section last and made especially the income question voluntary. The mentality in the upper class in Vietnam is that status is everything; in such a way that they want to make themselves seem richer or more prominent than they really are (Evason 2016).

In general, we have tried to construct the questionnaire so it would follow a logical relationship between the questions and the sections, but also so there would not be any order effects between the sections. An important factor we also considered in the construction is that this questionnaire is going to be introduced in an Asian country but originates from Europe. We had to make sure that the questions and the order of them corresponded with the Vietnamese mindset. This was ensured through the pre-testing phase, the training of enumerators and the translation of the questionnaire.

Another important factor in creating a successful questionnaire is the quality and structure of the questions (Frederiksen et al. 2017). Poorly formulated questions can result in incomplete, biased and/or unfocused responses, which ultimately can cause validity issues. In order to avoid this, we considered the cognitive process (as seen in figure 2.3) when constructing the questions such that the respondents, in theory, would respond with the most optimal answer (Tourangeau et al. 2000).

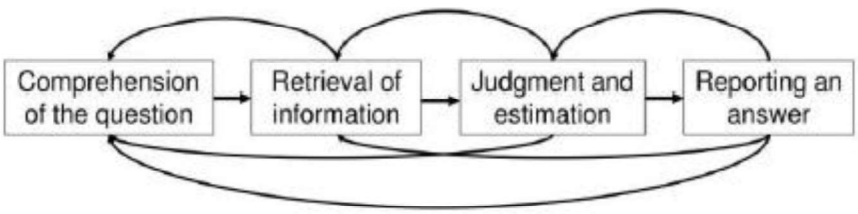


Figure 2.3: Cognitive processes in answering questions (Tourangeau et al. 2000)

The process the respondent should go through begins with the interpretation of the question. The longer the question, the more words the respondent has to consider, which leads to a larger potential misinterpretation.

We tried to define the questions as simple as possible, in order to reduce the risk of misunderstandings. We have to be aware that the respondents' memory plays a role when they are asked non-sensitive questions about behavior or status. Some words and explanations can mean something different to different people, but it should not be up to the respondents to interpret the question. We were faced with this problem concerning the purity of tiger glue, as everyone had an opinion on what was best. So, in order to avoid any reliability problems, we made sure that it was clearly defined what we expected the different purity to reflect. We also tried not to use leading questions or specific words that would send a signal to the respondent about what the appropriate answer would be.

The sensitivity of a question differs between individuals, cultures and countries. Tourangeau & Yan (2007) state that when you ask respondents sensitive questions, they tend to have higher non-response rates or a bigger measurement error than other types of questions. In our questionnaire we had several questions such as income, current and previous use of tiger glue that can be perceived as sensitive and therefore can create a dilemma for the respondents. The respondents in our questionnaire might have agreed to help provide information on the topic, but they may be unwilling to answer specific questions (Groves et. al 2009). Due to the sensitivity of these questions and the questionnaire as a whole, we only interviewed respondents that the enumerators had built a good relationship with (as described in section 2.2.3 Data collection). The trust that is built up will reassure the respondent such that the information given reflects the true behavior. Trust can also help to reduce the concept of social desirability which is frequently a problem in sensitive or very personal questions such as our case. If a true answer does not make the respondent appear in good light, the respondent will tend to either refuse to answer or give a false answer.

The different sections contain different kinds of questions. Brace (2008) states that

> *"a questionnaire that measures behavior is likely to consist mostly of closed questions (...), whereas one exploring attitude is likely to have a higher proportion of open questions".*

The questionnaire mainly consists of close-ended questions but with a variety of response categories to maintain the respondent's focus. The reason for choosing close-ended questions is that it is easier to statistically model when conducting the analysis, rather than making use of opinion questions that are harder to quantify. Beside closed-end questions we also have a few dichotomous questions. In this type of question there are two possible answers, which often will be *yes* and *no*. We use this type of question to screen users, in order to forward them to the next correct question. It will not make sense to ask respondents questions they have no possibility to answer; so, if they have not used tiger glue before they would skip the *use* questions in section A1 and go straight to section A2. We also used this to find people's knowledge about the legality of tiger glue. The only open questions we use in this study are for question 5, where respondents had to state how many

times, they have bought tiger glue. Question 5 is however a grey zone since the answer is limited to its categories (year, month, wild/farmed and price) that were pre-defined.

As important it is to have a variety of questions, a variety of response categories is also crucial. It will make the interview more interesting but also make sure that the respondent does not consider the interview as mechanical (Hansen & Andersen 2000). Multiple choice is our most used response category, with mostly nominal and Likert scale responses. Nominal scales have qualitative differences as used in question 20 where the respondent must choose between a predefined list of countries. We also use Likert scales where the categories are ranked from strongly agree to strongly disagree, used in the attitude statements. Ratio scales are also used where a numeric category has a fixed zero point, as seen in question 29 where we ask about the year the respondents were born.

2.3.3 Choice Experiment

According to Johnston (2017), stated preference approaches such as choice experiments (CE) are today broadly used to support environmental policies. They can reveal information on the preferences and trade-offs of consumers and in relation to policies, aim to direct individual behavior. Walelign et al. (2019) state that:

> "*Stated preference methods have shown potential to overcome problems affecting data quality when asking sensitive questions in conservation research and are thus increasingly used (e.g., Moro et al., 2013; Nielsen et al., 2014)*".

A CE also generates data beyond the current market situation, making it possible to predict the consumers response to price changes. This kind of data can provide relevant insights into a market and its development for policymakers (Walelign et al. 2019). CE is also one of the only known approaches to estimate values for public goods such as environmental policies (Johnston 2017), and values of willingness to pay (Bateman et al. 2002).

Davis et al. (2020) has been investigating the demand on tiger products in Vietnam. They focused on the consumption, for the particular level of use and the motivations of consuming tiger products. They found that consumers of tiger products were most likely to be influenced by quality and whether the product was genuine or not. Also, some consumers do not know it is illegal to purchase tiger products, as it is socially acceptable to use (Gratwicke et al. 2008). The third most influential factor was the price for the products. On the supply-side of wildlife trade, researchers have found that provision of legal, if the product is farmed or wild can depress prices, and thereby lower demand for illegal exploitation of wildlife (Coals et al. 2020). Some consumers will ignore the legality of the product and still buy illegal wildlife products because they maintain social legitimacy in their social groups. For some social groups the illegal products will actually boost social

status (Hinsley & ‘t Sas-Rolfes 2020; Bulte & Damania 2005). Hinsley & ‘t Sas-Rolfes (2020) find that consumers who prefer wild products may be influenced by legality, prices or even availability. The preferences for wild and farmed products can be different between consumers and different parts from the animal. It also differs between species and it can therefore be hard to compare different animals. As wildlife products are illegal to sell and buy, some consumers are willing to pay more for products with certification labels from a trader they trust. Trust is therefore important for some to guarantee the purity/source of products and is likely to be a significant influence for consumers. Geographical origin of the tiger can for some be important, which means that the origin of the tiger may be valued higher than other attributes (Hinsley et al. 2019).

A good can be broken down into a set of characteristics, called attributes. Consumers can have different preferences for different attributes, such that they are more willing to trade off those they prefer less for those they prefer more. The consumers will also trade off all attributes for the price of the good. Based on what is relevant and feasible (in relation to current literature), we use source, purity and price attributes to describe the tiger glue good in this study.

The choice sets will be divided into two different blocks for the interviews, which represent two different scenarios. The first block is based on the current situation where farmed tigers are not allowed for the production of tiger glue, while the second block is based on a hypothetical scenario where farmed tigers are legalized to supply the traditional medicine market. This allows us to find the potential impact on tiger poaching if the trade with farmed tigers is legalized. The division was done by every second respondent having to consider a scenario with legality and the other the status quo.

We chose to only have two levels for the source attribute, wild and farmed, for simplicity. We did not look into semi-wild or semi-farmed but focused only on these two main categories. The purity and price range were based on information obtained from focus group interviews and pilot tests conducted face-to-face and online in Hanoi.

Table 2.1: Attribute levels

Attribute	**Levels**	**Assumption**
Source	2 levels (Farmed, Wild)	Consumers prefer wild over farmed tigers due to beliefs about higher potency of glue from wild tigers
Purity	3 levels (Low 30%, Medium 50%, High 70%)	Consumers prefer a higher purity of tiger bone in the tiger glue
Price	6 levels	Price has a negative effect on consumer preferences

	(15, 20, 25, 30, 35, 40 million VND)	

Based on existing empirical evidence, and to support the attribute assumptions in Figure 2.1, we test the following Hypothesis that:

Hypothesis 1: The purity of bone in the glue is the most important attribute of their choice to purchase this product.

Hypothesis 2: Consumers prefer tiger glue from legal sources (i.e., a legally controlled trade in farmed tigers).

Hypothesis 3: A legally controlled trade in farmed tigers reduces consumer preferences for wild products and purity.

Hypothesis 4: The consumers' price sensitivity is dependent on their income, i.e. consumers of higher incomes are less sensitive to price.

Hypothesis 5: The preference for farmed tigers is positive for younger consumers only.

Hypothesis 6: The preference for farmed tigers depends on the current needs of the consumer (i.e. the consumer's health condition or that of relatives).

In the CE, the respondents were faced with 12 choice sets, where each choice set had three different alternatives 'Tiger glue 1', 'Tiger glue 2' and 'Don't Buy', as shown in Figure 2.4. The attributes were illustrated in the choice sets for two reasons. First, because it will make the situations more realistic for the respondent's comprehension and second because it makes it easier to understand the differences. The images were chosen carefully, such that the answers provided were not affected by the pictures. For the source attribute, we chose pictures that were simple and within the same color range, but that still showed the differences between the wild and farmed choices. For the purity attribute we illustrated the purity with a picture of a skeleton. One picture for the low purity, two for medium and three for the high purity.

Attribute	Tiger glue 1	Tiger glue 2	Do not buy
Source	**Farmed tiger** 	**Wild tiger** 	
Proportion of tiger bone in the glue	**High (70%)** 	**Medium (50%)** 	
Price (100 grams)	**30 million VND**	**20 million VND**	
Your choice (X)	[…]	[…]	[…]

Figure 2.4: Choice card example

The objective of our CE is to estimate the parameters of the utility model. The parameters are typically found by pilot test or focus groups interview on the target populations and are thereafter used to make the choice sets used in the experimental design (Rose & Bliemer 2009). But since there is limited prior knowledge, we started the design process with a pilot test implementing the choice experiment with an orthogonal design without any primers on 10 tiger glue consumers. A design is said to be orthogonal if it satisfies the notion that the attribute levels are balanced and that all parameters are independently estimable (ChoiceMetrics 2018).

One of the benefits of using orthogonal designs is that it is easy to construct with help from IT software and academic papers. Orthogonal designs will ensure that the model does not have multicollinearity, while it is hard to minimize the variances of the parameter estimates. Orthogonal designs allow an independent determination for the contribution on the variable for each of the attributes and maximize the power of the design to statistically significant relationships (ChoiceMetrics 2018; Bateman et al. 2002). However, our orthogonal design resulted in a lot of choice sets:

2 levels (of source) X 3 levels (of purity) X 6 levels (of price) = 36 choice sets

The high numbers of choice sets will make the questionnaire very lengthy, making it difficult to conduct on a larger sample. Instead we are using an efficient design, where we only need a subset of all of the alternatives. Contrary to an orthogonal design, an efficient design helps minimize the correlation in the data for estimating parameters while generating parameter estimations with small standard error (ChoiceMetrics 2018). However, the orthogonal design was used to collect data on 10 respondents in our focus group, resulting in an estimated Multinomial Logit (MNL) model based on the collected data. The estimated parameters from the MNL model are used as primers for an efficient design, which results in a shorter questionnaire, as only 12 choice sets are used instead of the 36. The tricky point in producing an efficient design is that in each choice set, the two alternatives (tiger glue 1 vs. tiger glue 2) should be close in utility. Otherwise, we will not be able to have much information for the estimation of parameters. Our design will not be effective if an attribute level is too dominant (e.g., wild tiger) or if all choice tasks are too obvious where the respondents do not have to think.

The Ngene software helps produce these designs. It takes less than 1 minute to produce an orthogonal design, as there can only be one design combining all attributes and levels, however running an efficient design is more time consuming, as it involves selecting one design out of many with a subset of alternatives such that the D-error is as small as possible. The D-error is a function of the experimental design, that has been derived from the asymptotic variance-covariance (AVC) matrix. When finding the efficient design, the design itself had to be expressed in a quantitative way, by using a certain measure. There are many measures described in the literature; common to them all is they all are using AVC matrix to determine the design efficiency. AVC implies that it aims to minimize the asymptotic standard errors or if the model parameters are estimated with consideration in a stated choice experiment it will maximize the t-ratios. In most cases the AVC matrix depends

on the questionnaire outcome, but with a multinomial logit model it is possible that the AVC matrix can be determined independently (Bliemer & Rose 2010). It is a comprehensive task to assess the whole AVC matrix, so instead the design will be based on a single value. One of the most used measures is D-error, which describes the inefficiency of a design. When the D-error is close to zero, the design will be more efficient. D-error is calculated by taking the determinant of the AVC matrix and is scaled to the number of parameters (Bliemer & Rose 2010).

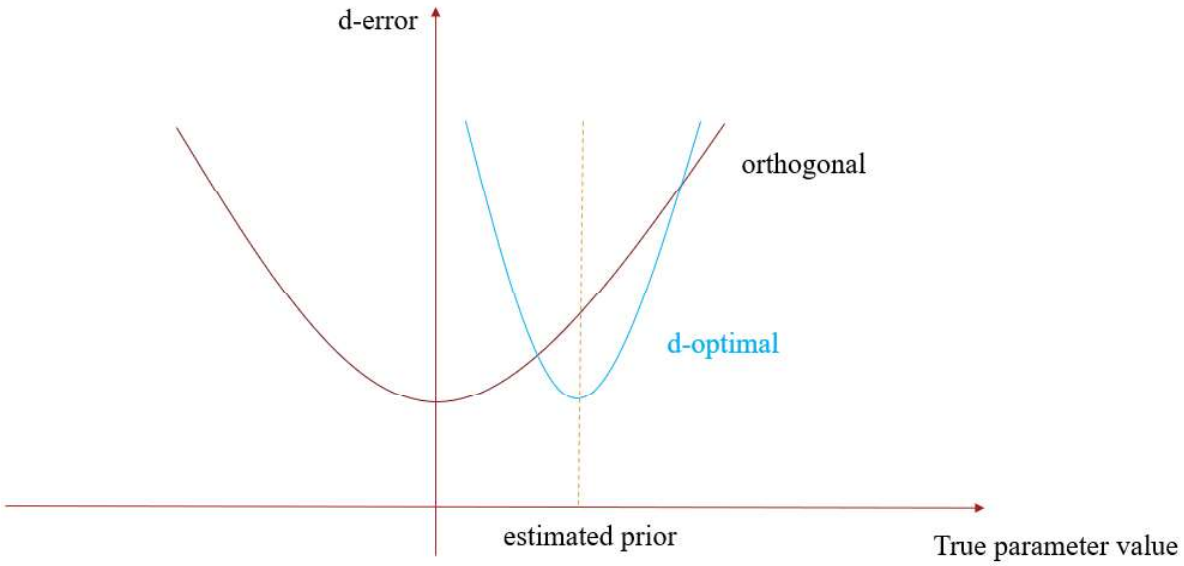


Figure 2.5: Orthogonal vs. D-optimal design (Jacobsen 2019)

D-optimal is a design with the lowest D-error possible, however, this is in practice very difficult to obtain, so according to ChoiceMetrics (2018) a D-efficient design is satisfied if the design has a sufficiently low D-error. After determining the priors, an MNL model is estimated. This model was used to run an efficient design based on the data collected in the first pilot. This new design was then tested on a second pilot. The second pilot showed some different potential issues, such that after two pilot studies the final experimental design was satisfying. In our interviews, each respondent responded to a decreasing amount of choices that lead to a statistical modeling that uncovers the respondents' preference for each of the attributes.

2.4 Variables

The following section describes the variables in the collected dataset. Each variable is described in relation to its format and purpose.

Past use: This variable shows whether the respondents have used tiger glue in the past (users) or if they expect to use it in the future (intenders). Intended use is defined as within the next one to three years. The

knowledge from this variable can be used to compare expectation and experience and to decode preferences. The difference in users and intenders are used as a baseline for all variables concerning socio-demographics, attitudes, beliefs and trust.

Frequency of use: Describing the frequency tiger glue is used by the consumers. Response categories was defined as; Always = once per week, Often = once per month, Sometimes = once per year, Rarely = less than one time per year

Last use: Describing when the individual respondent last consumed tiger glue.

Last obtained: To get a better understanding of how tiger glue is used we asked the respondent how they last obtained the product. We ask whether it was purchased to be used in private, for other family members or as a gift.

Perceived benefits: This variable describes the perceived benefits of tiger glue for the respondents. This is a hear-say variable and the respondents' answers reflect the medicinal benefits that they have heard about. The respondents had to choose from a predefined list of options, that was obtained from the focus group interviews and pilot studies.

Purpose of use: Describes for what reason the respondents are using tiger glue. The predefined list the respondents could choose from, was developed through the implementation stage through focus group interviews and pilot studies.

Known benefits: This variable, opposite to the perceived benefits, describes the known benefits and effects of tiger glue for the respondents. It is based on personal experience, both personal use but also what the respondents might have observed from others having used tiger glue. The options that the respondents could choose from, corresponded to the perceived benefits, originating from the pretesting phase.

Purchase: Describing the different possibilities of purchasing tiger glue.

Trust: This variable is a descriptive measure that determines what makes tiger glue consumers trust their seller.

Other TM products: This variable describes which other products that tiger glue consumers might also be consuming. This could help increase the understanding of how the respondents' use traditional medicine (TM). But also, to see if there are any links between tiger glue and other products on the market of traditional medicine.

Origin: This variable describes consumer preferences regarding the country origin of tiger glue. The questions were stated as:

"*If your option was to purchase 100g tiger glue and it originated from one of these countries, which one would you choose? Note: the price is the same*"

The respondents had to choose one alternative between a predefined list of countries; *Thailand, Vietnam, Lao, India, China, Myanmar* and *Others*. This will support any policy work going forward, to see which countries might be interesting to focus on.

Law: As consumption of tiger glue in many Asian countries is not seen as a crime, and even considered socially acceptable, this variable describes whether the respondents believe that using tiger glue is prohibited by law.

Willingness to pay for wild and farmed: This question was asked in order to find consistency in the respondents' choices from the CE. We have used different tools in order to be able to obtain an understanding of the different willingness to pay (WTP) factors. This is done by using a combination of revealed (questionnaire) and stated preference (choice experiment) techniques, which made us able to obtain complementary information about the respondents' purchasing behavior for tiger glue on both scenarios (legal and illegal) (Nuno et al. 2017). The question was formulated as:

Now, considering your usual disposable income and the current context (i.e., no changes in availability of tiger glue and law enforcement), how much are you at maximum willing to pay in million VND for 100 grams of glue made from wild tigers (the proportion of tiger bone in this glue is medium)?

The respondents were faced with intervals of prices, ranging from 0-9 million VND to 60+ million VND. The enumerators asked the respondents one interval at the time, whether they were willing to pay that interval, and noted the last agreed interval as their WTP.

Attitude: This is used to see what the respondent thinks about the purchase and use of tiger glue, legalizing the trade in farmed tigers, and other factors influencing the decision to buy or use tiger glue. The questions in this section focus on what the respondents think about legalizing tiger glue, and whether legalizing farmed tigers is the right thing to do. We also asked them to rate food safety in regard to farmed tigers, and whether tiger glue from farmed tigers is less potent than tiger glue from wild tigers. These questions support our results from the choice experiment and the answers here will help us recommend future policies.

Element importance: In relation to the choice experiment, this variable describes the ranking of the elements from the choice sets. The respondents were asked how important each element was in relation to answering the relevant alternatives, i.e. how big of an influence they had on the answers.

2.4.1 Time series variables

Time series variables were obtained from the questionnaire for the consumers that have been identified as users. The respondents were asked to answer in which year and month the purchase happened, whether it was a wild or farmed tiger product and at which price it was purchased. However, due to incomplete information, the month and source variables are not included in this analysis. The time series variable is used to locate any trends for tiger glue over time, in order to see what could have affected the price, such as financial crisis or campaigns against wildlife trade with tigers. The time series analysis is based on the following variables:

Price/year: Indicating the price per 100 grams for the specific year corrected with inflation. The respondents were asked to note down each time they purchased tiger glue to the best of their knowledge. However, due to several data points being on the same year, without any specification of the month of purchase, we had to take the mean of the prices in order to generate a continuous price per year variable. This was simply done by taking the average of the prices for each year across the sample. 72% of the responses only stated one price per year value, 26% stated two price per year values and 2% stated three values. The price data was corrected for inflation, with data obtained from The World Bank (2020). With the Consumer Price Index as our deflator, we created a price index with year 2010 as our index, which we then divided on each price point for each year.

Seized tigers: This variable describes the number of tigers seized in a 19-year period between 2000 to 2018. The data is derived from Wong & Krishnasamy (2019), a TRAFFIC report that analyzes tiger seizures and trade patterns within the mentioned period. The seizures have been split per country and year, such that there was no need to transform the amount of seizures. Thus, the seizures of tigers are defined as seizures of illegal trade with tiger parts and not necessarily whole tigers.

Consumer Price Index: This variable describes the annual percentage inflation in Vietnam. Measured by the consumer price index, the inflation reflects the annual percentage change in the cost for the average consumer of purchasing a good. Data is derived from The World Bank (2020).

2.5 Data analysis

The data analysis is divided into four sections. A descriptive section that represents the raw data. Followed by a time series analysis, to show general trends for changes in price over time. The third part consists of the analysis of the choice experiment. The analysis is divided into three different sections for three separate

models. First the Multinomial Logit (MNL) model with homogenous assumptions, then the Random Parameters Logit (RPL) model, where we include potential randomness and at last the Latent Class model. The fourth and final part consists of the estimation of willingness to pay for each attribute level in two contexts; legal and illegal.

2.5.1 Descriptive statistics

Initial analysis was done using R version 4.0.2 (R Core Team 2020). The respondent's status as user or intenders, was used as a proxy to examine other variables that might have a significant influence on the respondent's choice. We looked at dummies with t-test and ANOVA for categorical variables. We also tested the differences between groups using t-test parametric data and Kruskal-Wallis test for non-parametric data. The function of the descriptive statistic is to inform the reader, and to identify interesting trends that support further analysis.

2.5.2 Time Series

The aim is to describe the development of tiger glue prices over time, and to see if there are any fluctuations in the prices that correspond to global incidents or local campaigns. Time series analysis is performed using R version 4.0.2 (R core team 2020). The time series analysis is done on the amount of tigers seized, inflation in consumer prices and tiger glue prices over time. This section will be based on Wooldridge (2015) and Becketti (2013) if nothing else is stated.

Time series is made up of different concepts. Time, signals and noise. The observation considered at time t is noted as Y_t. Y_{t+1} is the observation in the period after Y_t, and $Y_{t-1}$is the observation in the period prior to Y_t. In order to analyse such data, we have to understand that the past can affect the future, and not the other way around. There are three kinds of signals; trend, seasonal and cycle. Trends indicate the persistent, systematics indications for a series to increase or decrease, changing over time, giving current, recent or local trends. Trends are also supposed to be long term and not only an upward or downward phase in a circle. Seasonality and cyclic describes different patterns in the data. Seasonality refers to a pattern with a fixed frequency, such as every January and October, every Monday or even every summer. While cycles are not related to any specific frequency. They instead explain a pattern of events that makes the data increase and decrease without being subject to a specific period.

Time series consist of combinations of signal and random noise, as mentioned above, which in other words can be shown as:

$$series=signal+noise \tag{2.3}$$

This can also be written as

$$series = fit + residual \tag{2.3}$$

Here we assume that the fit is a tolerable, well behaved product of a trend and the residual is unpredictable and unsystematic. Therefore, "jumps" in the data can be attributed to the residual and subtracted from the data, making a smooth estimating of the fit.

The most common intuition behind smoothers can be described with the decompositions of a time series y_t and with fit and residual as below.

$$y_t = f(t) + e_t \tag{2.5}$$

Here f(t) is the fit and e_t is the residual. The residual is assumed to be independent and there is no reason to expect that the residuals around the same time have any relations to each other. When having *N* observations in time t_j, reasonably close to t_i, a smoother for this relationship can be the mean of the associated y value as:

$$y^*_{t_i} = \frac{1}{N\sum \quad y_{t_i}} = \frac{1}{N\sum \quad f(t_j)} + \frac{1}{N\sum \quad e_{tj}} \approx f(t_j) + \frac{1}{N\sum \quad e_{tj}} \tag{2.6}$$

If we assume that the residuals are independent, the mean is 0 and a constant variance σ^2 then the sum of the residual is σ^2/N. The smoother thereby does not remove the residual component from the series but it does reduce the variance of the residual component and makes it prominent. The reduction of the variance does only hold under more general assumptions about the residual then independent and constant variance. The span shows the degree of smoothing of the time series. The higher the smoothing values (h) the softer the functions, and the function will therefore move less in response to fluctuations in the data. If the span is too small the regression function will begin to capture the random error in the data. It is hard to say what is the right value, but in general the range is between 0.25 to 0.5 (Najera 2019). However, it is about finding the value that maximizes the estimation of the models, and in that way avoid overfitting or underfitting. We therefore use the *loess.as* function, from the fANCOVA package. The *loess.as* function searches for the optimal smoothing value from two methods *bias-corrected Akaike information criterion* (AICC) and *generalized cross validation* (GCV) (Najera 2019).

2.5.3 Choice experiment

The choice experiment analysis is based on the random utility theory. The random utility theory assumes that consumers act rationally and choose the alternative with the highest level of utility, such that the individual is a utility-maximizer (Kjær 2005). The utility is determined by the attributes and their corresponding levels from the choice sets. Our utility function is defined as:

$$U_i = V_i + \varepsilon_i \tag{2.7}$$

Where U_i is the true but unobservable utility for alternative i, V_i is the observable component and ε_i is the factor unobservable to the researcher (Kjær 2005). Since there are multiple attributes in the choice sets, we need to transform the utility function into a single utility number that represents the overall utility value for the specific respondent. We consider V_i as an indirect utility function which can be written as

$$V_i = \beta x_i \ , \ x_i(x_{1i}, x_{2i}, \ldots, x_{pi}) \tag{2.8}$$

where x_i is the vector of attributes for alternative *i.* Assuming the utility is linearly additive, our transformed utility function looks like:

$$U_i = \beta x_i + \varepsilon_i \tag{2.9}$$

We use the probabilistic utility function in the estimation, as we cannot observe the true utility function for the respondents. The best methods for probabilistic choice depend on the assumptions made about the random parameter. If the respondent can choose between two alternatives the probability that the consumer prefers alternative *i* over *j* in a given choice set is given by:

$$P_i = P(U_i > U_j) = P(\beta x_i + \varepsilon_i > \beta x_j + \varepsilon_j) = P(\beta x_i - \beta x_j > \varepsilon_i - \varepsilon_j) \quad \forall\, i \neq j \tag{2.10}$$

From equation 2.10 we can see that the higher chance for choosing an alternative, the higher the difference in the observed utility is. The input from this model is the observed choices and the output is the difference in the utility for the two alternatives (Kjær 2005).

As we have an unobserved factor in our utility function, we add an alternative-specific constant (ASC), as it finds the average impact on the utility by all those factors that are not included in the model. When ASC's are included, the unobserved part of the utility ε_i has a zero mean by construction (Train 2002). The indirect utility function then looks like:

$$U_i = (\beta x_i + k_i) + \varepsilon_i \quad \forall\, i \tag{2.11}$$

Where k_i is the ASC to represent those preferences that are inherent and independent of a specific attribute value (Train 2002). By incorporating the ASC, the basic utility function for our analysis is given as:

$$\mathbf{U = \beta_{ASC} * ASC + \beta_{wild} * farm + \beta_{prop\_50} * prop\_50 + \beta_{prop\_70} * prop\_70 + \beta_{price} * price + \varepsilon_q} \tag{2.12}$$

In our case, the ASC will take the value of 1 for the "Do not buy" option, and 0 otherwise. This means that it captures the status quo effect, i.e. the tendency to choose the "Do not buy" option regardless of the attribute levels in the other two alternatives (tiger1 and tiger2).

The difference between our utility assumptions leads to different modelling alternatives: Multinomial Logit (MNL), Random Parameters Logit (RPL) and Latent Class (LC) model. This will be further specified in the following sections. The analysis was conducted using R version 4.0.2 (R Core Team 2020) with the Apollo package version 0.1.0 (Hess & Palma 2019; Hess & Palma 2020).

2.5.3.1 Multinomial logistic regression

A multinomial logistic regression (MLR) model is a simple extension of the binary logistic regression, the difference is that MLR allows for more than two categories of the dependent variable. MNR can therefore be used to predict the categorical placement or the probability of category membership on a dependent variable based on multiple independent variables. It also allows the independent variables to be binary or continuous and is an attractive tool because it does not assume normality, linearity, or homoscedasticity (Simonoff 2014). We based our model on *income* and if they have *used tiger glue in the past*. The dependent variable would be "type of tiger glue", with four *price* ranges, *source* and *purity* and the independent variable is the categorical variable, *used tiger glue in the past (usedtg)*, and the continuous variable, *income*, measured in Vietnamese dong VND.

From the above information, we use the Mcfadden model, called the Multinomial Logit model (MNL) (McFadden 2001), where the strict utilities were specified as functions of observed attributes.

$$Pc(i) = \frac{expexp\,(V_i)}{\sum_{k \in C} \; exp\,(V_k)} \tag{2.13}$$

$P_c(i)$ is choice probabilities for alternatives *i* and V_k is the systematic utility which is a linear function of the measured attributes for alternative k. *C* is the limited set containing the feasible choice alternatives. The MNL model is built on the restrictive assumption of homogenous error variances, and one of the special things about the MNL model is that it takes the Independence from Irrelevant Alternatives (IIA) into account.

The models are based on the assumption that the utility maximizes the behavior of the individual, if an individual is chosen among *J* alternatives, who all provide different levels of utility. The utility function will consist of an observable part V_i and random elements ε_i (Haan 2004) as seen in equation 2.7.

$$U_{ni} = V_{ni} + \varepsilon_{ni} \tag{2.14}$$

The probability of the individual *i* choosing alternative k can be written as.

$$Pr_{ik} = Pr(U_{ni} > U_{ik}; \forall m \neq i) = Pr(V_{ni} + \varepsilon_{ni} > V_{ik} + \varepsilon_{ik}; \forall m \neq i) \tag{2.15}$$

In order to derive an operational model, the crucial question is how to treat the unknown part of the utility function. When the MNL model assumes the IIA, it implies that the ratio of choosing one of the alternatives

over another in the experiment is unaffected by any of the additional alternatives. The IIA assumes an equal part of utility for each alternative, which would distribute the utility unfairly in relation to the alternatives. Even though the IIA also has some consequences for the MNL such as, when unobserved and observed attributes in the utility function are not independent of one another. There can also arise problems when the unobserved components in the utility function are correlated between the alternatives. This will cause biases in the utility parameters and give the wrong forecast. When working with IIA restriction we imply that the ratio of two alternatives *i* and *j* are the same, this is regardless of whether there are other alternatives available (Haan 2004).

2.5.3.2 Random Parameters Logit

The Random Parameters Logit (RPL) model is characterized by accommodating heterogeneity as a continuous function by adding randomness in the parameters (Sagebiel 2011). The MNL model, from the previous section, has provided the foundation for choice modelling analysis, but the assumption of IIA is easily violated, hence models like the RPL are a better choice (Greene & Henscher 2003). According to Greene & Henscher (2003) the RPL Model can include nearly any behavioral assumptions in terms of preference distribution, which makes the model more flexible, while Train (1998) states that it is able to correct interpretation of insignificant parameters.

In general, logit models assume that unobserved factors are independent for all the respondents. When working with a choice experiment, the unobserved factors are independent over the choice sets shown by each individual. However, it is often seen that the unobserved factors that affect the respondent are persistent and correlated over the choice set. The assumption mentioned above together with the assumption that constant observed factors for each individual supports the assumption of stable preferences for each individual. This is further supported by the assumption in economic theory of rational behavior where the individual effect is the same as the effect accounted for in a random effects' specification for binary choices (Kjær 2005). Kjær (2005) states that

"*The RPL appears to have some advantages over other discrete choice models as it provides the researcher with valuable information regarding the interpretation of the unobserved part of utility, and provides unbiased estimates even if unobserved heterogeneity is present in the data*".

The RPL Model assumes further a continuous distribution of the parameters in order to introduce heterogeneity (Sagebiel 2011). From equation 2.8 we know that the utility can be divided in two sections; one where we can observe effects and one that is unobservable.

$$U_i = V_i + \varepsilon_i = \beta x_i + \varepsilon_i \tag{2.16}$$

We assume that preferences vary between consumers and that the preference heterogeneity is important in the development of policies and behavior modification strategies. To capture this, we allow the attribute parameters to vary among respondents, as we are considering them to be random parameters. We also include interaction terms in the utility function with socio-demographic variables in order to account for some of the heterogeneity in the preferences between the respondents (Kjær 2005). Including the interaction term *Z*, the observable utility of individual *n* for alternative *i* is given as:

$$V_i = \beta x_i + \beta z_n \tag{2.17}$$

Where $z_n = (z_1, z_2, \ldots, z_r)$is the vector of interactions. We do not include the interaction variables as level terms in the model, simply because it is only applicable for interactions between attribute levels. In other words, since the variables were not a part of the choice sets, they cannot directly influence the respondent's choices as the level did not change across the alternatives in each choice set. Socio-demographic characteristics do not vary over alternatives, so they have to enter our model such that it creates differences in utility over alternatives instead. Our utility function is given as:

$$U_i = k_i + (\beta x_i + \beta z_n) + \varepsilon_i \tag{2.18}$$

In this study we end up using four different RPL models. One with no interaction (Model 1):

$$\mathbf{U = ASC + \beta_{wild} * farm + \beta_{prop\_50} * prop\_50 + \beta_{prop\_70} * prop\_70 + \beta_{price} * price + \varepsilon_q} \tag{2.19}$$

One interacting only with legality (Model 2):

$$\begin{aligned}\mathbf{U} &= \mathbf{ASC} \\ &+ \beta_{wild} * \mathbf{farm} + \beta_{wild\ legality} * \mathbf{farm} * \mathbf{legality} \\ &+ \beta_{prop\_50} * \mathbf{prop\_50} + \beta_{prop\_50\_legality} * \mathbf{prop\_50} * \mathbf{legality} \\ &+ \beta_{prop\_70} * \mathbf{prop\_70} + \beta_{prop\_70\_legality} * \mathbf{prop\_70} * \mathbf{legality} \\ &+ \beta_{price} * \mathbf{price} + \beta_{price\_legality} * \mathbf{price} * \mathbf{legality} + \varepsilon_q\end{aligned} \tag{2.20}$$

And one interaction with income and the use of tiger glue (Model 3):

$$\begin{aligned}\mathbf{U} &= \mathbf{ASC} \\ &+ \beta_{wild} * \mathbf{farm} + \beta_{wild\_inc} * \mathbf{farm} * \mathbf{inc} + \beta_{wild\_usedtg} * \mathbf{farm} * \mathbf{usedtg} \\ &+ \beta_{prop\_50} * \mathbf{prop50} + \beta_{prop50\_inc} * \mathbf{prop50} * \mathbf{inc} + \beta_{prop50\_usedtg} * \mathbf{prop50} * \mathbf{usedtg} \\ &+ \beta_{prop\_70} * \mathbf{prop70} + \beta_{prop70\_inc} * \mathbf{prop70} * \mathbf{inc} + \beta_{prop70\_usedtg} * \mathbf{prop70} * \mathbf{usedtg} \\ &+ \beta_{price} * \mathbf{price} + \beta_{price\ inc} * \mathbf{price} * \mathbf{inc} + \beta_{price\ usedtg} * \mathbf{price} * \mathbf{usedtg} + \varepsilon_q\end{aligned} \tag{2.21}$$

The fourth Model is the same as model 3, though *income* and *used tiger glue* has been replaced by the *age* and *family* variable, that reflects whether the respondent and/or anyone in their close related family are in current need of tiger glue. Model 4 is only used to test Hypothesis 5 and 7 from section 2.4.3 and not for any further analysis.

When choosing between the different models, we start looking at the alternative-specific constant (ASC) parameters where we want to minimize this as much as possible. The ASC captures the average effect on utility of all factors that are not included in the model. ASC can therefore represent the preferences that are inherent and independent of specific attribute values. Akaike information criterion (AIC) is a number score which can determine which of the different models is likely to be the best one for the specific dataset. AIC estimates the Models relatively; this means that the AIC scores are only useful when it is compared with AIC scores for the same dataset. A lower AIC score is best (Zajic 2019), however the AIC should not be the only measure when determining the model. One also needs to look at the ASC parameter and the effect of the other parameters. If the ASC parameters are not significant, this suggests that it should not be treated as a random variable, and that a fixed ASC might be better. Also, when adding more variables to a model, this will often increase the value of R-squared and decrease the AIC measure, which might generate a misleading result. The effect of this addition could affect the variables to change (from positive to negative or vice versa) along with changes in the significant levels. One of the reasons for this could be collinearity, which is not the case for our variables as the correlation between the variables in the dataset has a maximum value of 0.3 as seen in Figure 3.5.

2.5.3.2 Latent Class Model

The latent class model (LC) is a semiparametric variant of the RPL and MNL models (Sagebiel 2011). The LC model is based on the assumption that individual behavior depends on the observable attributes and that the latent heterogeneity varies with factors that are unobserved by the analyst (Greene & Hensher 2003). From the LC model estimate, we can derive heterogeneity from different classes, where every class has its own parameters. This is desirable because it is an alternative method of capturing the unobserved heterogeneity and other potential unobserved factors that creates variability in the utility (Greene & Hensher 2003). Greene & Hensher (2003) further states that the semiparametric specification frees the analyst from assuming potential strong or unwarranted distribution on individual heterogeneity, and that there is no need for any assumptions for the distribution of parameters.

The population is split into a number, Q, groups of the individuals. All groups are heterogenous and have a common parameter, β_i, for the number of members in the group, and are different from each other. By assuming that the classes are distinguished by the different parameter vectors in the entire data generating process, the probability density for the interesting variable is the same. When working with the data it is not known which observation is in which class. When using the LC model, it is possible to work with two types of parameters, *fixed* and *random*. Fixed parameters are often called the standard and the parameters are normally unconstrained, so they are different between classes (Hensher et al. 2015b).

With LC models the individual behavior totally depends on the observable attributes and the latent heterogeneity. This is different between all the factors and is unobserved by the analyst, making it possible to

analyze the heterogeneity with discrete parameters variation. In some dataset the number of observations and the number of choices presented can vary between individual respondents and it could also vary between choice situations. Therefore, the probability for the specific choice by an individual can be described in different ways.

2.5.4 Willingness to Pay

From the output of our choice models we get the marginal rate of substitution (MRS). The MRS is a financial variable that is often found in the trade-off and is expressed in dollar terms. Due to this, the MRS is commonly referred to as a willingness to pay (WTP) estimate. Our choice model therefore allows for calculation of the marginal WTP. This is the indicative amount of money that respondents pay for an upgrade from farmed to wild, in addition to the price they are already paying now (Hensher et al. 2015a). The calculation of WTP is based on a specific utility function and is calculated by taking the ratio of the derivatives of the attributes of interest and cost. If there is linearity in the attributes' indirect utility specification it can be described as:

$$WTP = \frac{\Delta x_k}{\Delta x_t} = \frac{\frac{\partial V_{nsj}}{\partial x_i}}{\frac{\partial V_{nsj}}{\partial x_c}} = \frac{\beta_k}{\beta_c} \tag{2.22}$$

For the estimation of WTP we are using the three models estimated from section 2.6.3.2:

- **Model 1:** no interactions
- **Model 2:** *wild*, *prop_50*, *prop_70*, *price interacting with legality*
- **Model 3:** *wild*, *prop_50*, *prop_70*, *price*, *income* and *used tiger glue*

For Model 1 we are estimating the WTP for each attribute level with equation 2.22, which can be described simpler as:

$$WTP = -\frac{\beta_{attribute}}{\beta_{price}} \tag{2.23}$$

Where the attribute levels are estimated by the $\beta_{attribute}$ parameter, and β_{price} is the estimated parameters of price when the price is normally distributed. With the given parameters, our utility function looks like:

$$U = (-2.8892) + (-2.4758) * \textbf{farm} + 5.1533 * \textbf{prop\_50} + 7.7293 * \textbf{prop\_70} + (-1.721) * \textbf{price} \tag{2.24}$$

However, since the *price* variable is log-normally distributed in our models, we have to use the mean value of the price parameter instead:

$$WTP = -\frac{\beta_{attribute}}{exp(\mu + \frac{\sigma^2}{2})} \tag{2.25}$$

Where μ and σ are the location and the scale parameters of price. We use the log-normally distributed prices because it shows less fluctuations, than linear price scales do. Using equation 2.24 and 2.25 from above, we

can estimate the marginal WTP to change from a 100 grams of the fixed attribute amount to 100 grams of the given attribute level.

Model 2 includes the interaction term with legality, thus it makes the WTP estimation more complicated as we enter interaction terms into the equation. The utility function for Model 2 with estimates end up looking:

U = **(**-2.259)
+ (-6.4343) * **farm** + 8.1664 * **farm** * **legality**
+ 4.7849 * **prop_50** + (-1.8861) * **prop_50** * **legality**
+ 7.4663 * **prop_70** + (-2.5808**)** * **prop_70** * **legality**
+ (-2.0304**)** * **price** + (-0.0299) * **price** * **legality** + ε_q (2.26)

We start off by estimating the utility for the price and one of the attributes when legality = 0:

$$\text{U(attribute)} = \beta_{attribute} \tag{2.27}$$

$$\text{U(Price)} = exp(\mu + \frac{\sigma^2}{2}) \tag{2.28}$$

We do the same when legality = 1:

$$\text{U(attribute)} = \beta_{attribute} + \beta_{attribute\_legality} \tag{2.29}$$

$$\text{U(Price)} = exp(\mu + \frac{\sigma^2}{2}) + \beta_{price\_legality} \tag{2.30}$$

Using equation 2.25, the WTP estimate for the specific attribute on price when legality = 0 are:

$$\text{WTP} = -\frac{\beta_{attribute}}{exp(\mu + \frac{\sigma^2}{2})} \tag{2.31}$$

And the WTP estimate for when legality = 1 is:

$$\text{WTP} = -\frac{\beta_{attribute} + \beta_{attribute\_legality}}{exp(\mu + \frac{\sigma^2}{2}) + \beta_{price\_legality}} \tag{2.32}$$

The last thing we want to estimate is the extra utility gained when the legality status changes from 0 to 1. The extra utility obtained for the attribute is simply the parameter estimate $\beta_{attribute\_legality}$ or the difference between equation 2.27 and 2.29, while the extra utility in price is the same as equation 2.30. The extra utility obtained with the new legality status is as such:

$$\text{WTP} = -\frac{\beta_{attribute\_legality}}{exp(\mu + \frac{\sigma^2}{2}) + \beta_{price\_legality}} \tag{2.33}$$

In Table 2.2, a summary of the equations described above along with an example for how the WTP estimate can be calculated on the wild attribute is shown:

Table 2.2: WTP estimating example

		Legality = 0	**Legality = 1**	**Extra utility when legality = 1**
Utility	**Wild**	β_{wild}	$\beta_{wild} + \beta_{wild\_legality}$	$\beta_{wild\_legality}$
	Price	$exp(\mu + \frac{\sigma^2}{2})$	$exp\left(\mu + \frac{\sigma^2}{2}\right) + \beta_{price\_legality}$	$exp\left(\mu + \frac{\sigma^2}{2}\right) + \beta_{price\_legality}$
WTP	**Wild**	$-\beta_{wild} / exp(\mu + \frac{\sigma^2}{2})$,	$-(\beta_{wild} + \beta_{wild\_legality}) / (\beta_{price} + \beta_{price\_legality})$	$-\beta_{wild\_legality} / (exp\left(\mu + \frac{\sigma^2}{2}\right) + \beta_{price\_legality})$

For Model 3, we expand it further by including other interaction terms such as the *income* and *used tiger glue* variables. The utility function with the corresponding estimates looks as:

$$
\begin{aligned}
U = {} & (-3.1408) \\
& + (-1.1239) * \textbf{farm} + (-0.0256) * \textbf{farm} * \textbf{inc} + (-2.0462) * \textbf{farm} * \textbf{usedtg} \\
& + 4.1473 * \textbf{prop50} + (-0.0276) * \textbf{prop50} * \textbf{inc} + 1.7707 * \textbf{prop50} * \textbf{usedtg} \\
& + 5.6775 * \textbf{prop70} + (-0.0223) * \textbf{prop70} * \textbf{inc} + 3.3995 * \textbf{prop70} * \textbf{usedtg} \\
& + 0.6921 * \textbf{price} + (-0.0012) * \textbf{price} * \textbf{inc} + (-0.0446) * \textbf{price} * \textbf{usedtg} + \varepsilon q
\end{aligned} \tag{2.50}
$$

The *usedtg* variable is a dummy variable just like *legality* is, but the income variable is considered continuous even though it is a categorical variable. We do this, as it is not possible to estimate the marginal WTP for each consumer as the income varies over the respondents. We therefore estimate the marginal WTP for a specific consumer, a consumer of income bracket X1 or X2, having not used tiger bone glue and in the current context: *legality* = *usedtg* = 0). Following the same steps as for Model 2 for equation 2.26 through 2.33, still having price as log-normally distributed, we end up having the following summary seen Table 2.3.

Table 2.3: WTP estimation for Model 3

		inc = X_1	**inc = X_2**	**Extra utility when inc changes from X_1 to X_2**
Utility	**Wild**	$\beta_{wild} + \beta_{wild\_inc} * \mathbf{X_1}$	$\beta_{wild} + \beta_{wild\_inc} * \mathbf{X_2}$	$\beta_{wild\_inc} * (\mathbf{X_2} - \mathbf{X_1})$
	Price	$exp\left(\mu + \frac{\sigma^2}{2}\right) + \beta_{price\_inc} * \mathbf{X_1}$	$exp\left(\mu + \frac{\sigma^2}{2}\right) + \beta_{price\_inc} * \mathbf{X_2}$	$exp\left(\mu + \frac{\sigma^2}{2}\right) + \beta_{price\_inc}$
WTP	**Wild**	$-(\beta_{wild} + \beta_{wild\_inc} * \mathbf{X_1}) / \beta_{price} + \beta_{price\_inc} * \mathbf{X_1}$	$-(\beta_{wild} + \beta_{wild\_inc} * \mathbf{X_2}) / \beta_{price} + \beta_{price\_inc} * \mathbf{X_2}$	$-\beta_{wild\_inc} * (\mathbf{X_2} - \mathbf{X_1}) / \beta_{price} + \beta_{price\_inc} * (\mathbf{X_2} - \mathbf{X_1})$

3. Results

3.1 Descriptive statistics

Initial descriptive statistics support the understanding of the data. In total, 228 interviews were conducted, none were incomplete or dropped. 79.8% of all respondents have used tiger glue in the past (users), while 20.2

% intend to use it in the near future[1] (intenders) (Appendix 5.1). Among users, nearly half (45.6%) reported having used tiger glue often[2] and within the last six months (41.8%).

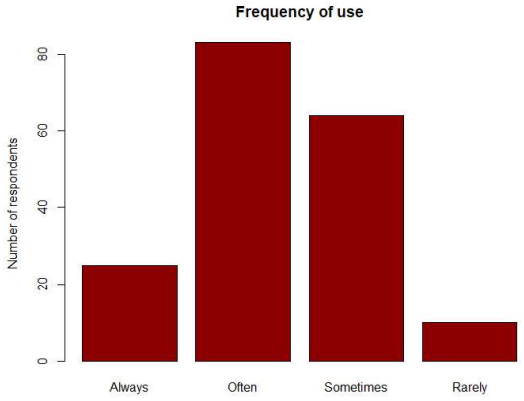


Figure 3.1: Frequency of using tiger glue

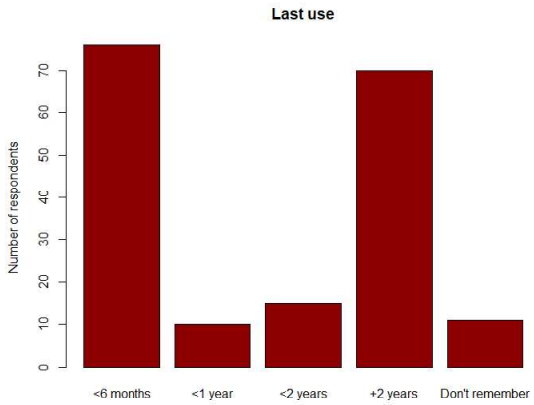


Figure 3.2: Last use of tiger glue

Respondents were aged between 23 and 81, with mean and median of 49 and 46 years of age respectively. The results showed that 97% was married, 73% were university graduates or had higher education (14%), while male respondents were dominating with 83.8%. About one third (27.6%) were government officials, while about one fifth (19.3% and 23.7% respectively) were either self-employed or business owners[3]. The median of the individual monthly income was reported as 40-49 million VND (1,700-2,100 USD), while the national average individual monthly income in 2018, was only 3.76 million VND (176 USD) (General Statistics Office of Vietnam 2018)

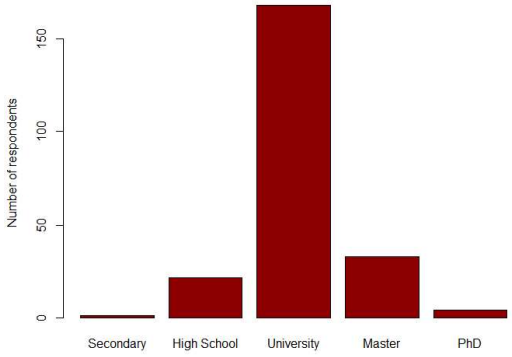


Figure 3.3: Education level of the respondents

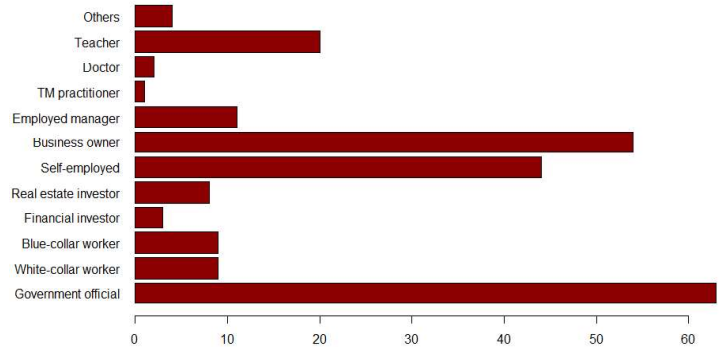


Figure 3.4: Occupation of the respondents

Respondents either bought tiger glue themselves or received it from others through sharing or as a gift. Among users, a majority used tiger glue to treat bone-related diseases and for general health benefits. In general, all

[1] Near future is defined as within one to three years.
[2] Response categories was defined as; Always = once per week, Often = once per month, Sometimes = once per year, Rarely = less than one time per year
[3] Self-employed is defined as a one-man business, where a business owner is defined as someone who is in charge of one or more businesses with employees.

respondents reported that the most commonly known effect of tiger glue is for treatment of bone-related diseases (see more in Appendix 5.2).

Table 3.1: Behaviors related to uses of tiger glue

	Total (*n = 228*)	
	N	*%*
How respondents obtained tiger glue in the last time?	182	
I bought it	71	39.0
Others gave me as a gift	40	22.0
My family member bought it	13	7.1
I was shared by others (e.g., in a party or house visit)	47	25.9
Others (specify):……	11	6.0
Purposes of use	182	
Treatment of bone-related diseases (e.g., arthritis, rheumatism)	129	39.7
For good health/General health benefits	104	32.0
Disease prevention (specific diseases)	15	4.6
Enhance sexual prowess	19	5.9
Gift to others	12	3.7
Others	46	14.1

Note: Categories are not exclusive for the purpose of use, meaning it is possible for the respondents to choose more than one option

Respondents believed that tiger glue is good for staying up late without being tired, recovery after a stroke, stomachache, and hangovers (Appendix 5.3). However, when purchasing tiger glue, most respondents reported that they would ask their friends to purchase some for them. Notably, nearly half of the respondents (45%) thought that there is no legal sanction on their purchase and use of tiger glue. And, users revealed that they also consumed bear bile (92.3%), shark fin (53.3%), and rhino horn (52.2%), while many intenders had used bear bile (76.1%). Being asked about the preferred source of tigers, both users and intenders mentioned Thailand or Laos.

Table 3.2: Wildlife use and knowledge

	Total (*n = 228*)		Users (*n = 182*)		Intenders (*n =46*)	
	N	*%*	*N*	*%*	*N*	*%*
How can you buy tiger glue						
I know a tiger glue seller	78	34.2	62	34.1	16	34.8
I can ask my friends to buy for me	154	67.4	116	63.7	38	82.6
I can contact some TM practitioners	4	1.8	3	1.6	1	2.2
I have purchased the whole skeleton myself	24	10.5	24	13.1	0	0.0
Others (specify):……	26	11.4	22	12.1	4	8.7
Don't know	11	4.8	10	5.5	1	2.2
Knowledge of legal sanctions						
Yes	127	55.7	101	55.5	26	56.5
No	101	44.3	81	44.5	20	43.5
Use of other traditional medicine products						
Rhino horn	98	43.0	95	52.2	3	6.5
Bear bile	203	89.0	168	92.3	35	76.1
Gayal bile	84	36.8	79	43.4	5	10.9
Deer antler	105	45.1	92	50.5	13	28.3

Pangolin meat and/or scales	58	25.4	52	28.6	6	13.0
Shark fin	114	50.0	97	53.3	17	37.0
Other	42	18.4	34	14.2	8	17.4
With horse glue	27	11.8	21	11.5	6	13.0
If your options were to purchase 100g tiger glue and it originated from one of these countries, which one would you choose?						
Thailand	57	25.0	46	25.3	11	24.0
Vietnam	38	16.7	30	16.5	8	17.4
Lao	58	25.4	43	23.6	15	32.6
India	19	8.3	17	9.3	2	4.3
China	2	0.9	0	0.0	2	4.3
Myanmar	37	16.2	31	17.0	6	13.0
Other	17	7.5	15	8.2	2	4.3

In Figure 3.5, the correlation between the willingness to pay (WTP) variables for *wild* (*wtpwild*) and *farmed* (*wtpfarm*) tigers and the sociodemographic characteristics, can be seen. Of the 36 sociodemographic variables, 11 are significant, where the income variable is responsible for four of them. Few variables are significantly correlated with the WTP variables such as *age* and *fam* for WTP wild, and *fam* for WTP farmed. *wtpwild* is positively correlated with *fam, edu* and *age*, while *wtpfarm* is positively correlated with *age, mar, fam* and *edu*.

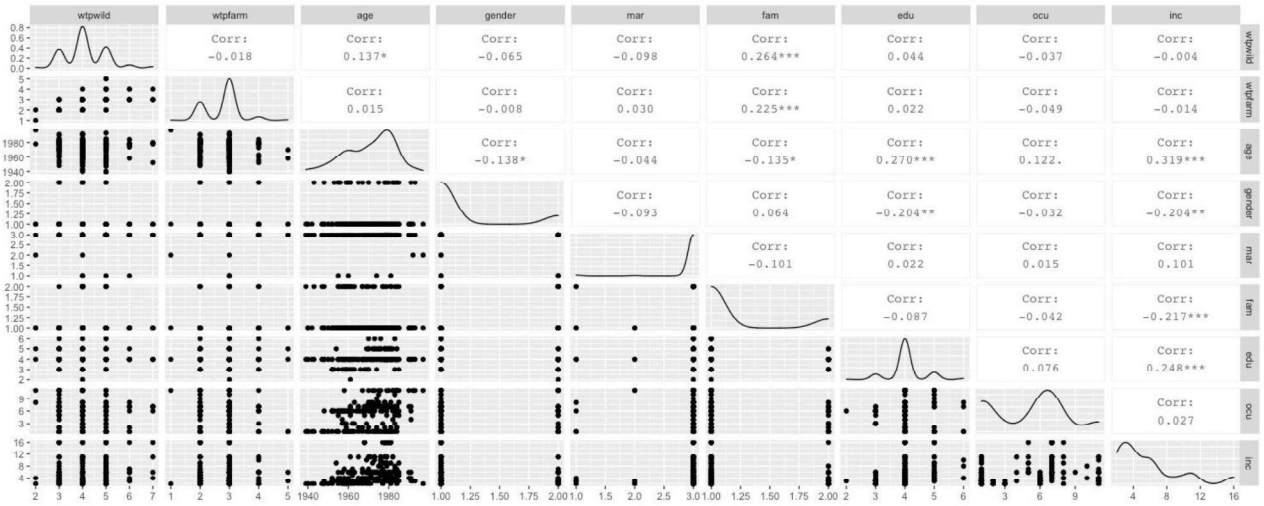


Figure 3.5: Correlogram between WTP and socio-demographic variables

Significant codes: 0 '***', 0.001 '**', 0.01 '*' and 0.05 '.'. The graphs are adjusted such that 88 and 99 are not shown for illustration purposes. They are however still included in the correlation matrix between WTP wild-/farm and the socio-demographic characteristics variables. The Figure shows the distribution of each variable shown on the diagonal graph from the left top corner. Under the distribution, scatter plots are shown over each numeric variable and above the distribution, the value of the Pearson correlation plus the significance level is shown.

The correlation between *income* and *age* is positive and has the highest correlation value between the sociodemographic characteristics of 0.319. This correlation makes sense as people with more experience are more likely to have higher income. The same argument applies to the correlation between *income* and *education*, that is also strongly significant and positive. It is also shown that the correlations between *fam* (i.e., family members in need of tiger glue for health-related purposes) and *wtpwild* and *wtpfarm*, are significant and have the value of 0.264 and 0.225 respectively. Comparing to Figure 3.6, it can be seen that most of the

respondents preferred wild tigers as they agreed or strongly agreed on farmed tigers being less potent than wild tigers, i.e. the medical effect for wild tigers is perceived to be better than that of farmed tigers.

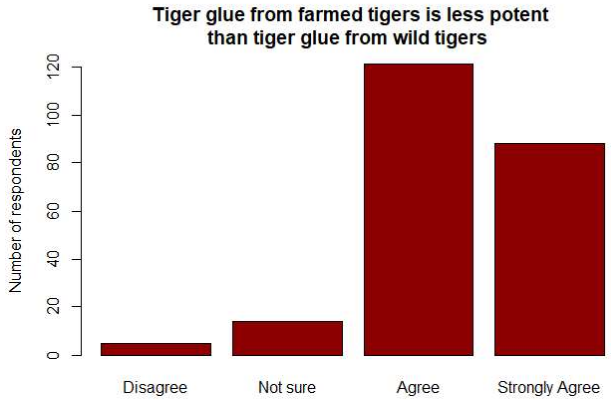
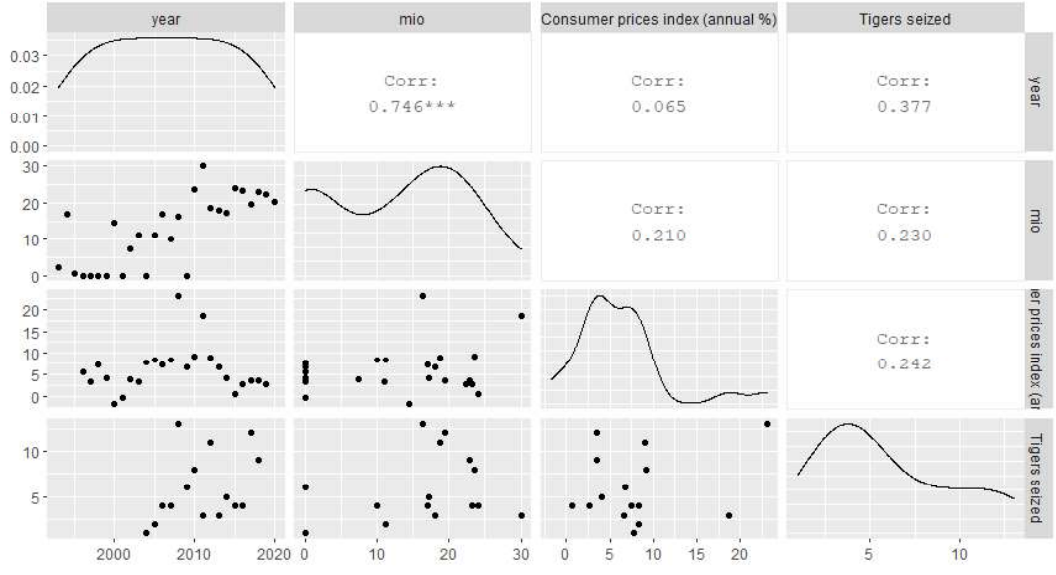


Figure 3.6: Attitude toward the medicinal efficacy of tiger glue from farmed and wild tigers

3.2 Time series

A part of the questionnaire contained a question regarding previous purchase of tiger glue. From that question we obtained a mean price per year variable (corrected for inflation), that along with *consumer price index (annual %)* and *tiger seized* contributes to the time series analysis. In Figure 3.7 it can be seen that there is a positive correlation between million and year. This is expected as data has been collected as a million per year variable and shows that there is a time trend in the price.



Significant codes: 0 '***', 0.001 '**', 0.01 '*' and 0.05 '.'

Figure 3.7: Correlogram between the variables in the time series analysis

The smoothing trend lines are plotted in Figure 3.8. Figure 3.8 shows the overall trend in tiger glue prices from 2000 to 2020. Three different trend lines have been added; a linear trend, a 50% smoothing trend and the optimal smoothing trend with 73%. The general tendency shows that tiger glue prices are decreasing, even though the prices have shown to be very volatile through the years. The price decreased with 17 million VND in the period, starting at 30 million VND (1,300 USD) in 2000 to 13 million VND (560 USD) in 2019 for 100 gram of tiger glue. Even though the general tendency for prices are decreasing, it seems that the prices never reach the same level as in 2000.

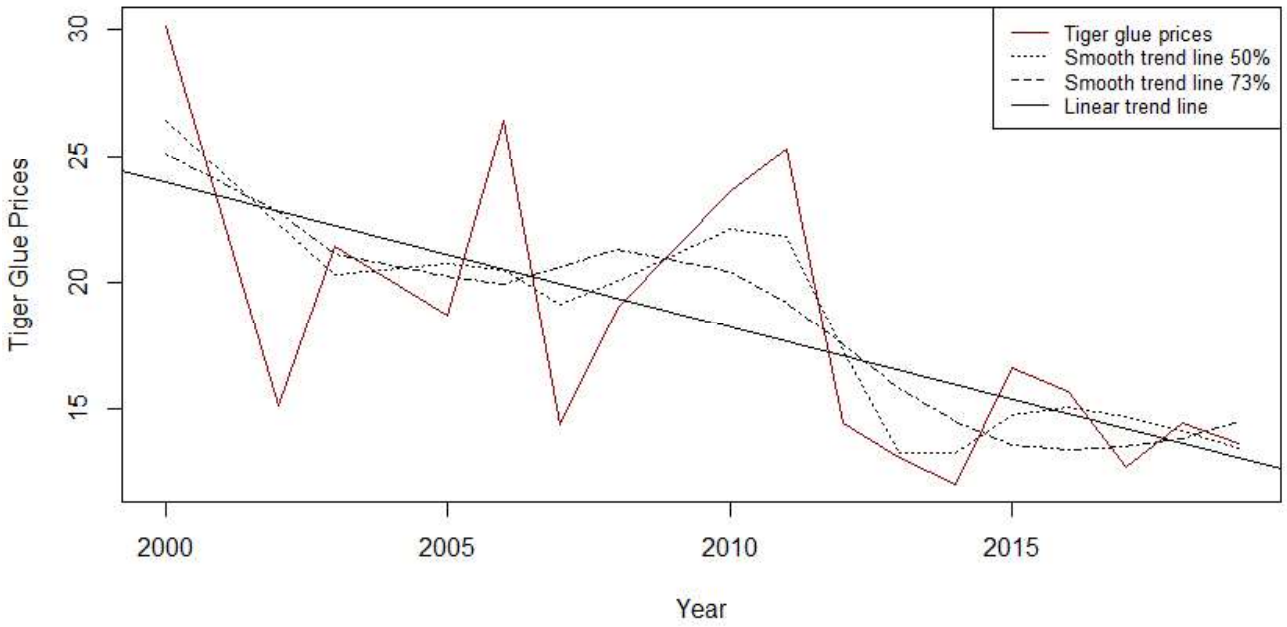


Figure 3.8: Time series plot of tiger glue

In 2007 there was a low peak in the prices, which could correspond to a market effect from the financial crisis in 2007 to 2009. Notice that there is also a high peak in 2011, which seems to be the largest change in the prices during the period. This high increase in the prices from 2007 to 2011 could indicate that there are some external factors influencing the market. In Figure 3.9 it can be seen that there in the same period has been a decrease in the number of tigers seized, which might indicate that there has been less trade with tigers, i.e. a decrease in supply, which can cause the price to go up, i.e. with the same level of demand. Through the years, it can be seen that the relationship between the number of tigers seized and the tiger glue prices has an opposite relationship. When the prices increase, the number of tigers seized decreases, or vice versa. This does not necessarily mean that there is a strict relationship between these two variables, however the tendencies are present. One explanation could be that with a higher number of tigers seized, some sort of uncertainty is created on the market from both sides. The producers can have lowered the prices, due to them being afraid of being caught, or the consumers can have postponed their purchase of tiger glue, which also would decrease the price.

Another thing that might explain the peaks in 2011 and 2015, and the low peak in 2014, is the presence of tiger awareness campaigns. In 2010 and 2014 two campaigns were launched against wildlife trade and tiger products, TX2 in 2010 and a TV commercial in 2014 targeting the upper-class consumers. The effects of these campaigns might have increased the awareness of the problems of tiger glue, such that the demand has decreased and therefore an increase in the price on tiger glue. Several national law initiatives have also been enforced during 2008 and 2019 with a new initiative almost yearly, however it does not seem like there is any price effect from these or at least not a major one.

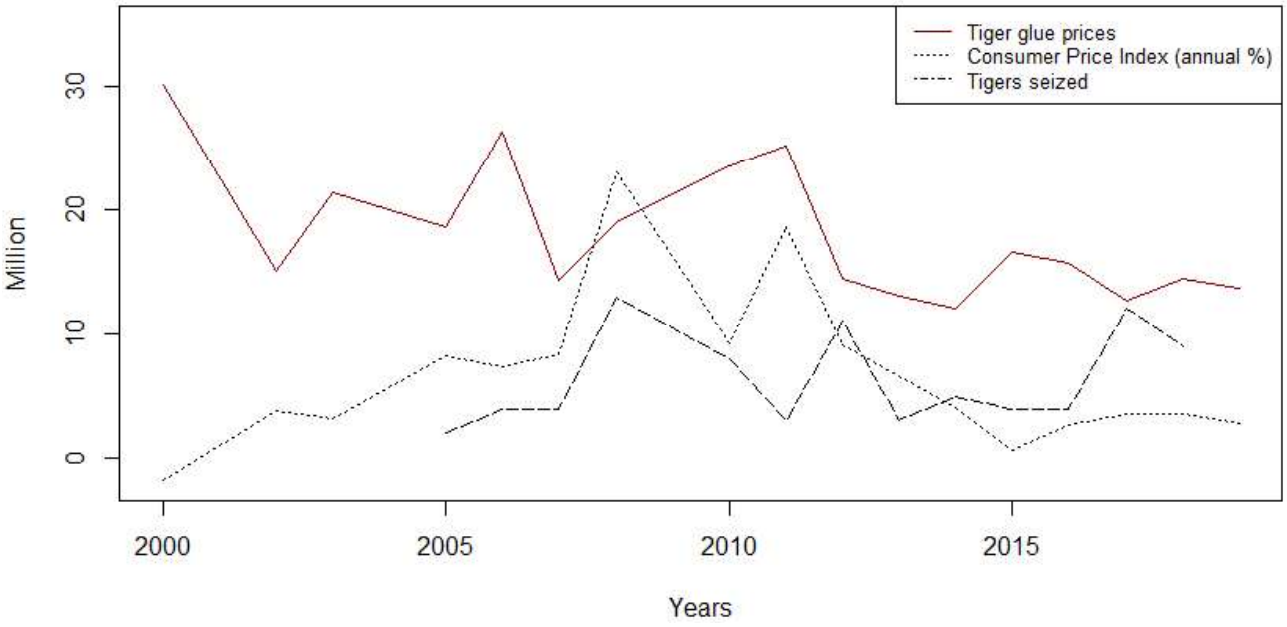


Figure 3.9: Time series plot of tiger glue, consumer price index and tiger seized

To get a better understanding of tiger glue price over time we also compare it with the Consumer Price Index (CPI). In Figure 3.9 above, it can be seen that every time there is a small spike in the CPI in the period between 2000 and 2010, the year after there is an increase in price for tiger glue. It seems that there is an opposite relationship between tiger glue prices and the CPI, such that an increase in one of them shows a decrease in the other, and vice versa. After 2011, the CPI has decreased constantly and gotten somewhat stable through to 2019. In the same period, the price for tiger glue is also getting more stable with fewer and smaller spikes. The only year where the CPI and tiger glue prices differ is in 2008, where the CPI has an increased spike and the prices increase constantly without any spikes. The presence of inflation on each year, i.e. an increasing CPI, ensures that the tiger glue prices do not increase as rapidly as the nominal prices.

3.3 Choice Experiment

A total of 228 consumers participated in the choice experiment questionnaire, which gave 2,736 choice observations. Introductory analysis using the MNL model was carried out, however due to the model being

very simple and violating the IIA assumption, we do not include the results in this analysis. These however can be found in Appendix 5.4. A Latent Class model was also estimated, thus this was not useful as the contribution of *income* and *usedtg* to the class distribution was not significant. It was estimated with both 3 and 2 classes, but the results remain the same, hence the RPL models fit the dataset better. The results of the LC estimation can be found in Appendix 5.5.

Table 3.3 shows the respondents' general choice distributions for each scenario for each alternative. It can be seen that alternative 1 has been chosen by more than 68% of the respondents for choice 3 and 5, and more than 50% for choice 10 and 12. Choice 3, 5 and 12 all have wild as the attribute, a higher purity and either lower or equal prices. Choice 12 is also having the lowest response percentage for all of the responses in alternative 2. Choice 10 has equal prices, however, the purity is significantly higher in alternative 1, which indicates that purity trumps the source of tigers. The distribution of attributes in the relevant choices can be seen in Appendix 2. Alternative 2 is chosen more than 60% for choice 1, 2, 7, 8 and 9, and more than 50% for choice 11. Equal for choice 1, 2, 7 and 9 is that the source is wild, and the purity is higher than alternative 1. The price however is not always lower than alternative 1. Choice 8 and 11 however, both have a higher purity and a lower price than alternative 1.

Table 3.3: Respondents choice distribution

	Alternative 1		Alternative 2		Do not buy	
	N	*%*	*N*	*%*	*N*	*%*
Choice 1	85	37.28	139	60.96	4	1.75
Choice 2	24	10.53	159	69.74	45	19.74
Choice 3	157	68.86	31	13.60	40	17.54
Choice 4	89	39.04	68	29.82	71	31.14
Choice 5	159	69.74	61	26.75	8	3.51
Choice 6	23	10.09	87	38.16	118	51.75
Choice 7	66	28.95	158	69.30	4	1.75
Choice 8	80	35.09	143	62.72	5	2.19
Choice 9	45	19.74	146	64.04	37	16.23
Choice 10	114	50.00	25	10.96	89	39.04
Choice 11	31	13.60	119	52.19	78	34.21
Choice 12	131	57.46	14	6.14	83	36.40

The *do not buy* option has been chosen more than 50% for choice 6, which has equal prices but higher purity for farmed tigers than wild tigers. Four choices have been made in the interval of 30% to 40%, while the rest of the choices are below 20%. Choice 4, 10 and 11 have in common that the alternatives with wild tiger all have a low purity, and choice 12 has a price of 40 million VND which is the same as in choice 6.

We estimated several RPL models with and without interaction terms. Three models were selected to test the hypotheses: Model 1 with no interaction terms, Model 2 interacting with legality, and Model 3 interacting with

usedtg and *income*. By adding interaction terms with *usedtg* (whether the respondent is a current user of tiger glue or intended user) and *inc* (income), and by allowing correlation between the attribute levels, the best fit RPL model has an AIC value of 2873.95. The four main attributes *farmed*, *prob_50*, *prob_70* and *price* are all significant except for *farmed*, and both *price*, *prop_50* and *prop_70* is positive, while *farmed* are negative.

The estimated coefficients in Table 3.4 show the mean change in utility for one-unit change when holding other attribute levels constant. All attribute levels are significant, including the ASC. The coefficient for ASC in Model 1 is negative and significant suggesting that respondents preferred buying tiger glue over the no-buy option. The same goes for Model 2 and Model 3. Respondents preferred wild over farmed tigers, and by looking at the purity attributes, it shows that respondents gain a higher utility level with the higher level of purity. Hence the relative gain from 50% to 70% is smaller than 30% to 50%. It can also be seen that *prop_70* has the highest mean coefficient, meaning that the respondents valued a high purity (70%) of tiger bone.

Table 3.4: Results from chosen RPL Models

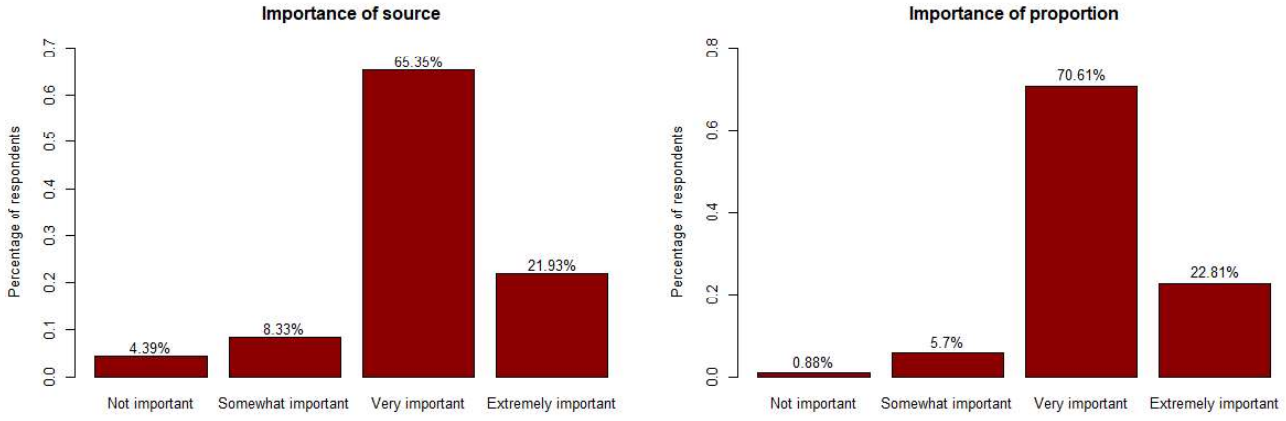
	No interaction	Interact with legality	Interact with usedtg & inc
ASC	-2.8892*** (0.4523)	-2.259*** (0.2237)	-3.1508*** (0.4315)
Farmed	-2.4758*** (0.3927)	-6.4343*** (0.5806)	-1.1239* (0.6428)
Prop_50	5.1533*** (0.3293)	4.7849*** (0.3283)	4.1473*** (0.4971)
Prop_70	7.7293*** (0.4599)	7.4663*** (0.5172)	5.6775*** (0.5951)
Price	-1.721*** (0.0806)	-2.0304*** (0.0907)	0.6921*** (0.0531)
Price x legality		-0.0299* (0.0116)	
Farmed x legality		8.1664*** (0.7373)	
Prop_50 x legality		-1.8861*** (0.37)	
Prop_70 x legality		-2.5808*** (0.5366)	
Price x inc			-0.0012 (0.001)
Farmed x inc			0.0259 (0.0264)
Prop_50 x inc			-0.0276 (0.021)
Prop_70 x inc			-0.0223 (0.029)
Price x usedtg			-0.0446. (0.0206)
Farmed x usedtg			-2.0462. (0.8947)
Prop_50 x usedtg			1.7707** (0.5377)
Prop_70 x usedtg			3.3995*** (0.6957)
Number of observations	2736	2736	2736
Loglik	-1434.878	-1460.07	-1418.975
Rho-square	0.5226	0.5142	0.5279
Adj.Rho-square	0.5193	0.5099	0.5219
AIC	2889.76	2946.14	2873.95
BIC	2948.9	3023.03	2980.41

Notes: The reference attribute levels are wild and prop_30, and dummies for these are not included in the Model. Standard errors of the estimates are provided in the parentheses. Significant codes: 0 '***', 0.001 '**', 0.01 '*' and 0.05 '.'.

Introducing legality into the RPL model has a significant effect on other attribute levels, while it also increases price sensitivity. Thus, this relationship between *price* and *legality* is only significant at a 10% level. The effect of *legality* on farmed is positive and strongly significant. Hence the option of getting legal tiger glue reduces the preferences for wild such that the coefficient for farmed becomes positive, supporting Hypothesis 3. The effect on the two purity attributes is also negative, but strongly significant.

In Model 3, interaction terms with *usedtg* (i.e., past experience in using tiger glue) and *inc* (income) are added. All coefficients are positive and significant, except for *farmed* with a negative estimate, while the price sensitivity is decreasing and strongly significant. However, *inc* has no significant effects on other attribute levels, and therefore Hypothesis 4 is not supported. Notably, *usedtg* increases the preference for purity, i.e. respondents who had used tiger glue preferred a higher purity of bone in the glue. Both purity attributes are significantly different from zero at a 1% level, while *farmed* is significant at a 5% level. The price sensitivity increases and is significant at a 5% level, i.e. respondents that use tiger glue are more likely to purchase from wild tigers. *Prop_70* still has the highest mean coefficient.

After the choice experiment, the respondents were presented with four questions concerning how important each element in the choice set was for them, when they had to choose between the alternatives. The results from these questions are shown in Figure 3.10. About 67% of the respondents said that the price was *not important* or *somewhat important* for their choices, while 32% said it was very important. This result fits well with the results from the RPL Model 1 and 2 in Table 3.4 where the price coefficient is negative and significant. Model 3 cannot be compared to these results as it includes other variables, whereas Model 1 and 2 reflect the situations in the choice alternatives. Figure 3.10 also shows that the respondent states that source and purity were *very important* or *extremely important* for their choices in the choice experiment. 65% of all respondents said source was *very important*, while purity had a 70% response. This also fits with the results shown in Table 3.3, where it can be seen that the respondents tend to choose wild over farmed tigers. Further supported by the result from the RPL model in Table 3.4 that applies for both source and purity.



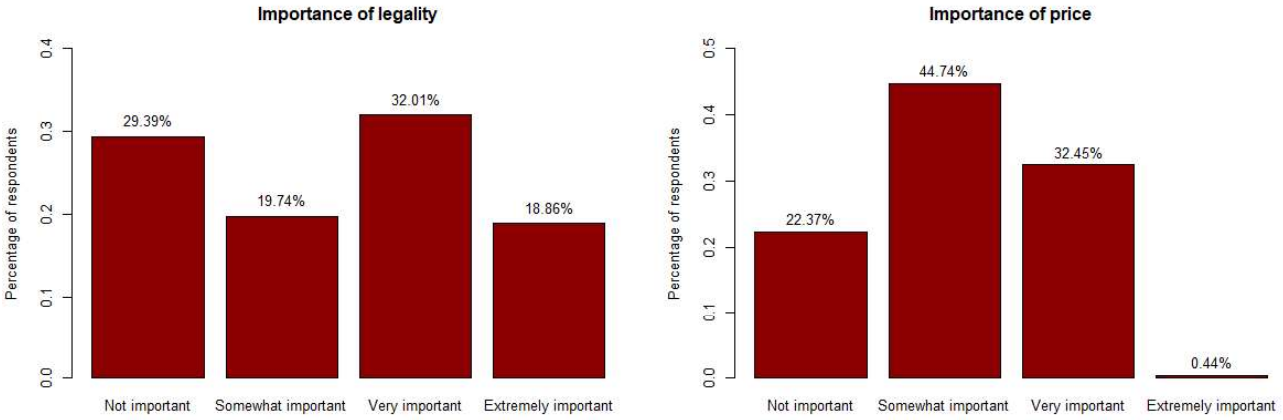


Figure 3.10: Respondents' perceived importance of the attributes

The respondents did not agree on the same level for all attributes. When looking at Figure 3.10, legality has split the respondent in two. Around 49% states that legality was *not important* or *somewhat important*, while 51% stated it was *very important* or *extremely important* for their choices. As legality is used as treatment in this study, 48% of the respondents were faced with the legality change, while 52% were faced with the current situation. Figure 3.11 therefore shows the respondents' perceived importance of legality.

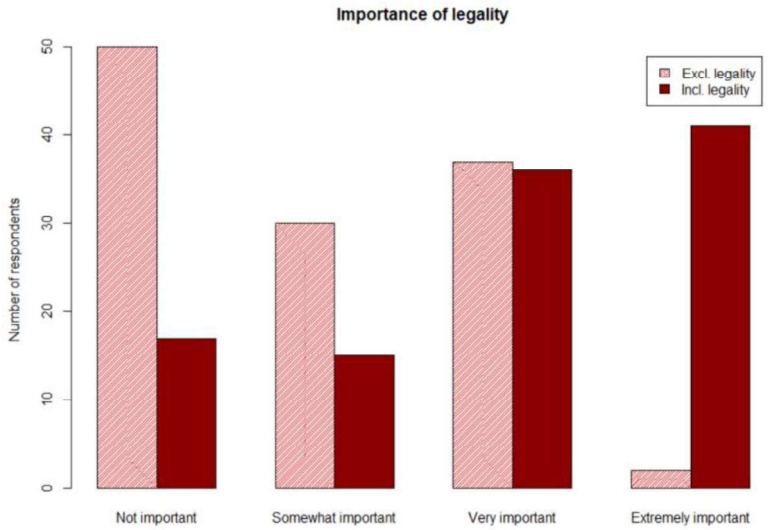


Figure 3.11: Respondents' perceived importance of legality

When presented with the hypothetical scenario of a legally controlled trade in farmed tigers, respondents' perceived importance of legality changed completely. Figure 3.11 shows that when the respondents were faced with the legality change, it had either a *very important* (33%) or an *extremely important* (38%) effect. Where those not faced with legality stated that it was *not important* (42%) and *very important* (31%) for their choices. The distribution of answers makes sense, having the treatments in mind, however having 31% of the respondents in the *status quo* group answer *very important* could indicate that they have some sort of knowledge on the legality status of tigers.

We estimated an additional model to see the effect of *age* and *fam* (i.e., family members in need of tiger glue for health-related purposes) on the respondent preferences in order to test Hypothesis 5 and Hypothesis 6. The coefficient for ASC is negative and statistically significant, meaning that the respondents still preferred buying tiger glue over the no-buy option. *Farmed* is positive and not significant, while *prop_50* and *prop_70* both are positive while *prop_50* is the only significant one at a 1% level. The price sensitivity is increasing and strongly significant. *Farmed* is the coefficient with the highest nominal mean. *Age* has a positive effect on all attributes, though none of these coefficients are significant. The effect of *fam* is positive on all attributes but not significant, the price sensitivity also decreases and is not significant either. The results shown in Table 3.5 do not support either Hypothesis 5 or 6.

Table 3.5: RPL Model estimation interacting with peers and age.

	Estimate	Std. Error
ASC	-2.9899***	0.4707
Farmed	-7.388	8.0951
Prop_50	4.2595*	1.4853
Prop_70	6.8884	3.93
Price	-1.9731***	0.5367
Price x fam	0.0091	0.0339
Farmed x fam	1.2254	1.1306
Prop_50 x fam	0.2043	0.5578
Prop_70 x fam	0.2208	0.8874
Price x age	-0.001	0.0008
Farmed x age	0.0713	0.1456
Prop_50 x age	0.0083	0.02
Prop_70 x age	0.0125	0.0508

Number of observations	2736
Loglik	-1432.803
Rho-square	0.5233
Adj.Rho-square	0.5173
AIC	2901.61
BIC	3008.06

Notes: The reference attribute levels are farmed and prop_30, and dummies for these are not included in the Model. Significant codes: 0 '***', 0.001 '**', 0.01 '*' and 0.05 '.'.

3.4 Marginal Willingness To Pay

Using the coefficients estimated in Model 1 and Model 2, we calculated the marginal willingness to pay (WTP), which is the indicative amount of money that consumers are willing to pay for a particular feature of the product. We use Model 1 to calculate the WTP for the average consumer in a real-life setting. In Model 2 *farmed* is reference, and we use this to test the legally controlled trade for Hypothesis 2 and 3. The results from the marginal WTP estimation can be seen in Table 3.6.

Table 3.6: WTP

	Illegal	Legal
Farmed	N. A	12.67
Prop_50	22.39	21.19
Prop_70	33.58	35.73

In the current illegal context, respondents were willing to pay 22.4 million VND (970 USD) more for wild tiger glue with a purity of 50%, and 33.6 million VND (1450 USD) more for tiger glue with 70% of wild tiger bones. In a legal context, the average consumer is willing to pay 12.6 million VND (550 USD) more for farmed tiger products, compared to wild tiger products. These results support Hypothesis 3 and indicate a positive impact of legalizing tiger farms on consumer preference. They are also willing to pay a premium of 21.2 million VND and 35.7 million VND for the tiger glue product with 50% and 70% of tiger bone respectively. In Table 3.6 above, it can be seen that the WTP decreases on *prop_50* when the legal scenarios are introduced. This supports the results of the respondents preferring wild over farmed tigers, and therefore, in general, being willing to pay less for farmed tiger glue compared to wild. However, since the legal context has changed, the preference of the composition of tiger glue has not changed, and the respondents are therefore willing to pay less for a higher purity of tiger bone for farmed tiger glue compared to wild. However, the overall results show that a legal trade increases the preference for farmed tigers but reduces the preference for purity, i.e. the purity of actual tiger bone in the tiger glue, perhaps due to the expectation of the supply being higher on the market.

In the questionnaire we also used two contingent valuation (CV) questions asking respondents' WTP for 100 grams of glue from wild tigers and from farmed tigers (with 50% of tiger bone), given their current disposable income and no changes in availability of tiger glue and law enforcement. The mean and median WTP for wild tiger glue is within the range of 30-39 million VND and for farmed tiger glue within the range of 20-29 million VND. This result is supported by the estimated results from the RPL Models in Table 3.4 and confirms consistency in the respondent's choices.

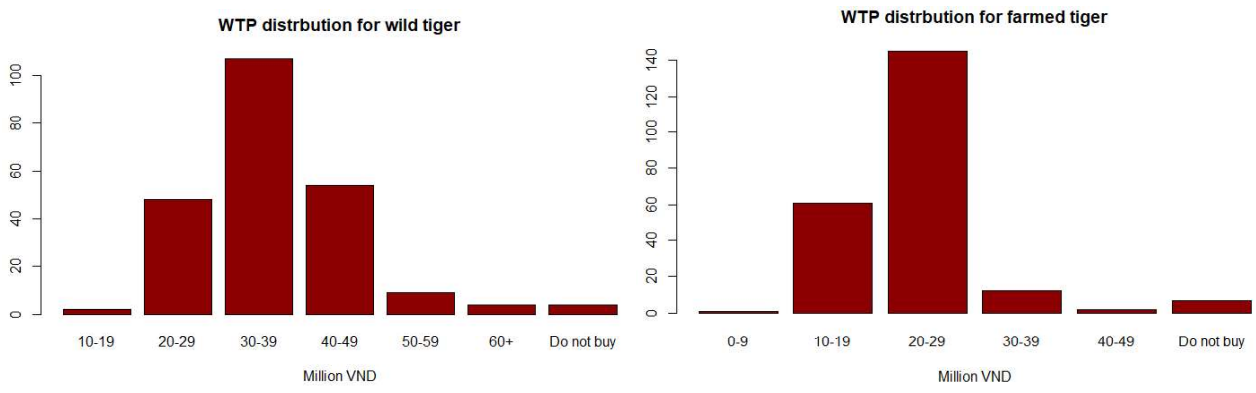


Figure 3.12: Respondents' WTP for 100 grams of glue from wild tiger and from farmed tiger.

The answers obtained in the two WTP questions are for wild normally distributed tigers, while the same goes for farmed tigers. The responses, however, are not distributed as equally as the wild tiger. From Figure 3.12 it can be seen that 63.6% of the respondents would be willing to pay between 20 and 29 million VND for 100 grams of tiger glue with farmed tiger bones, while 47% of the respondents would be willing to pay between 30 and 39 million VND for 100 grams of tiger glue with wild tiger bones. The second most reported for farmed tiger glue was 10-19 million VND with 26%, while both 20-29 million VND and 40-49 million VND both had more than 21% of the responses for wild tiger glue.

3.5 Attitude statements

Following the choice experiment, the respondents were asked to state their opinion on different statements regarding the purchase and use of tiger glue, legalizing the trade in farmed tigers, and other factors influencing the decision to buy or use tiger glue. The respondents were asked whether they *Strongly Disagreed*, *Disagreed*, *Agreed*, or *Strongly Agreed* to the different statements. The response distribution in percentage, can be seen in Table 3.7, divided into user's vs intenders and whether the respondent or someone in their close family is currently in need of tiger glue.

In general, respondents had a positive attitude toward a legally controlled trade in farmed tigers. A majority (87%) agreed that legalizing the tiger glue trade will reduce price. There is not really any difference between the subcategories, showing that the respondents have some sort of understanding of how the market works and a basic supply and demand understanding. This is further supported as 86% of the respondents think that legalizing tiger glue will increase demand from other consumer groups. Intenders however state 67% for *agree* and 33% for *not sure*. Throughout the results in Table 3.7 it can be seen that the intenders are the only subgroup that differs from the results compared to the other subgroups.

Asking whether legalizing tiger glue trade will help reduce poaching on wild tigers, respondents are more diverse in their answers. The majority *agree,* 15% *disagrees*, while around 10% are *not sure*. Thus, when asked if farmed tigers are the right thing to do, 70% *agrees* and 23% *strongly agrees*, while only 6% *disagrees*. This indicates, that even though the respondents have preference for wild tigers, they are aware of the current poaching situation with wild tigers and that the tiger population is very low in the wild. It can also be seen that the respondents think that if tiger glue was purchased from a legal source, that it would help secure food safety and quality. 80% of the intenders agree with this, while the other subgroups are between 50% and 60%. This result corresponds well with the legalization statement that was asked earlier, showing that the respondents in this study truly believe that a change in the legality status will have a positive effect on the wild tiger population.

The last statement the respondents were asked to answer, was how easy it was to find cheaper alternatives to tiger glue with the same effect. 45% of the current users *disagree* with this statement, while only 35% of the intenders *disagree*. 35% of the intenders are *not sure*, while 21% *agree*. This indicates that the intenders think they might be able to find another product with the same qualities, whereas the users perhaps have tried different qualities of tiger glue over several years for different prices and know there is no cheaper alternative.

Table 3.7: Percentage distribution of answers in attitude statements

		Total	Users	Intenders	In need	Not in need
		%	%	%	%	%
Legalizing the tiger glue trade will reduce the price of tiger glue	Strongly disagree	0.0	0.0	0.0	0.0	0.0
	Disagree	3.5	3.8	2.2	3.9	2.1
	Not sure	6.6	6.6	6.5	6.7	6.3
	Agree	88.6	87.9	91.3	87.8	91.7
	Strongly agree	1.3	1.6	0.0	1.7	0.0
Legalizing the tiger glue trade will create additional demand from other consumer groups	Strongly disagree	0.0	0.0	0.0	0.0	0.0
	Disagree	1.3	1.6	0.0	1.7	0.0
	Not sure	11.0	12.6	33.3	8.9	18.8
	Agree	86.4	84.1	66.7	87.8	81.3
	Strongly agree	1.3	1.6	0.0	1.7	0.0
Legalizing the tiger glue trade will help reduce poaching	Strongly disagree	1.3	1.1	2.2	1.1	2.1
	Disagree	15.8	15.4	17.4	15.0	18.8
	Not sure	9.6	9.9	8.7	10.0	8.3
	Agree	69.3	71.4	60.9	71.1	62.5
	Strongly agree	3.9	2.2	10.9	2.8	8.3
Overall farming tigers is the right thing to do	Strongly disagree	0.0	0.0	0.0	0.0	0.0
	Disagree	6.2	7.1	2.2	5.6	8.3
	Not sure	0.4	0.5	0.0	0.6	0.0
	Agree	70.5	68.7	76.1	72.2	62.5
	Strongly agree	22.9	23.6	21.7	21.7	29.2
Buying tiger glue from legal sources can ensure quality and food safety	Strongly disagree	0.4	0.5	0.0	0.6	0.0
	Disagree	10.1	12.6	0.0	11.7	4.2
	Not sure	11.0	12.6	4.3	10.6	12.5
	Agree	58.3	52.7	80.4	57.8	60.4
	Strongly agree	20.2	21.4	15.2	19.4	22.9
Tiger glue from farmed tigers is less potent then tiger glue from wild tigers	Strongly disagree	0.0	0.0	0.0	0.0	0.0
	Disagree	2.2	2.2	2.2	2.2	2.1
	Not sure	6.1	4.9	10.9	3.9	14.6
	Agree	53.1	52.2	56.5	55.0	45.8
	Strongly agree	38.6	40.7	30.4	38.9	37.5
It is easy to find cheaper substitutes for tiger glue with the same or better medicinal efficacy	Strongly disagree	13.2	14.8	6.5	13.3	12.5
	Disagree	43.0	45.1	34.8	46.1	31.3
	Not sure	26.3	24.2	34.8	23.3	37.5
	Agree	17.1	15.9	21.7	16.7	18.8
	Strongly agree	0.4	0.0	2.2	0.6	0.0

4. Discussion

4.1 Wild vs farm

Our results show that respondents generally prefer wild over farmed tiger glue, supporting the attribute hypothesis and resonating with findings of previous studies (USAID 2017; Coals et al. 2020; Gratwicke et al. 2008; Moorhouse 2020). This preference could be explained by the fact that consumers generally believe tiger glue made from wild tigers is more potent than from farmed tigers, although there is no scientific evidence supporting this belief. The results further showed that respondents prefer tiger glue from legal sources i.e. a legally controlled trade in farmed tigers, supporting Hypothesis 2. Thus, attempting to decrease the demand for tiger glue by substituting other products, depends on the consumer's willingness to accept. Liu et al. (2016) finds that consumers in China are willing to accept farmed-animal alternatives in order to protect endangered wildlife. We argue that other substitutes, besides farmed tigers, can be hard to introduce. We find that consumers do not believe that there are no cheaper and better substitutes for tiger glue, which creates a default on the market. Thus, the respondents are willing to change preference from wild to farmed, when farmed tigers are legalized, supporting Hypothesis 3. This however creates another concern, namely whether farmed tigers can supply the entire market. Gratwicke et al. (2008) state that the demand for tigers cannot be met from farmed tigers alone. If it is not possible to feed the demand solely with farmed tigers, black market demand for wild tigers will still be present. This will generate two different markets, where wild tigers are laundered as farmed (Gratwicke et al. 2008). Liu et al. (2016) also found that consumers in China choose substitutes to protect endangered wildlife, such as tiger bone and bear bile. A more recent study on bear bile, however, shows that consumers in Vietnam are not willing to change their demand, even though there have been massive campaigns to reduce the demand for bear bile, driven by a widespread belief in its health benefits (Davis et al. 2019). This finding might be related to the consumers self-image and the prestige that follows with it. Tiger glue being a high-status product, follows that the high-income consumers are willing to pay more for wild tigers without being concerned about legality due to their position in the society. Results show that there is no relationship between income and the attributes, meaning that the respondents price sensitivity is not dependent on their income (Hypothesis 4). However, we cannot say that there is no relationship between income and the attributes levels for the whole population, as our sample only focuses on the high-income consumers.

4.2 Purity

One element of tiger glue that is special compared to other wildlife products is the composition. Tiger glue consists of tiger bones along with a mix of other ingredients, which makes it more complex compared to other wildlife products. There is no product composition differentiation for rhino horn in the same way, so purchasing this, the consumers know what they get. However, when purchasing tiger glue the consumers need to trust their trader, in order to ensure that they receive the purity they wanted and paid for.

The results show that the respondents gain a higher utility with the higher level of purity, and that they valued a high purity (70%) the most, supporting the attribute assumption and Hypothesis 1. It further showed that the proportional gain in utility is higher when the proportion of tiger bones increases from 30% to 50% compared to 50% to 70%. This can potentially be explained by the belief that quality and purity are positively related, such that the respondents must make a tradeoff between the price and the wanted effect. However, this does not really explain why the proportional gain in utility is higher, thus one might look at the psychological side of the consumer preferences instead.

The results further show that previous use of tiger glue increases the preference for purity. We argue that users will have an indication of the product composition, under the assumption that they have tried different levels of purity over the years, and such understand the product. But also, that they previously have experienced no effect and therefore believe that the concentration of tiger bone needs to be higher in order to obtain the wanted effect. We find that there is no relationship between the income and purity preference level, showing that the consumer preferences do not vary significantly across different income groups. However, since the sample is not representative of the whole Vietnamese population and the respondents are from high-income groups, we cannot conclude that there is no relationship for other types of income groups. We argue that tiger glue is a luxury good, so consumers might be willing to pay for the additional purity despite no current need, but also due to the prestige of it. Thus, a legally controlled trade in farmed tigers reduces consumer preferences for purity, supporting Hypothesis 3. This change might be explained by the consumers trusting the product quality in a legal trade, where each product has a certificate of origin and quality control.

4.3 Price

The results show that including previous use will decrease price sensitivity, showing that the consumer behavior is less affected by the price of tiger glue. We also hypothesized that there was an effect depending on the current needs of the consumer and their family, as we expected the respondents would be willing to pay more for the product when a peer was in need. Thus, there is no support of this in the results, hence we reject Hypothesis 6. However, MacGregor (2006) and Moyle (2013) find that when legality is introduced on trade, this will cause prices to fall on illegal supplies, due to the price premium being diminished. We cannot reject the possibility that some of the respondents might have answered strategically on the price related questions, in order to signal a wish for lower prices in the case of the legal scenario or have tried to impress the interviewer by overestimating their WTP (Carson & Groves 2007). We argue that this type of behavior is accompanied by the high income, thus the results show that the respondents price sensitivity is not dependent on their income, rejecting Hypothesis 4. It can further be supported by the argument of the price range in the choice experiment perhaps being too limited, and therefore create some kind of bias.

4.3.1 Willingness to Pay

The results from the marginal WTP estimation show that the consumers are willing to pay more for farmed tigers in a legal context, supporting Hypothesis 3. We argue that this indicates a positive impact of legalizing tiger farms on consumer preferences and may reflect the general tendency in traditional medicine. The results further show that the respondents are willing to pay more for tiger glue with 70% of tiger bone in a legal situation, but less with 50%. Indicating that the respondents' have a need for being compensated when changing from farmed to wild. The respondents perceive farmed tiger glue to be less potent than wild, so if they have to change preference, they need to be compensated in a way that would make sense, such as a higher purity. Thus, if the consumer is not satisfied with the effects of the farmed product, there is a risk of them returning to wild tiger glue. The results are further supported by Hanley et al. (2018), that showed the same outcome on rhino horn.

From the WTP questions obtained in the questionnaire, it can be seen that the respondents are willing to pay a higher price for wild than farmed, supporting the marginal WTP findings and consistency in the respondent choices. The results from the contingent valuation indicate that the price categories on the choice cards suit the results obtained from our CE estimation. There is however a large part of the respondents that are willing to pay 40-49 million VND for wild tiger glue, so it can be discussed whether the price range in the choice sets is truly representative. The choice cards range between 15 to 40 million VND, so the price category 40 million VND should capture these, but not those willing to pay more than this.

4.3.2 Time Series trends

The general tendency showed the tiger glue prices to be decreasing, even though the prices have shown to be very volatile over the years. This was quite surprising for us, as the opposite was expected due to fewer wild tigers and a decreasing habitat area in nature. There are no other studies that have looked at the price for tiger glue over time, but studies on other wild animals such as rhinos and pangolins have shown that the price has been increasing over the last few years (TRAFFIC 2008; Haas & Ferreira 2017; Vallianos 2017). The decreasing price might indicate that there are potential issues with the obtained data, as it contradicts the general tendencies in wildlife prices. We argue that it also could be explained by potential slowdowns in the economy of Vietnam, or larger supplies of farmed tigers. However, even though the respondents have purchased tiger glue in the past, it seemed difficult for them to answer this question, raising several concerns such as whether the respondents remember correctly or if they stated a higher amount in order to have a better presence. We further argue that the decreasing price can be explained by the awareness campaigns having an effect on the new generations. The internet, easy access to school and the opportunity to travel around the world at low cost may also have changed the perception of the younger generation. Or it might simply be that

the number of tigers produced in captivity has increased substantially to exploit demand and as such kept the prices low, which would benefit the wild tiger population.

Even though there are some uncertainties in the time series data, the results reflect the actual price based on information obtained from tiger traders in Vietnam. The stated price of tiger glue in Vietnam ranges from 6,500 USD to 13,000 USD per kilogram, while our results show that the prices over time ranges from 5,200 USD to 13,000 USD, corresponding well with the perception of the tiger glue trader.

4.4 Legalizing trade in farmed tigers

For some people it might seem absurd to suggest legalizing farmed tigers, as wildlife trade has been illegal for many years under the Convention on International Trade in Endangered Species (CITES). In Vietnam, illegal wildlife trade can be punished with up to 15 years in prison and/or a fine up to 2 billion VND, equivalent to 87,000 USD. Though purchasing, owning and consuming wildlife has limited or no police attention and consequence (Dang & Nielsen 2018). Hanley et al. (2018) and Olmedo et al. (2017) find that the majority of rhino horn consumers reported that prison or heavy fines for purchasing rhino horn, would be more efficient than information campaigns alone. Dang et al. (2020) find that information campaigns that focus on the status of wildlife populations and the illegality of the trade will influence only the most marginal consumers. We argue that since tiger glue is comparable with rhino horn, that there is a high risk of these types of campaign to have the same effect.

The current perception of consumers of wild tiger products is that a wild tiger is worth more dead than alive. Wellington (2013) argues that since the current efforts have not paid off, i.e. no change in the demand for wildlife products, new methods must be considered, such as legalizing trade with farmed animals:

> *"If legalizing trade is our only alternative, we have to decide: is a live, farmed rhino without a horn really better than no rhino at all?"*.

Which in itself is an interesting point of view, but also very controversial. However, when the suggestion of legalizing tiger farms is initiated, a topic like animal welfare arises. The ethics and animal welfare behind this topic are important to discuss, as we have a responsibility to treat all animals with respect, regardless of the intended use (WAP 2020b). Like Brandt & Øster (2018) state, most humans agree that animals should not be sick, scared or in pain, however animal welfare is much more than that. Not only does it depend on the capacity in the farms, having room to move around and the ability to be around other animals, but the definition of animal welfare itself differs from individual to individual, and from country to country. The International Fund for Animal Welfare (2020) states that:

"*Animal welfare (...) provide objective assessments of the physical and mental wellbeing of animals in relation to the quality and suitability of environments they are in*".

Even though the results from our choice experiment support the notion that a change in the legality status will change consumer preferences, there are still some things that have to be considered when thinking of legalizing tiger farms. One thing in particular is whether there is going to be an increase in the demand for tiger glue when the source is changed to legal. Specifically, if it would encourage people to try it, which is not the intention. Supported by our attitude results, we argue that a legalization will create additional demand for other consumer groups, but questions whether farmed tigers can supply the entire market. Gratwicke et al. (2008) state that the demand for tigers cannot be met from farmed tigers alone. If it is not possible to feed the demand with farmed tigers, there will most likely still be a demand for wild tigers. We argue that this will create a secondary market for illegal tigers, as there still is a benefit in selling these and demand may increase by additional consumers being attracted due to the removal of the stigma. This secondary market will in most cases consist of trade with wild tigers or farmed tigers under poor conditions who are cheaper than the legal sources (Lyons & Natusch 2011; Tensen 2016).

Trade bans have shown to increase prices and stimulate poaching, which could help reduce the demand from poaching activities (Rivalan et al. 2007; MacMillan & Han 2011; Hanley et al. 2018). This finding may indicate that rare and illegal wildlife products such as tiger glue, may be especially coveted by consumers because they are illegal. This is due to the fact that in Vietnam you want prestige and maintain your image, which mainly is shown by sharing wildlife products at parties with their friends (Shairp et al. 2016). Biggs et al. (2013) suggest four different conditions such that a legal trade can disconnect from market powers from suppliers in order to reduce the poaching pressure. Some of the conditions state that regulators can prevent laundering of the illegal supply and that it is more cost-effective and reliable to have a legal supply. The illegal and legal wildlife are often sold on the same market and sometimes in the same shop, which makes it hard to control what is illegal and legal. Endangered species such as elephants, rhinoceros and tigers are possible to sell for traditional medicine purposes if the trader had the product before the ban was added. It can therefore be difficult to control a trader, as illegal wildlife trade can be kept in the shop and sold if the trader has a paper on the import before the ban was implemented. Evans (2020) and Yang et al. (2020) find that if a permanent ban is implemented, it will be easier to control and stop all sales with these products. However, the culture in many Asian countries is complex concerning the use of wild animals, as traditional medicine is an important part of their culture and therefore it might be difficult to control (Ribeiro et al. 2020; Wang et al. 2020). Thus, it might be helpful to gain international support that will help make it happen.

4.4.1 International corporation

Illegal trade has been an unresolved problem for a long time, and there is a need for new law enforcements that can lead to strong and deterrent convictions in the fight against poaching and illegal tiger trade. To get this to succeed, there is a need for information sharing in the effort to stop international smuggling. Cooperation and information sharing need to be supported by all countries through a standardized and systematic database, and this can be very tricky since all countries have their own way of enforcing it (Wong & Krishnasamy 2019). Tittensor et al. (2020) also argued that collecting and centralizing data and reporting is important for understanding relationships between the legal and illegal wildlife trades. Thus, the corporation needs to be worldwide and not specifically for Asian countries. Developed and Western countries are also part of the market with trade of tigers often without knowing. This is for instance seen when visiting a private zoo that sells tigers against the law, or when you travel around the world and in that way might be influenced into eating protected animals (Bale 2020; Ying et al. 2020).

The World Animal Protection scores countries based on how well the individual countries' legislation protects animals, ranging from A to G, with G as the lowest score. Scored with an F, WAP (2020a) states that the current legislation on animal welfare in Vietnam is very vague in the language and lacks an understanding and prioritization on the prevention of animal suffering, while also missing enforcement mechanisms. Comparing Vietnam to other countries with a high density of tiger trade, countries like India and China are scored with a C and E respectively on the API scale. It is noticeable to see that countries with a higher market activity on trade with tiger parts, are scored higher than Vietnam on the API. Thus, this might indicate that the legislation is implemented with the correct enforcement mechanisms. As mentioned by Wong & Krishnasamy (2019), this could further be supported by the number of seizures, as a higher number of these might indicate that the enforcement mechanisms work. Looking at the neighboring countries and their implementation mechanisms could be valuable when designing a policy and implementation. However, it is important to be critical of this, as the high number of seizures simply also could imply that the wildlife trade is more concentrated in those countries. Or that it is a way for the countries to make themself look better in the eyes of the rest of the world.

Sometimes external factors can have a positive effect for the wildlife trade, which can be seen with the outbreak of COVID-19. The initial epicenter for COVID-19 was perceived to be from a local wild animal market, which is now considered in relation to biosecurity, public health and economic impact. Though it is not the first time that a worldwide disease originates from wild animals, as seen with SARS, Ebola, Bird Flu, and MERS (OECD 2020). Before the pandemic, illegal wildlife trade was always criticized by conservationists for their lack of animal welfare (Evans 2020), though the ongoing COVID-19 outbreak has brought new attention to the global problem of wildlife trafficking. Lam et al. (2020) found in their study that smuggling pangolins in South-East Asia could have been the starting point of the current crisis. If there had been effective control on smuggling wild animals, or if farmed animals were legalized with more control and better food safety, the COVID-19

could perhaps have been discovered earlier and thereby potentially contained the virus to a smaller area. As the whole world is currently working for the same common goal, this should be translated into other areas such that a political involvement could create a demand change for the illegal wildlife trade.

4.5 Limitations

4.5.1 Study design

One of the things we were especially aware of in this study, was the translation of the questionnaire from English to Vietnamese. It was important that the meaning and the formulation of the questions was translated correctly such that it has the same meaning in both languages, but also so there were no misunderstandings when the questions were asked. The questionnaire was translated by our co-supervisor, a native Vietnamese, and was not chosen at random. It was important that the translator was qualified and had the necessary prerequisites, such as being familiar with the topic and culture in order to avoid response bias in our final dataset. The interviews were conducted face-to-face, which has the desirable feature that the respondent can be guided through the process by a trained enumerator such that the questions are understood in the way we imagined. However, the drawback of this method is that there is a chance that the responses may be affected by the interviewer, or that the respondent might be lying in order to appear better than he/she is (Nuno et al. 2014). We tried to avoid these issues by having training sessions and follow up meetings with the interviewers to ensure the best possible interview. But also, by making sure that the respondents were aware that they had full immunity and that their answers could not be traced back to them.

The choice experiment (CE) is chosen as the preferred method as it has the advantage of overcoming problems affecting data quality when asking sensitive questions (Moro et al. 2013; Nielsen et al. 2015). While the questionnaire is a great supporting tool, when one wants to explore individuals' behavior and preferences. Questions regarding sensitive topics can force the respondents to lie, which can generate a higher non-response and a bigger measurement error than other types of questions (Tourangeau & Yan 2007). We chose to ask the respondent about sensitive questions in the final part of the interview, in order to avoid the non-response or any misconception. It further allows the respondent and the interviewer to develop a relationship throughout the interview, which will decrease the chance of getting a measurement error (Brace 2008). The design of the survey can however take many forms and vary in how complex it is constructed and what information it should generate. However, as tiger glue is a fairly unexplored market, some of our response categories might have been relatively vague, especially the questions concerning the frequency of use. This is potentially a problem as it can be hard to quantify afterwards, but it might also be difficult for the respondent to choose an option. However, it seems that it would work nicely in this study as our pilot studies showed that it was not a product that was consumed regularly, but more in time of need.

Our CE is complex and realistic as we invested in focus group and pilot tests in the design phase. As we incorporate multiple different attributes and scenarios, the respondents' answers should result in being more truthful, hence the results give a more accurate view of consumer preferences and actual purchasing behavior (Hinsley & t' Sas-Rolfes 2020). One thing however, that should have been different in our choice modelling, was including legality as an attribute rather than a treatment. Typically, when creating the design, specifications that are not feasible would be incorporated in the model, such that they are included in the design. Legality should have been added as an attribute level with a restriction on the interaction with *farm*, however since that is not the case, we cannot include legality into the design but instead provide the legal context to the respondents.

In Model 3, the interaction variables are not represented as level terms as it normally would. This is due to the design of the model in the Apollo software, where the level terms only can be the attribute levels, i.e. those variables that were a part of the respondent choices in the CE. The attribute variables changed across alternatives, whereas the interaction variables are constant. Which is exactly the same issue that arises for legality. However, having these variables constant, it seems that the sign of the price parameter changes from negative to positive. One explanation for this could be that the effect of *usedtg* and *inc* are larger than the effect of legality compared to Model 1. This could further be supported by the presence of some sort of multicollinearity or misspecification. However, this can be hard to conclude as the issue might lie with the data or the model specification instead.

4.5.2 Sample size and demographics

We find that the average consumer of tiger glue is male, older than 49 years of age, has a university degree, and works as either a government official, self-employed or business owner. The results further showed no support for Hypothesis 5, stating that preferring a legal trade is not positively associated with the age of the respondents. Initially, we expected the average consumer to be around 10 years older than our results showed, as the believed benefits from tiger glue are for bone-related diseases such as rheumatism and for general health benefits such as body pains, which is generally seen in individuals above the age of 50 (Baslund et al. 2019). But our results on age are shown to be the same as previous studies done on tiger glue (TRAFFIC 2008; TRAFFIC 2019b; Davis et al. 2020). USAID (2017) did find that the consumers of tiger parts were over 55 years, which is older than our results and more what we had expected.

Our results show that 16.2% of the respondents were females, however this should not be interpreted as an absolute result but more of a question of whether the sample is representative. We expected the females to have a higher share of the responses such that the sample would follow the population distribution in Vietnam. As tiger glue is mostly used as medicine, on diseases that are not gender specific, our expectations were a more equal distribution. One reason why we see more men in the sample, could be due to the males are those that

purchase the tiger glue, while the women only consume it. Or perhaps women are more reluctant as they know that the product is illegal? Davis et al. (2020) do not find any differences in the gender of consumers of tiger glue, and USAID (2017) also find that many women used tiger products to treat rheumatoid arthritis and osteoporosis. However, another reason why women are underrepresented in this sample might be the sampling method. Here we used the snowball method which is a valid method when targeting consumers in a niche group. The enumerators used their network and for instance had to go to a new tennis club in order to recruit more respondents. When drawing on enumerators' social networks, snowball sampling can be effective as they gain the trust of a few consumers that will pass them on to other consumers. However, this relationship might show to be a problem in regard to the representativeness of the sample, as the enumerators recruit consumers within the same social groups. Once the enumerators are in contact with specific groups, it might be more difficult to find consumers elsewhere than just using those within that specific group. However, our results on the consumer socio-demographics, compared to other studies show many similarities.

In TRAFFIC (2019) they found that most consumers have a secondary high school education, which is considerably lower than the results from our study. A reason for the lower educational level in the TRAFFIC (2019) report, can be that their study was conducted on tiger products in general and not tiger glue specifically. When changing people's belief in the disadvantages of using tigers to medicine, it will be easier to increase the knowledge for those consumers with a low level of education, compared to consumers with a higher level of education. Consumers with a high education level have better social understanding and knowledge, and it would therefore be more difficult to change their perception. Whereas consumers with lower education might be easier to influence as they do not know better. Unless the low educational level increases their beliefs in traditional medicine, which then will make it more difficult to change their beliefs.

5. Conclusion

Tiger farming raises concerns amongst conservationists and policymakers over its threat to biodiversity conservation, poaching and laundering of wild tigers. This study is the first-choice experiment that exclusively is conducted on self-reported consumers and intended consumers of tiger glue. Our results show that consumers generally preferred and were willing to pay more for wild than farmed tiger glue. The respondents showed to have a strongest preference for purity (a higher proportion of tiger bone), especially for those having used tiger glue, which is an indicator about the quality of the tiger glue. Thus, we found little difference between the income groups, mainly because our study focused on high-income individuals.

In the hypothesized scenario of a legal trade in farmed tigers, our study showed changes in the respondents' preferences and trade-offs, in which the respondents preferred farmed over wild tiger glue and the preference for stated purity was reduced. This indicates a positive impact of a legal trade, showing that it will reduce the

pressure on wild tiger populations and that the respondents are actually concerned about the product quality. Thus, it does not ensure that the demand for wild tigers will be eliminated completely. Important questions such as whether the legal supply can meet demand and how tigers should be bred in farms (e.g. animal welfare and farming conditions), remain unanswered. Furthermore, a legal trade will require intensified law enforcement efforts in order to prevent laundering from illegal supplies. Tiger glue trade has not yet appeared as a top political goal. Market availability and consumer demand is as yet under researched compared to other species such as rhinos. The number of wild tigers left worldwide calls to actions in order to reduce the threats to the species and must be made a priority. International collaborative and effective actions are important to tackle the issues of illegal wildlife trade, and to ultimately prevent the extinction of tigers. Despite much effort made in campaigns to reduce tiger glue demand there has not been much success which can be explained by cultural contexts and direct benefits provided to consumers.

In conclusion, our results show evidence supporting a legalized trade, but we argue that this will unlikely eliminate the black-market trade. The impact of a legalized trade will depend on the price difference between the two markets and the law enforcement efforts. In any circumstances, the current initiatives such as behavior modification campaigns should be continued due to the high demand in Asian countries. Therefore, legalizing trade with farmed tigers should be a solution to consider.

6. Future perspectives

The literature on illegal wildlife trade is extensive for all kinds of endangered animal species, however it seems that there is a gap in the information concerning tigers. This study focuses on the demand for tiger glue and which factors that are important in relation to that, in order to contribute to the design of interventions and behavior modification campaigns. If we were to conduct this study again, several points need to be addressed.

The main thing that should be considered is the size and extent of the dataset. In general, the dataset should be increased, such that it includes more cities/provinces and countries. To really investigate the market for tiger trade, it would be effectful if the analysis included all the major players. The preferences and perception of the product can be different from city to city, but especially also between countries. Countries are different on all kinds of measures and it is therefore questionable whether the recommendations made for Vietnam are able to be transferred to other countries. Therefore, if a study is extended to the major players on the market, the impact of the policy changes will be larger.

There have been some economic constraints to this project which has affected the size of the dataset. As it is not possible to have an unlimited budget, the sample itself should be increased such that it has a more representative distribution of the population. This would include populations from all over the country, but also in the distribution of the demographics of the population, including more women and more intenders.

Looking at regional differences might have an impact due to the literacy and educational level, such that traditional medicine might have a larger meaning in specific areas compared to others. Thus, a study on the effect of a policy change on users and intenders, both in rural and urban areas would be interesting to conduct, such that it could be measured which group is the easiest to nudge, but also to test which group is larger. Conducting a study as such would specify further where the focus of interventions should lie.

There should also be conducted studies on the substitutes to tiger glue, as this is an unexplored subject. The idea is to stop illegal wildlife trade, so if this potentially happens, it will create a gap in the black market that needs to be filled by something else. It would be interesting to look into what tiger glue can be substituted instead of, that is not necessarily other traditional medicine products. But also, what happens when a product is removed from the black market, and what effect it would have on other wildlife products.

A more targeted time series study would have generated further insights to the market and predictions of the prices in the future. If this was to be conducted again, several things should be considered. If the time analysis is conducted on past prices that have been remembered by respondents, then it is not sure whether it is the correct price stated, due to either a lack in their memory or that the respondents try to appear better. Thus, we suggest that a time study on tiger glue prices is conducted on measurable prices instead of memory. This can be done in collaboration with tiger glue sellers, as they would have direct knowledge of the product composition and the prices it is sold at, thus this would potentially be generating other kinds of biases. It is a very time-consuming study, as tiger glue is not a product that is consumed regularly but more in time of need. Thus, if a study could be reflecting the prices of a seller then there would be more frequent data. Variables to be included in the model could for instance be the exchange rate, which reflects the relationships between countries. In this it would be interesting to look at the exchange rate between countries that are a part of the tiger trade market, such as China and India. If there was time series data from more than one country, the predictions of prices in the future would be more precise. The analysis could further be supported by the development in the numbers or production of tiger farms and farmed tigers.

7. References

‘t Sas-Rolfes, M. (2010): Tigers, Economics, and the Regulations of Trade. Tiger of the World, Second Edition, Elservier inc. Chapter 39. pp, 477-490.

‘t Sas-Rolfes, M., Challender , D. W. S., Hinsley, A., Veríssimo, D. & Milner-Gulland, E. J. (2019): *Illegal Wildlife Trade: Scale, Processes, and Governance*. Annual Review of Environment and Resources 44:1. pp, 201-228

Abbott, B. & G.C Van Kooten (2011): *Can domestication of wildlife lead to conservation? The economics of tiger farming in China*. Ecological Economics, 70, pp. 721-728.

Bale, R (2020): *Key facts that 'Tiger King' missed about captive tigers.* Wildlife Watch, National Geographic. Accessible on <https://www.nationalgeographic.com/animals/2020/03/captive-tigers-joe-exotic-tiger-king/>

Baslund, B., E. P. Larsen & G. Hansen-Nord (2019): *Reumatoid artritis*. Lægehåndbogen. Professionally updated September 18 2019. [cited 27. November 2020]. Accessible on <https://www.sundhed.dk/sundhedsfaglig/laegehaandbogen/reumatologi/tilstande-og-sygdomme/artritter/reumatoid-artritis/>

Bateman, I. J. et al (2002): *Economic Valuation with Stated Preference Techniques: A Manual.* Edward Elgar Publishing, Great Britain.

Becketti, S. (2013): *Introduction to Time Series Using Stata*. First Edition. Stata Press, United States of America.

Bhat, A. (2020): *Snowball Sampling: Definition, Method, Advantages and Disadvantages*.In: Consumer Insights, Market Research. QuestionPro. [cited 22. August 2020]. Accessible on <https://www.questionpro.com/blog/snowball-sampling/>

Biggs, D., Courchamp, F., Martin, R., & Possingham, H. P. (2013): *Legal trade of Africa’s rhino horn*. Science, 339, 1038–1039.

Bliemer, M.C.J. & Rose, J.M. (2010): *Construction of Experimental Designs for Mixed Logit Models Allowing for Correlation Across Choice Observations*. Transportation Research Part B, 44, 720-734

Bourton, J. (2009): *Tiger skin trade in China exposed*. BBC Earth News. Page last updated 23 October 2019. [cited on 23 October 2020]. Accessible on <http://news.bbc.co.uk/earth/hi/earth_news/newsid_8321000/8321033.stm>

Brace, I (2008): *Questionnaire Design. How to Plan, Structure and Write survey material for effective market research*. 2nd edition. Kogan Page Limited.

Brandt, B. & K. Øster (2018): *Dyrevelfærd 4-6. klassetrin*. Videncenter for Dyrevelfærd, Fødevarestyrelsen, Miljø- og Fødevareministeriet. 1. udgave, 1. oplag. ISBN: 978-87-93147-12-6.

Brennan, J.A & K.J. Kalsi. (2015): *Elephant poaching & ivory trafficking problems in Sub-Saharan Africa: An application of O’Hara’s principles of political economy*. Ecological Economics 120. pp, 312-337.

Broad, S. & R. Damania (2010): *Competing Demands: Understanding and Addressing the Socio-economic Forces that Work for and against Tiger Conservation*. Washington, D. C.: World Bank.

Brown, M. (2014): *New TV Campaign Aims to Save Vietnam's Wild Tiger.* Voice of America. [cited 11. september 2020]. Accessible on <https://www.voanews.com/east-asia-pacific/new-tv-campaign-aims-save-vietnams-wild-tigers>

Bulte, E. H., & Damania, R. (2005): *An economic assessment of wildlife farming and conservation*. Conservation Biology, 19(4). pp,1222–1233.

Carson, R.T. & Groves, T. (2007): *Incentive and informational properties of preference questions*. Environ Resource Econ 37, pp. 181–210. doi.org/10.1007/s10640-007-9124-5

Central Intelligence Agency (2020): *Vietnam*. In: The World Factbook. Last updated June 15 2020. [cited 22. August 2020]. Accessible on <https://www.cia.gov/library/publications/the-world-factbook/geos/vm.html>

ChoiceMetrics 2018: *Ngene 1.2 User Manual & Reference Guide. The cutting edge in experimental design.*

Coals, P., D. Burnham, A. Loveridge, D.W. Macdonald, M.T. 't Sas-Rolfes, V.L Williams, J.A. Vucetich (2019): *The ethics of human-animal relationships and public discourse: a case study of lions bred for their bones*. Animals 9 (2), 52.

Coals, P., T.P. Moorhouse, N.C D'Cruze D.W MacDonald & A.J Loveridge (2020): *Preferences for lion and tiger bone wines amongst the urban public in China and Vietnam*. Journals for Nature Conservation. DOI: 10.1016/j.jnc.2020.125874

Conrad, K. (2012): *Trade bans: a perfect storm for poaching?*. Tropical Conservation Science Vol. 5(3). pp, 245-254.

Dang, V. H. N. & Nielsen, M. R. (2018): *Understanding utilitarian and hedonic values determining the demand for rhino horn in Vietnam*. Human Dimensions of Wildlife, 23:5, pp. 417-432, DOI: 10.1080/10871209.2018.1449038

Dang, V. H. N., Nielsen, M. R., & Jacobsen, J. B. (2020): *Reference group influences and campaign exposure effects on rhino horn demand: Qualitative insights from Vietnam.* People and Nature. DOI: 10.1002/pan3.10121

Davis, E.O., Glikman, J.A., Crudge, B., Dang, V., Willemsen, M., Nguyen, T., O'Connor, D. & Bendixsen, T., (2019): *Consumer demand and traditional medicine prescription of bear products in Vietnam*. Biol. Conserv. 235. pp, 119–127.

Davis, E.O., M. Willemsen, V. Dang, D. O'COnner & J.A. Glikman (2020): *An updated analysis of the consumption of tiger products in urban Vietnam*. Global Ecology and Conservation. Elsevier B.V. DOI:10.1016/j.gecco.2020.e00960

de Bekker-Grob, E. W., Donkers, B., Jonker, M. F. & Stolk, E. A., (2015): *Sample Size Requirements for Discrete-Choice Experiments in Healthcare: a Practical Guide.* Springerlink.com

Drury, R. (2011): *Hungry for success: urban consumer demand for wild animal products in Vietnam*. Conserv. Soc. 9 (3), 247e257.

EIA (2007): *Availability of tiger bonewine at wild animal parks in China*. Environmental Investigation Agency. [cited 17. August 2020]. Accessible on <https://eia-international.org/report/availability-of-tiger-bone-wine-at-wild-animal-parks-in-china/>

EIA (2019): *Illegal trade seizures: Asian Big Cats.* Environmental Investigation Agency. Last updated July 2019. [cited 26. August 2020]. Accessible on <https://eia-international.org/wildlife/wildlife-trade-maps/illegal-trade-seizures-asian-big-cats/>

Encyclopædia Britannica (2019): *Population and Settlement patterns.* IN: *Vietnam*. [cited 19. August 2020]. Accessible on https://kids.britannica.com/students/article/Vietnam/277598#209850-toc

ENV (2019): *Stop the illegal tiger trade*. Education for Nature - Vietnam. [cited 17. August 2020]. Accessible on <https://env4wildlife.org/2013/03/28/stop-the-illegal-tiger-trade-2>

Esteves, R., & C. Reggiani (2014): *Elasticity of demand and behavior-based price discrimination.* International Journal of Industrial Organizations 32. pp, 46-56

Evans, S. (2020): *The Coronavirus outbreak is an important moment to finally address the illegal wildlife trade.* Australian Geographic

Evason, N. (2016): *Vietnamese Culture*. Cultural Atlas. [cited 7. September 2020]. Accessible on <https://culturalatlas.sbs.com.au/vietnamese-culture/vietnamese-culture-core-concepts#vietnamese-culture-core-concepts>

Fischer, C. (2003): *The complex interactions of markets for endangered species product.* Journal of Environmental Economics and Management 48. pp, 926-953. DOI:10.1016/j.jeem.2003.12.003

Frederiksen, M., P. Gundelach & R.S. Nielsen (2017): *SURVEY - Design, stikrpøve, spørgeskema, analyze*. 1st edition. Hans Reitzels Forlag.

General Statistics Office of Vietnam (2018): *Socio-economic situation of Vietnam in 2018*. [cited on 7. September 2020]. Last updated December 28th 2018. Accessible on <https://www.gso.gov.vn/default.aspx?tabid=382&idmid=2&ItemID=19041>

Goodrich, J., Lynam, A., Miquelle, D., Wibisono, H., Kawanishi, K., Pattanavibool, A., Htun, S., Tempa, T., Karki, J., Jhala, Y. & Karanth, U. (2015): *Panthera tigris*. *The IUCN Red List of Threatened Species* 2015: e.T15955A50659951.[Cited on 26. August 2020]. Accesible on <https://dx.doi.org/10.2305/IUCN.UK.2015-2.RLTS.T15955A50659951.en>

Graham-Rowe, D. (2011): *Biodiversity: Endangered and in demand*. Nature, 480, S101-S103.

Gratwicke, B., J. Mills, A. Dutton, G. Gabriel, B. Long, J. Seidensticer, B. Wright, W. You & L. Zhang (2008): *Attitudes Toward Consumption and Conservation of Tigers in China.* PLoS ONE 3(7): e2544. DOI:10.1371/journal.pone.0002544

Greene, W. H. & Hensher, D. A. (2003): *A latent class model for discrete choice analysis: contrasts with mixed logit.* Transportation Research Part B: Methodological, 37(8):681 { 698.

Groves R. M., Fowler F. Jr., Couper M. P., Lepkowski J. M., Singer E., Tourangeau R. (2009): *Survey Methodology*, 2. udg. Hoboken, NJ: Wiley

Haan, P. (2004): *Discrete Choice Labor Supply: Conditional logit vs. Random Coefficient Models*. German Institute for Economic Research, Discussion Paper 394.

Haas, T. C. & Ferreira, S. M (2016): *Combating Rhino Horn Trafficking: The Need to Disrupt Criminal Networks*. PLoS ONE 11(11): e0167040. doi:10.1371/journal.pone.0167040

Hanley, N., Sheremet, O., Bozzola, M., & MacMillan, D. C (2018): *The Allure of the Illegal: Choice Modeling of Rhino Horn Demand in Vietnam*. Conservation Letters, May/June, 11(3), pp. 1–8. doi: 10.1111/conl.12417

Hansen, E. J. & B. H. Andersen (2000): *Et sociologisk værktøj. Introduktion til den kvantitative metode*. 1st edition, 3 version. Hans Reitzels Forlag.

Hensher, D., Rose, J., & Greene, W. (2015a): *Other matters that analysts often inquire about. In Applied Choice Analysis.* Cambridge University Press. pp, (pp. 360-384) doi:10.1017/CBO9781316136232.010

Hensher, D., Rose, J., & Greene, W. (2015b): *Latent class models. In Applied Choice Analysis*. Cambridge University Press. pp, 706-741. doi:10.1017/CBO9781316136232.020

Hess, S. & D. Palma (2019): *Apollo version 0.1.0, user manual*. Choice Modelling Centre, University of Leeds. Accessible on <www.ApolloChoiceModelling.com>

Hess, S. & D. Palma (2020): *Apollo: a flexible, powerful and customisable freeware package for choice model estimation and application*. Journal of Choice Modelling, vol. 32, September 2019. Choice Modelling Centre, University of Leeds. Accessible on <www.ApolloChoiceModelling.com>

Hinsley, A. & t' Sas-Rolfes, M. (2020): *Wild assumptions? Questioning simplistic narratives about consumer preferences for wildlife products*. People and Nature. pp, 1–8.

Hinsley, A., Milner-Gulland, E. J., Cooney, R., Timoshyna, A., Ruan, X., & Lee, T. M. (2019): *Building sustainability into the belt and road initiative's traditional chinese medicine trade.* Nature Sustainability. pp, 1–5.

International Fund for Animal Welfare (2020): *Guiding principles. Statements of principle. Animal Welfare*. [cited 15 November 2020]. Accessible on <https://www.ifaw.org/eu/about/guiding-principles>

Jacobsen, J. B. (2019): *Day 3 Choice experiments. Methodology, Experimental design, IFRO cases, NIBIO cases.* Week 6, lecture 1. Lecture slides from the PhD course *Economic Valuation of Non-marketed goods* at the Department of Food and Resource Economics at the University of Copenhagen. Not published.

Johnston, J., K.J. Boyle, W. Adamowicz, J. Bennet, R. Brouwer, T.A. Cameron, W.M Hanemann, N. Hanley, M. Ryan, R. Scarpa, R. Tourangeau & C.A. Vossler (2017): *Contemporary Guidance for Stated Preference Studies.* The Association of Environmental and Resource Economists, vol. 4, no. 2, pp. 319-405.

Kjær, T. (2005): *A review of the discrete choice experiment - with emphasis on its application in health care*. Health Economics Papers, 2005:1. Health Economics, University of Southern Denmark. Accessible on <https://www.sdu.dk/~/media/52E4A6B76FF340C3900EB41CAB67D9EA.ashx>

Lam, T. T. et al. (2020): *Identifying SARS-CoV-2 related coronaviruses in Malayan pangolins*. Nature. doi.org/10.1038/s41586-020-2169-0.

Lapointe, E., K. Conrad, B. Mitra & H. Jenkins (2007): *Tiger conservation: It's time to think outside the box.* International Wildlife Management Consortium - World Conservation Trust, Lausanne, Switzerland.

Liu, Z., Jiang, Z., Fang, H., Li, C., Mi, A., Chen, J., Zhang, X., Cui, S., Chen, D. & Ping, X., (2016): *Perception, price and preference: consumption and protection of wild animals used in traditional medicine*. PLoS One 11, e0145901.

Lyons, J. A. & Natusch, D. J. D (2011): *Wildlife laundering through breeding farms: Illegal harvest, population declines and a means of regulating the trade of green pythons (Morelia viridis) from Indonesia*. Biological Conservation, Volume 144, Issue 12, pp. 3073-3081. ISSN 0006-3207

MacGregor, J. (2006): *The call of the wild: captive crocodilian production and the shaping of conservation incentives*. TRAFFIC International, Cambridge, UK.

MacMillan, D. & Han, J. (2011): *Cetacean by-catch in the Korean peninsula by chance or by design?*. Hum. Ecol., 39, pp. 757-768.

Matsangou, E. (2019): *The dark underbelly of the traditional Chinese medicine boom*. [online]. World Finance [cited 15. August 2020]. Accessible on <https://www.worldfinance.com/markets/the-dark-underbelly-of-the-traditional-chinese-medicine-boom>

McFadden, D. (2001): *Economic Choices.* The American Economic Review. pp, 351-378

Mills, J.A. & P. Jackson (1994): *Killed for a cure_A review of the worldwide trade in tiger bone.* Species in Danger. P. imprenta: Cambridge.

Milner-Gulland, E. J. & Wright, K (2017): *The Global Threat To Biodiversity From Wildlife Trade - A Major 21St Century Challenge*. Oxford Martin Programme on the Illegal Wildlife Trade.

Moorhouse, T. P., Coals, P. G. R., D'Cruze, N. C. & Macdonald, D. W. (2020): *Reduce or redirect? Which social marketing interventions could influence demand for traditional medicines?*. Biological Conservation 242 (2020), 108391.

Moro, M., Fischer, A., Czajkowski, M., Brennan, D., Lowassa, A., Naiman, L. C., et al. (2013): *An investigation using the choice experiment method into options for reducing illegal bushmeat hunting in western Serengeti*. Conservation Letters 6, pp. 37–45. DOI: 10.1111/j.1755-263X.2012.00284.x

Moyle, B (2009): *The black market in China for tiger products*. Global Crime, 10:1-2, 124-143. DOI: 10.1080/17440570902783921

Moyle, B. (2013): *Conservation that's more than skin-deep: alligator farming*. Biodivers. Conserv., 22, pp. 1663-1677.

Naderifar, M., Goli, H & Ghalijaei, F. (2017): *Snowball Sampling: A Purposeful Method of Sampling in Qualitative Research*. Strides Dev Med Educ. 14(3).

Najera, J (2019): *Time Series Forecast using the STL model.* [online]. Open review [cited 05. October 2020]. Accessible on <https://openreview.net/pdf?id=rylYCmQ_1H>

National Assembly (2015): *Vietnam's Criminal Code 2015*. he Office of the National Assembly of Vietnam

National Assembly (2019): *Handbook on wildlife conservation policy.* The Office of the National Assembly of Vietnam

Nguyen, M.H., V.V. Dung, N.V. Song, H.V. Thang, N.H. Dung, PN. Tuan, T.T. Hoa & D. Canh (2008): *Report on the review of Vietnam's wildlife trade policy.* CRES/FPD/UNEP/CITES/IUED, Hanoi, Vietnam

Nielsen, M. R., Jacobsen, J. B., & Thorsen, B. J. (2014): *Factors determining the choice of hunting and trading bushmeat in the Kilombero Valley, Tanzania: choice of hunting and trading bushmeat.* Conserv. Biol. 28, 382–391. DOI: 10.1111/cobi.12197

Nijman, V. & C.R Shepherd (2014): *Trade in tigers and other wild cats in Mong La and Tachilek, Myanmar - a tale of two border towns*. Biological Conservation, 182 (2015), pp 1-7

Nowell, K. (2010): *Tiger farms and pharmacies: the central importance of China's trade policy for tiger conservation*. Tigers of the World. William Andrew Publishing, pp. 463-475.

Nuno, A., J. M. Blumenthal, T. J. Austin, J. Bothwell, G. Ebanks-Petrie, B. J. Godley & A. C. Broderick (2017): *Understanding implications of consumer behavior for wildlife farming and sustainable wildlife trade*. Conservation Biology, Volume 32, Issue 2. DOI: https://doi.org/10.1111/cobi.12998

OECD (2020): *Coronavirus (COVID-19) and wildlife trafficking.* OECD. Accessible on <http://www.oecd.org/gov/illicit-trade/coronavirus-covid19-and-wildlife-trafficking-brief.pdf>

Olmedo, A., Sharif, V. & Milner-Gulland, E.J. (2017): *Evaluating the Design of Behavior Change Interventions: A Case Study of Rhino Horn in Vietnam*. Conservation letters. doi.org/10.1111/conl.12365.

Orme, B. (2019): *Getting Started with Conjoint Analysis: Strategies for Product Design and Pricing Research*. Fourth Edition, Madison, Wis.: Research Publishers LLC.

R Core Team (2020): *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria. Accessible on <http://www.R-project.org/>

Ribeiro, R., Bingre, P., Strubbe, D. & Luís Reino (2020): *Coronavirus: why a permanent ban on wildlife trade might not work in China*. Nature 578, 217. doi:org/10.1038/d41586-020-00377-x

Rivalan, P., Delmas, V., Angulo, E. et al. (2007): *Can bans stimulate wildlife trade?*. Nature, 447, pp. 529-530.

Rose, J. M. & Bliemer, M. C. J. (2009). *Constructing efficient stated choice experimental* designs. Transport Rev., 29. pp, 587-617.

Sagebiel, J. (2011): Comparing the Latent Class Model with the Random Parameters Logit - A Choice Experiment analysis of highly heterogeneous electricity consumers in Hyderabad, India. Department of Agricultural Economics, Humboldt-University, Berlin.

Seidensticker, J., Christie, S., & Jackson, P. (1999): *Riding the tiger. Tiger conservation in human-dominated landscapes*. New York, N. Y.: Cambridge University Press.

Shairp, R., Veríssimo, D., Fraser, I., Challender, D. & MacMillan, D. (2016). *Understanding urban demand for wild meat in Vietnam: implications for conservation actions*. PLoS ONE, 11(1), e0134787.

Simonoff, J. S. (2014): *Logistic regression — modeling the probability of success*. Unpublished manuscript. New York university. Accessible on <http://people.stern.nyu.edu/jsimonof/classes/2301/pdf/logistic.pdf>

Stoner, S. & Krishnasamy, K. (2016): *Reduced to skin and bones re-examined : An analysis of Tiger seizures from 13 range countries from 2000–2015*. Briefing paper. TRAFFIC, Southeast Asia Regional Office, Petaling Jaya, Selangor, Malaysia.

Stoner, S. & Pervushina, N. (2013): *Reduced to Skin and Bones Revisited: An Updated Analysis of Tiger Seizures from 12 Tiger Range Countries (2000–2012).* TRAFFIC, Kuala Lumpur, Malaysia.

Stoner, S., K. Krishnasamy, T. Wittmann, S. Delean & P. Cassey (2016): *Reduced to skin and bones re-examined: full analysis*. TRAFFIC Report. Southeast Asia Regional Office, Petaling Jaya, Selangor, Malaysia.

Tensen, L. (2016): Under what circumstances can wildlife farming benefit species conservation?. Global Ecology and Conservation, Volume 6, pp. 286-298, ISSN 2351-9894,

The World Bank (2020): *Inflation, consumer prices (annual %) - Vietnam*. International Monetary Fund, International Financial Statistics and data files. ID FP.CPI.TOTL.ZG. [cited on 25. September 2020]. Accessible on <https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG?locations=VN>

Tiger beer (NA.): *Uncaging art to fight illegal tiger trade.* [online]. Open review [cited 09. October 2020]. Accessible oon <https://www.tigerbeer.com/global/en/3890>

Tittensor, D. P., Harfoot, M., McLardy, C., Britten, G. L., Kecse-Nagy, K., Landry, B., Malsch, K. et al.(2020): *Evaluating the relationships between the legal and illegal international wildlife trades*. Conservation Letters. doi.org/10.1111/conl.12724.

Tourangeau, R. & Yan, T. (2007): *Sensitive Questions in Surveys.* Psychological Bulletin, Vol. 133, pp 859-883.

Tourangeau, R., L. J. Rips & K. Rasinski (2000): *The Psychology of Survey Response*. Cambridge University Press, USA.

TRAFFIC (2008): *What's Driving the Wildlife Trade? A Review of Expert Opinion on Economic and Social Drivers of the Wildlife Trade and Trade Control Efforts in Cambodia, Indonesia, Lao PDR and Vietnam*. East Asia and Pacific Region Sustainable Development Discussion Papers. East Asia and Pacific Region Sustainable Development Department, World Bank, Washington, DC.

TRAFFIC (2012): *Creative experts' meeting on messaging to reduce consumer demand for tigers and other endangered wildlife species in Vietnam and China: Meeting report*. TRAFFIC International, Cambridge, the United Kingdom.

TRAFFIC (2019): *Tiger Product Consumers. Suggested demand reduction messaging*. July 2019. TRAFFIC Briefing - Viet Nam Office.

TRAFFIC (2020): *Bringing the tiger back from the brink*. [cited 15. August 2020]. Accessible on <https://www.traffic.org/what-we-do/species/tigers/>

Train, K. E (2002): *Discrete Choice Methods with Simulation.* First editions. Cambridge University Press.

Train, K. E. (1998): *Recreation demand models with taste differences over people*. Land Economics, vol. 74, no. 2, pp. 230-239.

United Nations (2020): *World Wildlife Crime Report. Trafficking in protected species 2020*. United Nations Office on Drugs and Crime. [cited on 23 October 2020]. Accessible on <https://www.unodc.org/documents/data-and-analysis/wildlife/2020/World_Wildlife_Report_2020_9July.pdf>

USAID (2017): *What drives demand for wildlife? A situation analysis of consumer demand for wildlife and products in China, Thailand and Vietnam based on a literature review (elephant - pangolin - rhino - tiger)*. USAID Wildlife project.

Vallianos, C. (2017): *Pangolins - on the brink*. WildAid. San Francisco, US

Varian, H. R. (2014): *Intermediate Microeconomics - a modern Approach.* Ninth edition, Norton.

Verheij, P.M., Foley, K.E. & Engel, K. (2010): *Reduced to Skin and Bones. An Analysis of Tiger Seizures from 11 Tiger Range Countries (2000–2010).* TRAFFIC International, Cambridge, UK

VTC News (2019): *The tiger cooking industry, sophisticated tricks and creepy ways to bring tigers back to Vietnam.* Original title: *Kỹ nghệ nấu cao hổ, trò lừa tinh vi và những cách ghê rợn đưa hổ về Việt Nam* by Thứ Hai. Published July 1st 2019. [cited 23. October 2020]. Accessible on <https://vtc.vn/ky-nghe-nau-cao-ho-tro-lua-tinh-vi-va-nhung-cach-ghe-ron-dua-ho-ve-viet-nam-ar483818.html>

Walelign, S.Z, M.R Nielsen & J.B Jakobsen (2019): *Price Elasticity of Bushmeat Demand in the Greater Serengeti Ecosystem: Insights for Managing the Bushmeat Trade*. Front. Ecol. Evol. 7:162. doi: 10.3389/fevo.2019.00162

Walston. J, Robinson. J. G, Bennett. E. L, Breitenmoser. U, Fonseca G. A. B, et al. (2010); *Bringing the Tiger Back from the Brink—The Six Percent Solution*. PLoS Biol 8(9): e1000485. doi:10.1371/journal.pbio.1000485

Wang, H., Shao, J,. Luo, X,. Chuai, Z., Xu, S., Geng, M. & Gao, Z. (2020): *Wildlife consumption ban is insufficient*. SCIENCE. VOL 367 ISSUE 6485, pp. 1435-1435. 10.1126/science.abb6463

Wellington, K (2013): *Legalising trade in endangered species products - morally bankrupt or a conservation aid?*. Easy on environment. Accessible on <https://www.nature.com/scitable/blog/eyes-on-environment/legalising_trade_in_endangered_species/>

Whittington, D. (2010): *What Have We Learned from 20 Years of Stated Preference Research in Less-Developed Countries? The Annual Review of Resource Economics 2010*. 2:209-36. DOI:10.1146/annurev.resource.012809.103908

Williams, V., D. Newton, A. Loveridge & D. Macdonald (2015): *Bones of contention: An assessment of the South African trade in African Lion Panthera leo bones and other body parts*. TRAFFIC, Cambridge, UK & WildCRU, Oxford, UK

Wong, R. & Krishnasamy, K. (2019): *Skin and Bones unresolved - An analysis of tiger seizures from 2000-2018.* TRAFFIC Report. Southeast Asia Regional Office, Petaling Jaya, Selangor, Malaysia

Wooldridge, J. M. (2015): *Introductory Econometrics. A Modern Approach*. 6th edition. Cengage Learning, United States of America.

World Animal Protection (2020a): *Animal Protection Index (API) 2020. Socialist Republic of Vietnam: ranking F*. Last edited 16 November 2019. [cited 16 November 2020]. Accessible on <https://api.worldanimalprotection.org/sites/default/files/api_2020_-_vietnam.pdf>

World Animal Protection (2020b): *What Is Animal Welfare and Why Is It Important?* Published 05/07/2020. [cited on 16 November 2020]. Accessible on <https://www.worldanimalprotection.org.nz/news/animal-welfare-and-why-important>

WWF (2016): *WWF Position and Recommendations on tiger farming*. [cited on 23 October 2020]. Accessible on <https://wwfeu.awsassets.panda.org/downloads/wwf_position_on_tiger_farming_2.pdf>

Yang, N., Liu, P., Li, W., & Zhang, L. (2020): *Permanently ban wildlife consumption. Science. Vol. 367 (6585), pp 1434-1436. DOI: 10.1126/science.abb1938*

Ying, T., Wang, K., Liu, X., Wen, J. & Goh, E. (2020): *Rethinking game consumption in tourism: a case of the 2019 novel coronavirus pneumonia outbreak in China*. Tourism Recreation Research, DOI: 10.1080/02508281.2020.1743048

Zajic, A. (2019): *Introduction to AIC — Akaike Information Criterion.* [cited on 02 October 2020]. Accessible on <https://towardsdatascience.com/introduction-to-aic-akaike-information-criterion-9c9ba1c96ced>