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# HORN OF CONTENTION

A REVIEW OF LITERATURE ON THE  
ECONOMICS OF TRADE IN **RHINO HORN**  
COMMISSIONED BY IFAW **NOVEMBER 2013**







economists | at | large |

ADDING VALUE TO SOCIETY



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A close-up, shallow depth-of-field photograph of a rhino's head and horn. The horn is on the left, showing its textured, brownish-grey surface. The rhino's eye and part of its face are visible in the background, slightly out of focus. The overall color palette is warm and earthy, dominated by browns and tans.

# HORN OF CONTENTION

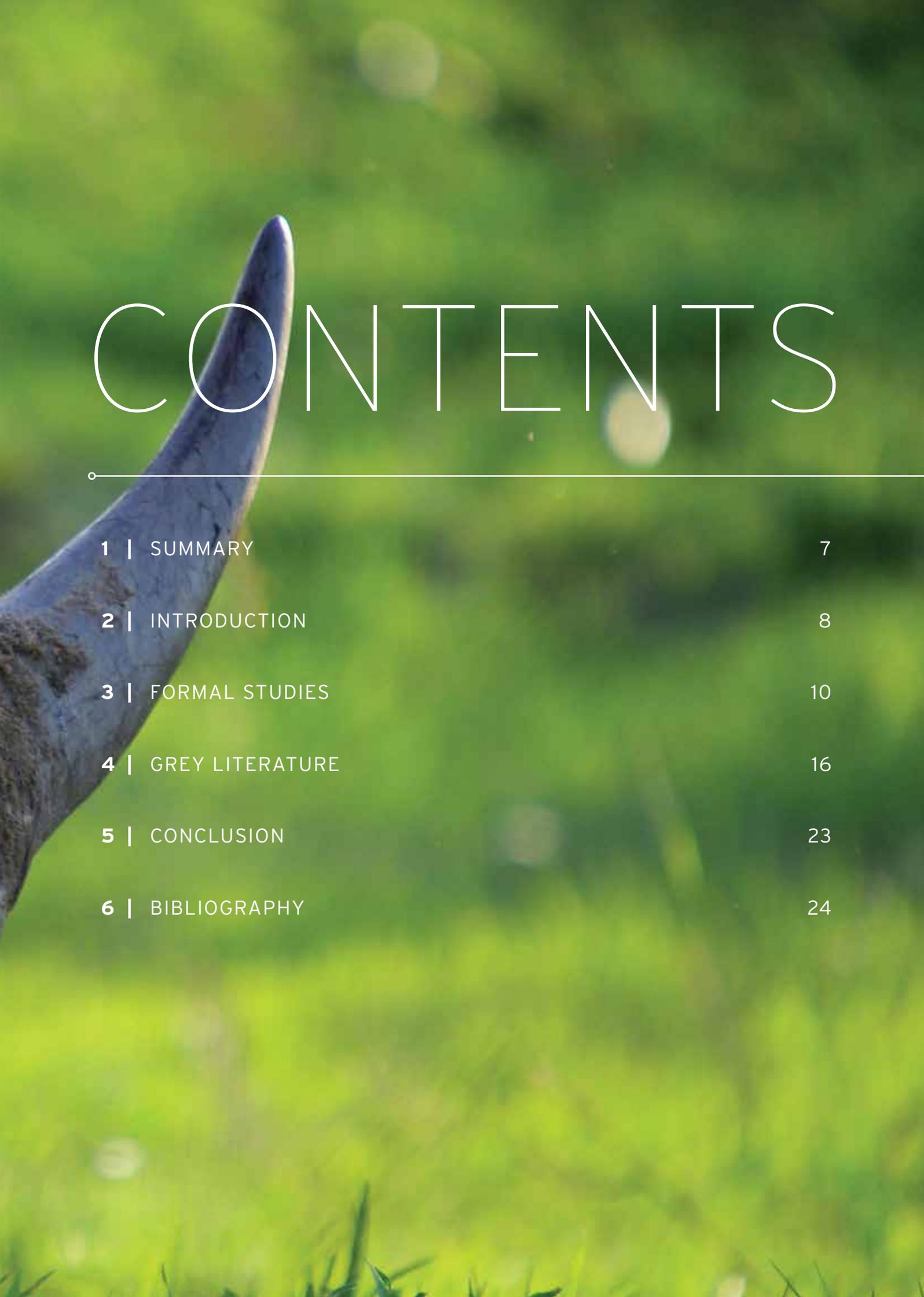
A REVIEW OF LITERATURE ON THE ECONOMICS OF TRADE IN RHINO HORN

PREPARED BY | **ECONOMISTS AT LARGE PTY LTD**

PREPARED FOR | **IFAW SOUTH AFRICA**

NOVEMBER 2013





# CONTENTS

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1   SUMMARY	7
2   INTRODUCTION	8
3   FORMAL STUDIES	10
4   GREY LITERATURE	16
5   CONCLUSION	23
6   BIBLIOGRAPHY	24



# 1 | SUMMARY



Poaching of rhinos in Southern Africa has increased dramatically in recent years. There is considerable debate within policy circles and the conservation movement as to the best policy response to increased poaching. Because many of the factors driving poaching and illegal trade in rhino horn are economic, many stakeholders are looking to economics for potential policy responses. In particular, there are suggestions that a legalised, heavily regulated trade in rhino horn could reduce rates of poaching.

This paper is a review of studies on the economics of trade in endangered wildlife in general and on rhino horn in particular. Two studies reviewed are from formal academic literature and another four are less formal articles or “grey literature”. The formal studies are from peer-reviewed journals, but do not explicitly address the recent increase in rhino poaching. The grey literature are less rigorous, but have the benefit of focussing on recent events in Africa.

The formal studies suggest that predicting the outcome of liberalising trade is complex and difficult to determine. Although it may decrease pressure on poaching, as rhino horn becomes increasingly supplied through the non-lethal legal trade, there is also a real risk that trade could drive an increase in poaching through any combination of five mechanisms:

- Through legal and illegal markets coexisting and interacting in complex ways.
- Through reducing the stigma attached to consumption of the product.
- By potentially reducing the supply costs of illegal supply.

- By potentially facilitating the laundering of illegal supply in with legal supply.
- As a result of uncertainty around the response of illegal suppliers to competition from a legal market.

The articles from the grey literature are all overtly pro-trade, generally assuming that:

- Legal markets will “hijack” consumers from illegal markets and that legal and illegal horn would be perfectly substitutable.
- Stigma effects are small and that efforts to reduce demand through education and information would be ineffective.
- Increased surveillance funded by rhino horn sales would increase poaching costs.
- Technical advances such as DNA technology would minimise laundering.
- Smugglers with market power would respond to the introduction of a legal trade passively, accepting reduced sales, rather than competing to retain market share.

Little empirical evidence is offered to support these views. Under certain conditions these assumptions may hold, but it is unclear if these conditions are in place in either supplying or consuming countries. We suggest further research should be undertaken before any formal steps are taken towards legalising trade in rhino horn.

# 2 | INTRODUCTION

Poaching of rhinos in Southern Africa, home to the majority of the world's rhino population, has increased dramatically in recent years. From a relatively steady average of 14 animals per year between 1990 and 2005, 448 animals were killed in 2011 (Milliken & Shaw, 2012) and 668 animals have already been killed in 2013<sup>1</sup>.

Many of the factors driving this increase are economic. Surging prices for rhino horn is clearly one of them. While reliable data is scarce, reports suggest prices in the early 1990s ranged between \$USD250-800/kg (Milliken & Shaw, 2012,p88) but have now reached levels many times this, with prices of \$60,000-70,000/kg being widely reported in international media<sup>2</sup>. Other economic factors include the poverty of parts of rural South Africa and other range states, insufficient budgets for protected area management and rising incomes in consumer countries, particularly Vietnam.

There is currently considerable debate within policy circles and the conservation movement as

to the best policy response to these increases. Because so many factors driving the poaching and illegal trade in rhino horn are economic, many stakeholders are looking to economics for potential policy responses. In particular, there are suggestions that a legalised, heavily regulated trade in rhino horn could reduce rates of illegal poaching.

All trade in rhino horn is currently illegal under the Convention on International Trade in Endangered Species (CITES). Pro-trade advocates are lobbying for the government of South Africa to propose to end the trade ban at the next CITES general meeting in 2016.

This report is a review of influential papers relating to the economics of rhino poaching and endangered species markets drawn from academic literature, self published articles, interest group journals and the mainstream media. Economists at Large were commissioned by the International Fund for Animal Welfare (IFAW) South Africa to review:

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<sup>1</sup> <http://asiancorrespondent.com/107462/rhino-crisis-if-theyre-gone-theyre-gone-forever/>

<sup>2</sup> See for example:  
<http://motherboard.vice.com/blog/rhino-horn-crisis-and-the-darknet>  
<http://www.iol.co.za/business/international/legalising-rhino-horn-trade-in-focus-1.1284989#.UiWegzZmCza>  
<http://www.theguardian.com/environment/2011/nov/25/cure-cancer-rhino-horn-vietnam>  
<http://www.thanhniennews.com/index/pages/20120427-vietnam-driving-increase-in-rhino-poaching-experts.aspx>  
<http://www.reuters.com/article/2012/04/26/ozatp-africa-money-idAFJ0E83P03N20120426>



FORMAL PEER-REVIEWED ARTICLES	GREY LITERATURE
Bulte and Damania (2005), <i>An Economic Assessment of Wildlife Farming and Conservation</i> , Conservation Biology	't Sas-Rolfes (2012), <i>The rhino poaching crisis: a market analysis</i> , self published
Fischer (2004), <i>Complex interactions of markets for endangered species</i> , Journal of Environmental Economics and Management	't Sas-Rolfes (1997), <i>Elephants, rhinos and the economics of the illegal trade</i> , Pachyderm
	Eustace (2012), <i>Rhino poaching: what is the solution?</i> , Business day
	Martin (2011), <i>A legal trade in rhino horn: Hobson's choice</i> , self published

**NOTE** | Full references in bibliography

The more formal articles conclude that impacts on poaching levels from the legalisation of trade are ambiguous, ie that poaching could increase or decrease with trade, depending on a wide range of considerations.

The less formal articles are all overtly pro trade, concluding that legalised trade in rhino horn would reduce poaching of wild rhino populations. These studies generally fail to address the factors that the more formal studies suggest could lead to increases in poaching.

# 3 | FORMAL STUDIES

Both Bulte & Damania (2005) and Fischer (2004) begin by outlining the basic argument of pro trade advocates:

Traditional economic theory says that selling confiscated goods should unambiguously lower prices by satisfying consumer demand. These lower prices mean the gains from poaching must be smaller, leading to reductions in that activity. Fischer (2004) p927

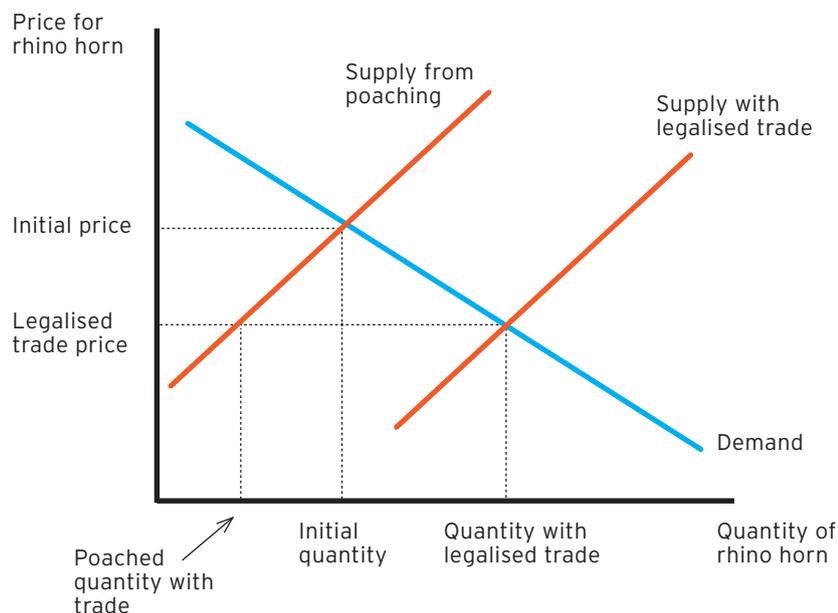
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consumer demand. These lower prices mean the gains from poaching must be smaller, leading to reductions in that activity. Fischer (2004) p927

Bulte & Damania (2005) go on to model this effect, showing that if a farmed quantity of wildlife product such as rhino horn is put onto the market, prices will decline and supply sourced from poaching will fall:

Bulte & Damania (2005) go on to model this effect, showing that if a farmed quantity of a wildlife product such as rhino horn is put onto the market, prices will decline and supply sourced from poaching will fall:

FIGURE 1 | BASIC MODEL OF IMPACT OF TRADE ON POACHING



SOURCE | adapted from Bulte and Damania (2005)

Under this model, the initial supply of rhino horn comes entirely from poaching, which results in the high “Initial price” and the “Initial quantity” supplied and demanded in the market. As trade is legalised, farmed and stockpiled rhino horn is allowed onto the market, expanding total supply and reducing price to the “Legalised trade price”. At that price poaching has become less attractive, so the quantity supplied to the market by poaching has reduced from the “Initial quantity” to the level “Poached quantity with trade”, the remainder of the supply to the market is made up of supply from legal sources.

The bulk of both papers, Bulte & Damania (2005) and Fischer (2004), is then devoted to discussion of whether this situation would or would not occur in real world markets for wildlife products. Both papers are concerned with markets for wildlife products in general, with Fischer having little focus on rhino horn in particular, while Bulte and Damania (2005) use markets for rhino horn as a hypothetical market in a modelling exercise.

Fischer (2004) points out four flaws in the traditional approach outlined above - perfect substitution, stigma and outrage effects, laundering and impacts on illegal supply costs.

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### 3.1. PERFECT SUBSTITUTION

The basic approach assumes that consumers do not differentiate between legal and illegal wildlife products, that they operate as one single market. Fischer points out that this need not be the case:

/// In reality...separate legal and illegal markets can exist, and arbitrage between them may not be perfect. In other words, while consumers in the illegal market may care only about price, as in the traditional model, law-abiding consumers also care about the source of the product. (p927) ///

In relation to rhino horn there is the potential for separate markets to exist for “wild” and “farmed” horns, particularly given reports of its use as a status symbol among wealthy Vietnamese. It is possible that “wild”, ie illegally sourced, horns could continue to function as a separate market, potentially attracting a premium price. This possibility is reinforced by a recent study in the willingness of Chinese consumers to pay for bear bile from wild or farmed sources. (Dutton, Hepburn, & Macdonald, 2011) find:

/// We find a willingness to pay considerably more for wild bear bile than farmed. Wild bear bile has low own price elasticity and cross price elasticity with farmed bear bile. The ability of farmed bear bile to reduce demand for wild bear bile is at best limited and, at prevailing prices, may be close to zero or have the opposite effect. The demand functions estimated suggest that the own price elasticity of wild bear bile is lower when competing with farmed bear bile than when it is the only option available. This means that the incumbent product may actually sell more items at a higher price when competing than when alone in the market. (p1) ///

Another example of this is consumers' preference for wild tiger bones, reported in (TRAFFIC, 2009):

/// Consumers also showed a preference for wild Tiger products to those made from captive-bred animals, motivated by the belief that wild animals are "unpolluted," "precious," and "special," as well as having nutritional and curative properties. (p1-2) //

In addition, Fischer suggests that law-abiding consumers' willingness to pay for goods from endangered species may depend on the relative size of the legal and illegal markets; where law-abiding consumers know that little of the supply has come from legal sources, their willingness to consume even legally sourced horn may be low. An increase in the portion of horn sourced legally may therefore increase these consumers' willingness to pay and consume. Under this reasoning, a legalised trade could increase demand for products such as rhino horn.

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### 3.2. STIGMA AND OUTRAGE

In relation to consumers' willingness to consume goods such as rhino horn, Fischer discusses two additional factors that may impact upon consumers' willingness to pay for goods such as rhino horn; stigma and outrage.

Fischer defines stigma as:

/// the perception that the product was obtained through illegal or inhumane means; the impact of stigma on utility then depends on how much the consumer cares about that perception in order to enjoy the product. (p932) //

Fischer considers that goods for ornamental use and display, such as ivory or potentially blood diamonds, might be more affected by stigma affects than goods which are consumed, such as rhino horn. However, Fischer's work predates the reported (see for example in Milliken & Shaw (2012) and links above) trend in conspicuous rhino horn consumption in social settings, particularly in Vietnam.

While Fischer feels that stigma relates to the relative amounts of poached and legal products, she differentiates "outrage" as relating more to perceptions of the overall industry and its "associated horrors" (p932). Under her model outrage is a function of the stock of animals and "the precariousness of [the population's] health." (p932)

Fischer argues that both the stigma and outrage effects could be reduced under legalised trade scenarios, leading to increased demand for products such as rhino horn.

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### 3.3. LAUNDERING

Laundering refers to the potential to bring illegal goods into legal markets. Much concern around a trade in rhino horn relates to whether illegally obtained rhino horn will be fraudulently sold as legally obtained horn. Fischer emphasises the difference between smuggling and laundering:

/// It is useful to make a distinction between smuggling and laundering. Smuggling is part of the process of supplying illegal consumers with poached goods. Laundering takes some of those illegal supplies and passes them off as certified products. Ongoing seizures of shipments of poached ivory reveal that smuggling remains a real problem. However, the important question for certified sales policy is the scope for laundering, since that is the mechanism for legal sales to raise illegal prices. (p944) //

Even in a well-regulated market, some degree of laundering seems likely to occur. Fischer notes that Japan has one of the most highly regulated ivory markets, yet continues to see imports of illegal ivory.

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### 3.4. ILLEGAL SUPPLY COSTS

Illegal supply costs could be affected in a number of ways by a legal trade. Fischer suggests that smuggling costs could be reduced depending on the size and scope of the legal market.

Although not incorporated into Fischer's modelling, she points out that in a more advanced model - or indeed in the real world - changes in the population of rhinos affect the costs of poaching. As a population grows, poaching potentially becomes cheaper and vice versa, making poaching more, or less profitable as an activity.

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### 3.5. IMPERFECT COMPETITION

Bulte & Damania (2005) adopt a different approach to Fischer, focusing on the nature of competition between suppliers of legal and illegal commodities. They believe that the basic view of trade legalisation - that prices will fall, reducing incentives to poach - relies on the assumption that markets for wildlife commodities are perfectly competitive. In economics, a perfectly competitive market is one that:

- All participants have perfect information about every aspect of the market - price, quality, quantity .
- There are many buyers and sellers, so that none has the power to influence prices themselves. People can enter or exit the market as purchasers or producers as they please.
- There is no government regulation.
- There are no external costs, such as the extinction of species or animal cruelty.

Bulte & Damania suggest that these conditions may broadly hold from a supply-side perspective, i.e. for poachers. But that it oversimplifies markets for wildlife commodities and ignores the role of traders.

▮▮ the implicit assumption that the market for wildlife commodities is characterized by perfect competition; that is, there are many hunters or poachers, each taking the price of the wildlife commodity as a given and beyond their control. (p1224) ▮▮

They suggest that while this assumption is: essentially correct [for poachers] - there are many poachers who take prices as given and typically do not have formal property rights to the resource they are harvesting...However [this] is too gross a simplification of reality and must be amended because it completely ignores the role of the traders in the middle. We demonstrate that failure to capture market power may result in bad policy recommendations. (p1226-1227)

Under Bulte and Damania's model, poachers in Africa do not sell direct to consumers in Asia, but sell first to traders, who then take the product to market. The poachers themselves are paid a given price by the traders, which they cannot influence, a price much lower than the Asian market price. In economics, this is known as being a 'price taker'. The traders buy cheaply from the poachers and then sell at high final prices, making substantial profits.

Under this model, poachers will engage in poaching as long as the price they receive from the traders covers the costs of poaching. The costs of poaching include the risks of being caught, time in the bush looking for animals, weapons, vehicles and other equipment, and any income foregone from not participating in other paid activities (i.e. other jobs). If the price they are paid by the traders goes down, then they will reduce the amount of poaching they undertake and would stop poaching when the

amount they receive does not exceed the costs of the activity.

Traders, however, in the Bulte and Damania model, do not face such stiff competition. While it is assumed that almost anyone could become a poacher, very few people can engage in multinational smuggling, bribery and marketing of illegal products. Because of the difficulties inherent in smuggling illegal wildlife products, many of the groups involved in trading have links to criminal organisations. As there are a relatively small number of firms or groups engaged as traders, they can to some extent set the price or quantity that they are willing to supply to the market. They do not sell at the costs they pay the poachers, but at a price that includes large profits.

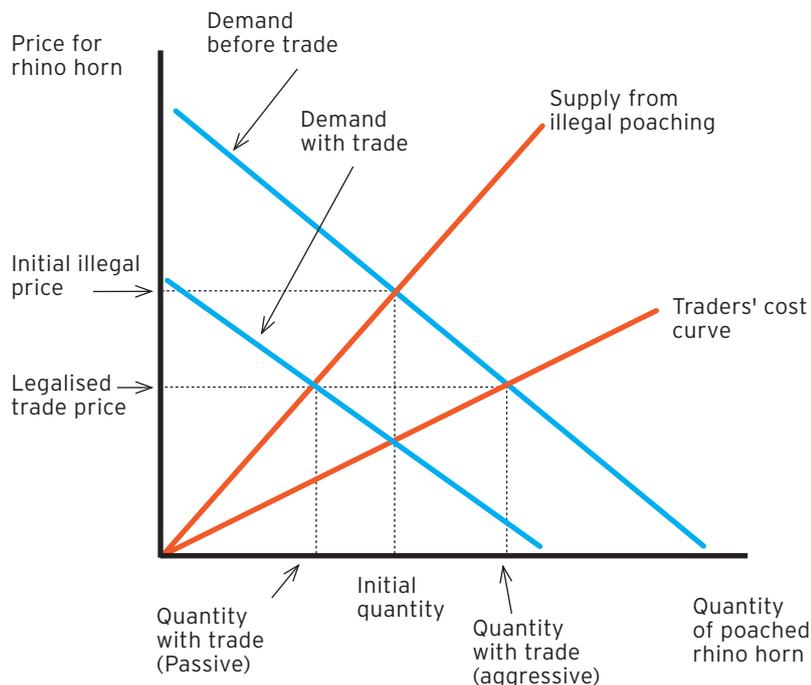
When competition from legal sources enters the market, Bulte and Damania make the assumption that demand for poached goods will reduce -

an assumption which is questioned by parts of Fischer's analysis. Bulte and Damania suggest that a range of outcomes are then possible.

In figure 2, we see this situation. Traders supply at the red "Supply from illegal poaching" curve, which is higher than the "Traders' cost curve". The distance between these curves is the traders' profits. As trade is legalised, demand for illegally poached horn should drop from the blue "demand before trade" line, down to the "demand with trade" line. Under the normal assumptions of pro-trade commentators, illegal suppliers passively accept the new market conditions. In other words, they reduce the quantity they supply and so reduce poaching, continuing to supply some smaller amount and still earning some profit.

Bulte and Damania argue, however, that traders may not respond passively. Instead, they may accept

**FIGURE 2 | POACHING UNDER IMPERFECT COMPETITION**



**SOURCE |** adapted from Bulte and Damania (2005)

reduced profits and push out their supply out close to their cost curve. In other words, they could pay their poachers a little more and supply more to the market, though at a lower level of profit per sale. Put simply, they may respond to increased competition from legal supplies and increase

illegal supplies, at lower profit margins, to maintain aggregate levels of profit. The quantity supplied, and poached, therefore, could range between the “passive” and “aggressive” quantity levels, which could be higher or lower than the initial quantity:

/// When the government allows [farming and trade] to conserve wild stocks, the outcome could be the exact opposite of what is desired—extra poaching pressure and smaller wild stocks. Evidence suggests that there is imperfect competition in the wildlife commodity market; hence, the mode of competition between suppliers is undetermined a priori. It is unclear whether competition will be intense or not, implying that it is unclear whether supplies from the wild will contract or expand. (p1228) ///

Both formal studies, Fischer (2004) and Bulte and Damania (2005) find that the effects of trade liberalisation and farmed supply of products from endangered species can have ambiguous effects on quantities poached from the wild. Without greater knowledge of the market situation it is impossible to predict whether such policies will aid

or hinder conservation. These studies do not focus specifically on rhino horn and predate the recent escalation in rhino horn price and poaching levels. They do, however, provide interesting insights into the nature of these markets, which can be applied to more specific studies of the current situation, such as the less formal articles below.



# 4 | GREY LITERATURE

The less formal articles reviewed are considerably less rigorous in their application of economic principles, but unlike the formal studies they are focused on rhino horn markets and most are recent enough to address the current surge in prices for rhino horn and the escalation in poaching. While the articles largely fail to address the issues identified above, they do offer insight and interesting opinions on the current situation and potential policy responses.

As all the articles reviewed adopt the basic pro-trade view outlined above (see figure 1), this section is organised by topics from the formal studies on the potential problems of legalised trade. We assess the views of the authors of the pro trade articles on these issues.

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## 4.1. PERFECT SUBSTITUTION AND COEXISTENCE OF LEGAL AND ILLEGAL MARKETS

't Sas- Rolfe (1997) identified information gaps about the role of illegal and legal markets and their relationship, foreshadowing Fischer's comments on this point:

/// There appear to be two aspects of wildlife trade that remain poorly understood. The first is the nature of the relationship between legal and illegal trade; the second is the extent to which trade can be "controlled" and the implications of this for policy (p28) ///

Emphasising the poorly understood link between illegal and a potential legal market in 1997, in 2012, 't Sas-Rolfe states:

/// The least law-abiding consumers under prohibition are also typically the least price-sensitive. These consumers will still most likely bid the highest prices for products in a legal market, with previously law-abiding consumers likely only willing to pay lower prices. With the repeal of prohibition prices are far more likely to fall than increase. (p16) ///

't Sas-Rolfe (2012) (p7) discusses that demand for rhino horn might be price inelastic - that is, that demand might be relatively insensitive to price changes. In the current, illegal market, he may be correct, given strong demand and rising prices. Above, he implies that a legal market might be relatively price elastic, again emphasising Fischer's point that legal and illegal markets might interact in complex ways. A legal, price elastic market could operate in one country, for example, while a neighbouring country hosted a price inelastic illegal market. Further research on similar markets could be valuable for policy makers on this topic.

Martin (2010) considers that substitution between legal and illegal markets is perfect:

/// How would the illegal demand be reduced? Very simply by stealing the customers away from the illegal traders. **This is a critical insight.** At the moment, all of the horn in the international trade is illegal and all of the customers for that horn rely on the black marketeers. Any horn purchased legally

from the [proposed legal trade body] has the unique characteristic that it has not caused the illegal killing of a rhino. Logically, the more customers there are that obtain their horn from the [legal trade body], the fewer are the numbers of rhino being killed illegally for any given level of demand. (p iv, bold and underline in original) //

Whether a legal trade would really “steal” customers away, or just attract new customers remains unproven. Martin suggests that his modelling holds “for any given level of demand”, but it seems that this level of demand is fixed in his model. Because of this, most of his hypothesised outcomes with trade “hijack” customers into the legal market from the illegal market, resulting in the latter’s “collapse”. There is no empirical evidence to suggest Martin’s assumptions will be valid and they are contradicted by the findings of (Dutton et al., 2011). While further study would be required for confirmation, Martin’s ideas seem to be unlikely postulations.

Eustace’s (2012) position seems to be the least well formed. Through some confusing and seemingly erroneous arithmetic, he arrives at an estimate of the number of rhino horns currently entering the illegal market of 940 per year (p3-4). He goes on to state:

// While we have no specific statistics on the demand, we can derive demand from the supply, as supply and demand must be equal. (p4) //

Supply does not always equal demand, particularly not in the short term, nor in the long term in imperfect markets<sup>3</sup>. The assumption of a perfect, or at least efficiently functioning market is particularly inappropriate for rhino horn, with externalities, market power of suppliers, corruption and imperfect information in every part of the market. It is exactly because demand has been growing faster than supply that prices have been increasing, stockpiling has been reported and the current situation has emerged.

Eustace goes on to suggest that Southern Africa could supply more than twice the currently supplied illegal Rhino horn through a combination of ‘cropping’ - cutting the horn and letting it re-grow without killing the animal - of rhinos on private land and continued harvesting from rhinos on public land:

// Southern Africa could easily supply the market with 940 horns a year and increase this by 40 horns a year from the increment of natural deaths provided poaching was controlled... In addition, private farmers in South Africa could provide the equivalent of 1000 horns, or 4000kg a year, by cropping their rhinos.... In theory, Southern Africa could provide the market with 1940 horns a year, or more than twice the current demand. //

<sup>3</sup> Debate over whether markets will “clear” has a long history, certainly including the work of early 20th century economists such as Irving Fischer and Maynard Keynes. An influential paper on the topic is (Akerlof, 1970), who uses the example of second hand car markets to demonstrate principles that apply to insurance, labour and credit markets.

Note that this should equal 1,980 horns, not 1940.

Arithmetic aside, it is Eustace's assumption that markets are perfect and always clear that leads him to his position on the coexistence of legal and illegal markets:

/// The agents like to say that demand is insatiable and that there are too few rhinos left to satisfy the demand. They ignore price and the fact that price brings whatever level of demand there is into balance with supply.

They suggest that the introduction of a legal trade will stimulate the illegal trade, whereas the reverse is probable. A legal trade will satisfy the market and there will be little room for the illegal trade. (p6) ///

Eustace ignores the likelihood that it is high prices which are driving expanded supply through illegal means and does not explain why an illegal market would not continue alongside an authorised trade, especially when it may be cheaper for traders to obtain illegal horns, rather than pay farmers. His faith in his estimates leads him even to doubt the need for further study on the topic:

/// The terms of reference [of a government study] ask for estimates of the size of the market, prices, why people buy, whether there is a trading opportunity and how trade might operate. All these issues are covered in this paper and are, in any case, well known. Of course there are "nice to know" but there is very little that we need to know that we don't already know. (p5) ///

With the more formal articles warning of the uncertainty that surrounds trade in wildlife goods, and exhaustive reports such as TRAFFIC (2012)

urging further research, Eustace's position on these issues seems simplistic and misguided.

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## 4.2. STIGMA AND OUTRAGE

The pro-trade articles all place little weight on the potential for stigma to be attached to consumption, or "outrage" attached to the production of at least parts of the rhino horn supply. The most extreme position is adopted by Martin (2011):

/// It is irrelevant whether rhino horn is a desirable medicinal product. The demand for the commodity is real and has persisted for a thousand years in the East. This is as much a cultural issue as it is a medical issue and it is somewhat arrogant for the West to assume it has the imprimatur on the matter. Such 'awareness campaigns' do not work. (p2) ///

Martin ignores the decline in demand for rhino horn in markets such as Japan, Taiwan and Korea (Milliken & Shaw, 2012) p104). His position is strongly contradicted by recent successful campaigns to reduce demand for shark fin in its traditional Chinese market:

/// People said it was impossible to change China, but the evidence we are now getting says consumption of shark fin soup in China is down by 50 to 70 percent in the last two years. (Denyer, 2013)p1 ///

In addition, the (near) disappearance of other East Asian "traditions" and vices such as whale meat, foot binding and opium smoking suggests that Asian preferences are not as concrete as he claims. Despite this, similar sentiments are expressed by Eustace (2012):

/// The Chinese have believed in rhino horn for centuries and although somewhat flimsy western medical research, paid for by a wildlife donor agency, claims that rhino horn is of no medicinal value, the Chinese buy it and pay no attention to western views. It is exotic, expensive, illegal (China banned its trade in 1993) and prestigious. (p3) ///

't Sas- Rolfe (2012) shares Eustace's antipathy toward western medicine:

/// Just because Western reductionist science has not (yet) established a healing effect for rhino horn does not negate the deeply held beliefs and rich ancestral experience of an Eastern culture that adopts a more 'systems-based' approach to medicine. (p14) ///

but also makes a more interesting point that:

/// a general publicity campaign may have an impact on marginal (fringe) consumers, but is unlikely to reach those actually responsible for paying the extraordinary high prices that are driving the poaching problem.(p14) ///

Although contradicted by (Denyer, 2013) in the case of bear bile in China, these authors may be correct in relation to the wider rhino horn market - the current consumers of rhino horn in Asia are acquiring their product illegally and many of them would be aware of this. It is possible that campaigns to inform this currently consuming public about the "horrors" of rhino poaching may have little effect on demand and also on rates of poaching. However, all these authors ignore the potential that stigma effects may be keeping large numbers of consumers out of the market at present, and that with a legal

trade these effects could be reduced, substantially increasing demand on current levels. 't Sas-Rolfe seems oblivious to this possibility:

/// The 'demand reduction' approach assumes that there is 'too much' demand for rhino horn, that this needs to be somehow 'reduced in volume' and that this might save the rhino. However, the challenge for rhino conservation may not be that there are too many potential consumers, but rather the existence of a relatively small number of really persistent ones, oblivious to legality and ethical arguments, and willing to pay increasingly high prices to acquire rhino horn. (p14) ///

We suggest that there is little understanding at this point in time as to how a legalised trade would affect demand through potential reduction of stigma and outrage effects as described by Fischer. This is one of the key questions for policy makers in the rhino conservation debate. While consumption of rhino horn is currently limited largely to Vietnamese cancer patients and nouveau riche, the potential for large and rapid increases in demand is obvious. While horn may remain expensive, the numbers of people that could afford to become consumers in China and Vietnam number in at least the millions, if not higher. The extent to which this demand would be realised would likely depend on the marketing approaches taken by producers, information campaigns by governments and non-government organisations and the extent to which rhino poaching does, or is perceived to, continue.

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#### 4.3. LAUNDERING

The less formal reports are, in general, unconcerned about the potential for poached rhino horn to find its way onto legal markets through laundering. Martin's (2010) position is again the most extreme:

/// Inevitably, there will be Doubting Thomases who will argue that if horns which have been seized from illegal hunters are allowed to be legalised and enter the trade then this will provide the mechanism by which the legal trade will launder substantial amounts of horn derived from ongoing 'rackets'. (p7) //

Aside from dismissing the concerns of the "Doubting Thomases", he offers little explanation as to why laundering of illegal stock should not be a concern. Eustace's claim that "*There would be no room for laundering of illegal horn or corruption.*"(p6) seems to be without any basis other than his belief that "*Having a profitable investment in the industry, these pharmaceutical companies would see that the Chinese government closed down the illegal operators.*" (p6) The continuation of illegal participants in Chinese industries as diverse as coal mining and software development suggest cracking down on illegal horn in China would be difficult enough, let alone in major markets such as Vietnam.

't Sas-Rolfe (2012) places great faith in technology:

/// technological advances such as DNA fingerprinting allow for the mitigation of so-called 'laundering' of illegal stocks, and legal suppliers would have strong incentives to keep illegal supplies out of their market. (p16) //

The practical consideration of who would conduct or pay for the DNA fingerprinting of all rhino horn on markets in Asia is not specified. None of these papers suggest any defensible reason why laundering of illegal horn would not be a serious risk to the legitimacy of the trade.

Adding weight to the difficulties in preventing horn laundering, is the existence of a large trade in fake horn. Ammann (2011)<sup>4</sup> suggests that perhaps 90% of the horn for sale in Vietnam is fake, usually made from buffalo horn. Consumers are evidently not always able to tell real rhino horn from fake, it seems unlikely that they will be able to tell legally sourced real rhino horn from poached rhino horn.

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#### 4.4. ILLEGAL SUPPLY COSTS

The issue of illegal supply costs is not addressed in detail by any of the articles. Eustace (2012) suggests that costs will go up, associated with increased security in Africa and greater law enforcement in Asia:

/// Inevitably there will still be some illegal trade (200 horns a year) but the risks will be much higher because Africa will have more money for law enforcement and China will be harsh with the illegal trade.(p6) //

Eustace does not offer a source for his estimate of illegal trade, or elaborate on what measures potential Chinese market regulators might have at their disposal to stamp out illegal trade. His point may be useful, however; if revenues from the sale of rhino horn are invested back into monitoring and protection of animals, illegal supply costs would rise in the poaching and marketing parts of the market chain.

't Sas-Rolfes (1997) identified that "Legalising trade may reduce the transactions costs of illegal trading" (p28). Fifteen years later he asks the same question:

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<sup>4</sup> [http://www.rhinosourcecenter.com/pdf\\_files/132/1321179326.pdf](http://www.rhinosourcecenter.com/pdf_files/132/1321179326.pdf)

/// Would the illegal suppliers' costs be reduced or raised under a legal trading regime? This would depend on how the legal market was set up, ('t Sas-Rolfes, 2012 p16) //

However, this time, as mentioned above, he suggests DNA scanning and the vigilance of trading partners will push costs for illegal traders up.

Other papers express the possibility that if well managed the rhino population could increase, although none considers that this might also reduce poaching costs.

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#### 4.5. IMPERFECT COMPETITION

The issues raised by Bulte and Damania (2004) are not well addressed in the informal articles. 't Sas-Rolfe is the main author to address this:

/// [We] know that illegal suppliers most likely do not enjoy a competitive cost function. Rhino poaching and illegal trade is an expensive and risky business, currently justified only by extraordinarily high consumer retail prices and the protective monopoly power of criminal cartels. From the mid 1990s until 2007 it was mostly not a viable form of enterprise. Would the illegal suppliers' costs be reduced or raised under a legal trading regime? (p16) //

This touches on the framework proposed by Bulte and Damania. Under their model, poachers face stiff competition - "do not enjoy a competitive cost function" - as almost anyone could become a poacher. Their entry into and exit from poaching would depend largely on the wages being offered elsewhere in the economy against the costs and risks of poaching. 't Sas-Rolfe and the other authors all assume they will face higher costs under legal trade.

But it is the monopoly power of smuggling cartels that Bulte and Damania identified as the important factor in potentially increasing poaching. The monopoly traders, or at least the small number of smugglers who may have market power, should be making strong profits (see also Euastace 2012, p3). It is uncertain whether they would respond to a legalised trade by passively accepting lower volumes, or whether they would cut into their profits per horn to try to sell more.

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#### 4.6. PROFITABILITY

One issue that is largely beyond the scope of this review, but that warrants further investigation, is the issue of whether, and under what conditions, it is profitable to manage rhinos for horn sales. Bulte and Damania are explicit that they do not consider "the private profitability of wildlife farming".

The less formal articles do, to some extent, address this question, particularly (Martin, 2011):

/// The annual horn production from a small population of white rhino managed under a dehorning regime averages about 1kg per rhino per year. Thus every animal in such a population is capable of earning a sustainable annual income of about US\$10,000. A hundred animals would generate US\$ 1 million annually. If these rhino were to survive entirely off natural vegetation, at an average rainfall of 700mm the stocking level would be about 1 rhino/k2 . This translates into a gross land use value of US\$100/ha: under the same rainfall conditions, cattle production would earn slightly more than US\$1/ha. Herein endeth the first lesson: the land use value of 10 rhino managed under dehorning is at least 100 times greater than that of domestic livestock. (p6, bold in original) //

Martin's optimism in this quote seems at odds, however, with his earlier assessment of the chief costs involved in raising rhinos, protecting them:

/// The minimum law enforcement effort needed to provide adequate protection is about one 'stick' to three rhinos, which implies some US\$20,000 per rhino.(p4) ///

While the second quote refers to protecting rhinos in the Kruger national park rather than on a private ranch, it seems clear that there are significant security costs in raising rhinos, other costs not discussed might include feed, veterinary expenses for health and dehorning, handling

and transport. Martin assumes rhino can be raised entirely from "natural vegetation", but the economics of such an operation are unclear - to minimise security costs might suggest restricting the rhinos to a smaller area, possibly then requiring provision of feed and other land use management. In-fact, Martin's analysis acknowledges that this is only a gross land use value, and so by definition it doesn't consider costs. Such considerations are beyond the scope of this paper, but it is far from clear that a legal trade "*would provide a huge incentive for conversion of land to rhino 'farming'*", as Martin suggests. A legal trade would clearly benefit those who currently own significant numbers of rhino or stockpiled horn, but whether a sustainable supply, sufficiently large to reduce poaching, can be profitable is uncertain.

# 5 | CONCLUSION

The formal economic studies emphasise that the liberalisation of trade in wildlife goods such as rhino horn can have ambiguous effects on demand and supply. Five mechanisms that would negatively affect poaching levels are discussed here:

- Legal and illegal markets would coexist and interact in complex ways. Substitution of legal and illegal products between these markets may not be perfect.
- Legal trade could reduce the stigma attached to consumption of the product and the outrage associated with the “horrors” of supplying it.
- Supply costs of the illegal trade could potentially be reduced, through reduced marketing costs or reductions in poaching costs as populations recover, for example.
- Legal markets may facilitate the laundering of illegal supply in with legal supply. The abundance of fake rhino horn reported to be on sale in Vietnam suggests this could be a real risk.
- Uncertainty around the response of illegal suppliers to the legal market suggests that illegal suppliers may either passively reduce their supplies or, more worryingly, they may aggressively respond, reducing profits to compete on price and retain their market share.

The formal papers do not address the recent issues of escalations in rhino poaching. The less formal articles reviewed are more up to date, but have varying degrees of rigour in regard to addressing the above concerns. All are overtly pro-trade, generally assuming that:

- Legal markets will easily “hijack” consumers from illegal markets and that legal and illegal horn would be perfectly substitutable.
- Stigma effects are small and that demand management programs would be ineffective.
- Increased surveillance funded by rhino horn sales would increase poaching costs.
- Technical advances such as DNA technology would minimise laundering.
- Smugglers with market power would respond passively to the advent of a legal trade.

The evidence offered for these views is generally not compelling. Implementing a trading system that could ensure these outcomes were achieved would be very challenging.

In conclusion, economic logic does not suggest that a legal trade in rhino horn would necessarily reduce poaching of rhino in Africa. Under certain conditions this may occur, but there is little empirical evidence cited in these papers to suggest that these conditions are currently in place.

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*Front and back cover: White rhinoceros (Ceratotherium simum).*

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