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Consumer income growth and rhino poaching in South Africa

Abstract

There is growing research in the market analyses of rhino poaching and the concomitant illicit trading; this paper adopts a slightly different approach to market dimension by examining the possible relationship between the income rise in Asian rhino horn customer countries and rhino poaching in South Africa. The paper combines a review approach with data analysis using the multiple regression statistics. Findings from the regression coefficients suggest that the rise in the income of Asian rhino horn purchaser countries has a positive significant relationship with the rise in rhino poaching in South Africa. The findings thus are significant for conservation policy management and research; in addition to local law enforcement, a greater joint international rhino trading pact is desirable between South Africa and the rhino horn Asian consumer countries. Literature findings indicate that regulation alone has not, and cannot, achieve desired rhino conservation; thus the paper suggests, inter alia, the need for a tighter immigration control on hunting permits to rhino horn consumer Asian countries. Additionally, given that rising income in Asia tends to spur a demand for rhino horn, the South African government may pursue a joint moral persuasion strategy on the Asian consumers to reduce the demand for rhino horn. Furthermore, given the relationship found between unemployment and rhino poaching in this analysis, the paper recommends that government needs to consider the creation of a better opportunity cost of poaching by initiating competitive income earning opportunities around the rhino habitat communities – this could be done by encouraging and supporting (with competitive financial incentives) rhino farming by communities and individuals around the rhino habitat in South Africa.

Keywords: rhino, consumer income, poaching, wildlife, conservation, income growth, South Africa.
JEL Classification: M14, M21, Q20, Q21.

Introduction

According to the International Union for Conservation of Nature (IUCN), South Africa is the source of many of the rhino horns that escape from Africa through illicit rhino horn trading (IUCN, 2009). In recent times, there has been a noticeable upsurge in rhino poaching globally, but particularly in South Africa which is home to the greater population of world rhino (Global Issues, 2014). Experts lament that the rising surge in rhino poaching seems to defy trade bans, regulations and enforcements globally and nationally (Challender and MacMillan, 2014; Biggs et al., 2013). For instance, poaching in Kenya overwhelmed all government efforts including well-armed anti-poaching squads and a ban on rhino horn trading, but poaching in Kenya continued to an alarming level that reduced the number of rhinos in Kenya from 20,000 in 1975 to only 500 in 1990 (Warchol et al., 2003). South Africa appears to be on the same unfortunate trajectory as alarming poaching is ubiquitous in South Africa despite huge government commitment in fighting rhino poaching using regulations, anti-poaching squads, and recently, backed by well-equipped military assistance. Yet in South Africa rhinos are frequently killed just to get the horns, leaving the giant animal to suffer to death; accordingly rhinos have become critically endangered (Global Issues, 2014). Official data from the Department of Environmental Affairs South Africa (2014, p. 1) indicate that between 2008 and 2013, a total of 2778 rhinos have been poached and killed in South Africa. In 2013, 1004 rhinos were poached and 343 poachers were arrested; 668 were poached in 2012 and 448 poached in 2011 (Department of Environmental Affairs South Africa, 2014). This thus shows that the rhino population in South Africa is critically endangered and vulnerable to poaching.

It is apparent thus, that as global and national campaigns against illicit killing, poaching and trade on rhino horn continue to gather increasing momentum, more poaching and illegal trade in rhino horn take place (Challender and Macmillan, 2014). Many current researches have looked at various dimension of rhino poaching, but of particular interest are those looking at the causes that sustain rhino poaching and selling: such as corruption, civil strife, poverty, economic and social drivers, unemployment, ignorance of conservation or ecology values or regulations (Milner-Gulland & Leader-Williams, 1992; Dudley et al., 2002; Smith & Walpole, 2005; Mancini et al., 2011; Raichev and Georgiev, 2012; Lopes, 2014; von Essen et al., 2014). The closest research so far to the focus of this current research is that of Challender and Macmillan (2014) which considered both the economic growth and demand implications on rhino poaching. This research does not intend to replicate these earlier ones, but attempts to look further into another angle of economic and/or market causes of rhino poaching – the possible relationship between the rise in the income of the rhino horn consumer Asian countries and rhino poaching in South Africa. This is apposite, as none of the pre-

vious researches had looked closely at this relationship within the South African context. According to the IUCN (2009, p. 1) *"Rhino poaching worldwide is poised to hit a 15-year high driven by Asian demand for horns, according to new research related literature"*; thus attempting to link the Asian market with the poaching in South Africa becomes a timely research as South African rhinos face extinction due to increased poaching.

Consequently the major question that underpins this article is the possible relationship between the income of rhino horn consumer Asian countries and rhino poaching in South Africa. Hence, the central aim is to examine a possible relationship between the income of rhino horn consumer Asian countries and the soaring rhino poaching in South Africa. Since no research within the South African setting has yet looked into this relationship, authors of this article therefore hope to modestly add to the literature on market approaches to understating rhino demand and poaching. The paper offers suggestions to assist with rhino conservation in South Africa, including, inter alia, the need to seek joint persuasive campaign relationships with Asian countries to use moral persuasion to curb the high demand for rhino horns in Asia, and to encourage and support rhino farming in communities near to rhino habitat in South Africa.

The paper is constructed as follows: Section 1 presents a review of related literature. Section 2 examines the income-demand theory for luxury goods. Following this Section 3 is the methodology section which presents an analysis of the relevant data. The final section draws conclusions.

1. Related literature

South Africa is located in the most southern part of the African continent, and it is embellished with an extensive coastline spanning beyond 1,500 miles between the Southern Atlantic Ocean and Indian Ocean; it is also adorned with a luxurious shoreline with a massive geography but yet often dry and sparsely populated (African Wildlife Foundation, 2014). Although poaching of wild life is rife in other countries, the greatest threat to one of South Africa's endangered species, rhino, is poaching. Poaching and killing of wildlife is thus attracting research across the globe to make a contribution to wildlife conservation – mostly the rhino (Manel et al., 2002; Gibson, 1999; Wright, 1992).

Growing research that attempts to suggest policy solutions to curb the extinction of endangered species, amongst which, rhino has currently been in the lime light (Lopes, 2014; Harding, 2013; Alves et al., 2010). The interest and need for more research stems from the fact that regulations and enforcements have not yet proved to be very effective and thus the singular panacea for curbing illicit trade in rhino parts (Conrad, 2012), and the concomitant poaching – mostly in South Africa has not solved the problem. The Republic of South Africa *"is one of the world's biggest mega-diverse countries"* (African Wildlife Foundation, 2014, p. 1) and South Africa is home to the greater population of the world's rhinos (Global Issues, 2014; African Wildlife Foundation, 2014), it has about 80% of the remaining of the world's rhinos (Global Issues, 2014; Fight for rhinos, 2014) and this makes South Africa an attractive destination for rhino poachers – an influx that is thwarting laudable government efforts to abate poaching. Apart from aesthetics and environmental values, South Africa generates part of its foreign revenue from tourism (African Wildlife Foundation, 2014), and as such, the threatening extinction of rhinos would be inimical to such foreign revenue earnings. In addition, the conservation of ecosystems and their species is important for restoring the natural environment that is being wrecked by human activities in the quest to satisfy human's unbounded yearnings for wealth (Global Issues, 2014). Hence, one of the vital supports that academics all over the world may lend to South Africa's poaching crisis is research that points to the causes and remedies to rhino poaching in South Africa.

In a current research, Lopes (2014) finds that civil unrest is positively associated with rhino poaching – indicating that societies with a greater propensity of civil disobedience may be susceptible to poaching of endangered species, whilst cultural reasons have been suggested by Harding (2013) and Alves et al. *(*2010) as a cause of demand and associated poaching of endangered species in Asia; it is perturbing that the use, consumption and/or acquisition and display of carvings from endangered species such as rhino horn or parts is regarded as a luxury and a sign of affluence in Asia (Harding, 2013) – a display of individual wealth (National Geographic, 2012); since economic theory indicates that demand and acquiring of luxury goods increases with an increase in income (Dubois & Duquesne, 1993). This is apposite to examine whether rhino poaching in South Africa can be related to the increase in the income of rhino horn consumer Asian countries; this is important toward rethinking conservation policies in South Africa. Harding (2013) posits that rising economic development in China has created a huge market for the demand and consumption of endangered species – luxury goods in Asia (Harding, 2013); and this demand has not been deterred by rising prices of rhino parts: *"It would appear that escalating prices for rhino trophies in South Africa*

apparently have been of little concern to Vietnamese hunters who were seeking to acquire horns for commercial trade transactions in Asia, suggesting that demand for rhino horn in Viet Nam is price inelastic" (Milliken and Shaw, 2012, p. 56).

Although National Geographic (2012) alludes to the demand for religious uses as one reason for accelerating slaughter of endangered species, but an ivory carving with a display price in the range of "hundreds of thousands of Dollars" (National Geographic, 2012, p. 1) cannot be within the reach of a poor Asian; hence be it religion, culture, nutrition, and/or aesthetics, a rhino ivory carving is seen as luxury goods for the affluent (National Geographic, 2012); this thus suggests economic power – income, as an important factor deserving consideration in the discourses on rhino poaching and conservation. It is no wonder therefore that increased poaching in South Africa seems to be increasing in response to the increase in the income of Asian countries. It is therefore apposite to reflect briefly on the income and demand theory for luxury goods.

Empirical literature

Related empirical literature includes those of Machin and Meghir (2000) on crime and economic incentives; Challender and Macmillan, (2014) on the economic growth and demand implications on rhino poaching. In their research, Challender and Macmillan, (2014) find that demand for rhino horn in Asia is price-inelastic – despite rising prices in African rhino horn. They also posit that rising economic growth in the Asian rhino horn consumer countries pose a major drive to demand for more rhino horns as consumers have more disposal income within their reach. In their study on the economic incentives of crime Machin and Meghir (2000) studied the effect of low wage on the incentive to commit crime; they find that those at the lower level of wage income pyramid are more predisposed to commit crime; this finding resonates closely with the findings of Challender and Macmillan (2014), that the income of rural dwellers close to wildlife habitat are generally low and hence they have innate pressure to poach in order to increase the means of livelihood. Also in their empirical study, MacMillan & Nguyen (2013) studied the wildlife killing habit and incentive of indigenous forest dwelling people of Katu in Vietnam, find that the incentive for illicit killing and trading of wildlife through hunting, trapping and snaring includes financial gains and social status and the fun of engaging in such despicable practice; this thus shows the dire need for a psychology approach to the management of poaching and conservation – a people centred approach as espoused in the research of Algotsson (2006).

In another similar empirical research on the analysis of ivory seizure data, Underwood et al. (2013) discover an alarming increase in global illicit trade in ivory, which they conclude is due to increased demand for ivory in the east and south-east of Asia. Underwood et al. (2013) also conclude that the major stock of raw ivory traded and consumed in the east and south-east of Asia are shipped from Africa and that the shipping route bypass other Asian countries – an indication of the complicity of not only the consuming countries, but also the route countries. Other researchers such as Wittemyer et al. (2011) find that rising ivory prices threaten the survival of endangered species such as the elephants and rhinos, reason being that poachers are highly incentivised and attracted by the rising prices that also leads to more income from the illicit trading in wildlife ivory; this thus corroborates the Challender and Macmillan (2014) findings that poaching crisis is beyond enforcement, it is embroiled in a market economic behavior of prices, income, demand and illegal supply (Underwood et al., 2013; Challender and Macmillan, 2014). A research conducted by Biggs et al. (2013) find that legal trade in rhino horns may reduce the enticement to poach if the demand for rhino horns does not rise beyond normal market levels; this indicates the overriding power of demand on rhino poaching in the source countries such as South Africa; furthermore the research finding of Biggs et al. (2013) may indicate that even with the legalization of rhino trade, there is the possibility that uncontrollable demand may still retain the poaching appetite of poachers. This is perhaps why in their research on the *supply and demand uncertainties of rhino poaching* Collins et al. (2013) find that conservation psychology, if applied, may function positively to reduce rhino poaching, but highlights the seeming neglect of this psychology in conservation contemporary management policies. They lament thus that:

"Psychological principles of persuasion, attitude, and behavior change have been used effectively for many decades, but they have been largely ignored or underutilized within biodiversity conservation" (Collins et al., 2013, p. 1168).

The application of psychology in conservation management is well expounded by Clayton (2012). Clayton (2012) stresses that applications of psychological positivity in sustainability present a renewed optimism for reduction in wildlife poaching and thus conservation. In a related empirical research in a zoology park, Clayton et al. (2013) find that there is little or no application of behavioral psychology in current conservation science, they adduce that this knowledge is not widely prominent to conserva-

tion scientists. Thus in their conclusion of the results of empirical study of a zoology Park, Clayton et al. (2013) suggest:

"To protect natural resources and biological diversity, both behavioral and natural scientists should do more to look beyond their disciplinary boundaries. Psychologists ought to be involved in environmental conservation and sustainability, conservation professionals, in turn, should consider the human dimensions of conservation initiatives" (Clayton et al., 2013, p. 382).

In a related empirical research, Mackenzie and Hartter (2013) find that socioeconomic conditions trigger illegal extraction of natural forest resources from the Uganda parks, they thus conclude that in order to enhance successful conservation, policies should integrate the economic needs of the local communities. In support of this view, Hamilton (2014) concludes that conservation of wildlife and reduction of poaching may be successful if the well-being local communities are considered in conservation policies. Moro et al. (2013) studied the trade-off between illegal hunting and other means of income, they find that illegal hunting compares well with other sources of income, but illegal hunting is not pervasive amongst all wealth groupings, suggesting the need for conservation management to incorporate the hunting group in conservation management policies.

2. Conceptual framework

Perhaps the most fitting theoretical framework to this article is the income and demand theory for luxury goods, thus in this section, the theory of income and demand for luxury goods is brought to the fore using the seminal essay of Dubois & Duquesne (1993). This theory is deemed fitting to contribute to the literature on the market causes of rhino poaching, with emphasis on South Africa. In their income demand theory for luxury goods, Dubois & Duquesne (1993) stress that income is the most suitable indicator to measure demand. Dubois & Duquesne observe that there has recently been a boost in the market for luxury goods (Dubois & Duquesne, 1993) and rhino parts – most prominently, the horn, which has been classified as one of the luxury goods and hence a status symbol in the Vietnam market (Conrad, 2012; see also Harding, 2013). Thus Dubois & Duquesne (1993) hypothese that "the higher the income of an individual, the higher the propensity to purchase luxury goods". It is therefore not surprising the literature assertion that the demand for rhino parts in Asia has been on the rise despite the high price of rhino horn (Milliken and Shaw, 2012). Hence the economic or market approach of understanding the rhino poaching may be necessary toward assisting with policies for rhino conservation and controlling of illicit trading in rhino horns. Status seeking consumers are not deterred by prices of luxury goods (O'cass & Frost, 2002) and this consumer behavior accounts for the reason why the high price of rhino horn does not deter the status seeking consumers of rhino horn, more so in the absence of a close substitute (Conrad, 2012).

Recent income trends as published by the World Bank indicate a rising income in the Asian countries – including those identified for their penchant for rhino horn – Vietnam, Thailand, China, Malaysia (Global Issues, 2014). Drawing from the theory of income and demand, it seems therefore that the rising income in Asia supports the demand for rhino horns despite the high price of rhino horn. Accordingly the TRAFFIC indicates that rhino poaching in South Africa is escalating *"with the surging demand from Asia, people willing to pay high prices to get their hands on rhino horn"*(TRAFFIC, 2012, p. 1).

There is thus an allusion that the Illegal trade and demand for rhino horn in Asia is driving the poaching and killing of rhinos:

"Illegal rhino horn trade to destinations in Asia is driving the killing, with growing evidence of involvement of Vietnamese, Chinese and Thai nationals in the illegal procurement and transport of rhino horn out of Africa" (IUCN, 2009, p. 3).

Thus IUCN believes that illegal Rhino horns from South Africa find their destination or route in Vietnam, Thailand and China "*It is believed that rhinoceros horns illegally leaving Southern Africa are moving into or through Thailand, Vietnam and China*" (IUCN, 2009, p. 3). This is further confirmed by TRAFFIC – a wildlife trade monitoring network that:

"Of 43 documented arrests of Asian nationals for rhino crimes in South Africa, 24 have been Vietnamese (56%) and 13 Chinese (28%), with the remainder from Thailand and Malaysia" (TRAFFIC, 2012, p. 6.).

This thus gives some clue to the high demand for rhino horn in these Asian countries and the apparent implicit financial gain. According to Challender and Macmillan (2014), the retail price of African rhino horn has risen in Asia to about US$65,000 per kg, a high price that supersedes previous years' rhino horn prices in Asia.

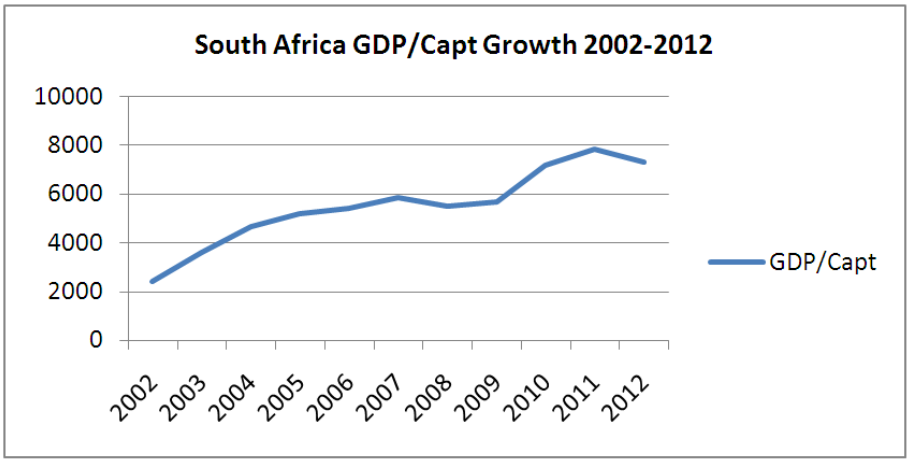
Thus with the willingness to pay high prices and the rising demand that lures poachers, it therefore means that rhino conservation policy makers should follow the route of negotiations with the rhino horn consumer countries to fashion some moral and persuasive strategies to reduce the rate of demand for rhino horn. In corroboration with the income and demand theory for luxury goods, Challender and Macmillan (2014) posit eloquently that the rising economy of

the Asian rhino horn consuming countries is a factor likely to be contributing to the boost in the demand for the rhino horn in these countries. According to Challender and Macmillan (2014), the GDP per capita growth of some Asian consuming countries such as China dwarfs the GDP of some rhino horn suppliers from Africa, a reason that leaves the Asian consumers with affluent financial girth to demand and purchase the rhino ivory despite the rising price.

Drawing therefore from the income and luxury good demand theory, and the literature evidence of rhino horn destinations coupled with the resounding involvement of the consuming country's nationals, this paper proceeds to examine a possible relationship between the rising income in Vietnam, Thailand, China, Malaysia and rhino poaching in South Africa. The analysis is thus presented in the following section.

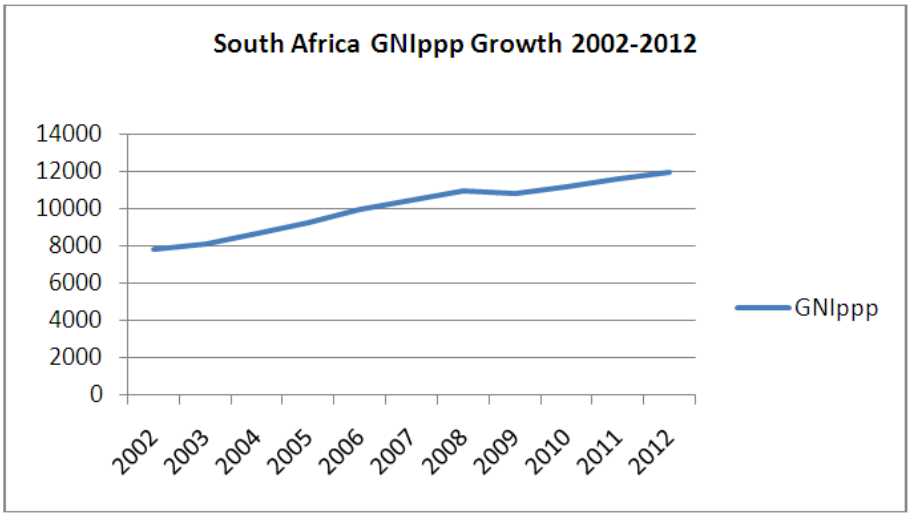
3. Method

In the search for solutions to conservation of wildlife, a few researches on illicit wildlife poaching and trading have recently turned attention to market conditions – most current amongst these researchers are Challender and Macmillan (2014) who alluded to the possibility that low economic growth and income in wildlife source countries is an important factor in illicit trade in wildlife. But South African economic growth and income has not declined within the periods of increasing growth in poaching of rhino in South Africa – 2002-2012; hence in this analysis, low economic growth and income in South Africa is not regarded as a possible causative factor as Figure 1 and Figure 2 depict a rising South African economy with a growing GDP per capita and GNI PPP of South Africa within the period of 2002 to 2012.



Source: Authors' graph with data from World Bank (2014c) GDP per capita (current US$). http://data.worldbank.org/indicator/NY.GDP.PCAP.CD/countries?page=1&display=default.

Fig.1. South Africa GDP per capita (current US$)



Source: Authors' graph with data from World Bank (2014d) GNI per capita, PPP (current international $) http://data.worldbank.org/indicator/NY.GNP.PCAP.PP.CD?page=2.

Fig. 2. South Africa GNI per capita, PPP (current international $).

The analysis thus considered other factors alluded to in the literature as possible causes of rhino poaching: drawing from the work of Challender and Macmillan (2014) the independent variable in this analysis is the income of Asian purchasing countries. Douglas & Alie (2014) suggest that violence may be linked to wildlife crime; and Kühl et al. (2009) also suggest that unemployment may trigger poaching behavior. Accordingly, the control variables in this analysis are: rate of violence in South Africa and unemployment in South Africa.

Therefore the regression model of analysis is represented as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon,$$

where: Y = Rhino Poaching (dependent variable) (shortened as: **PouchinSA**); b_0 = constant (Y intercept) $b_{1\text{-}3}$ = intercept (regression coefficient); x_1 = income of purchasing countries (first predictor) (shortened as: **IncofCon.**).

Control variables: x_2 = unemployment in South Africa (second predictor) (shortened as: **unemploySA**); x_3 = violence in South Africa (third predictor) (shortened as: **ViolenceinSA**); e = error = 0.

The model is thus rewritten as:

^R_PouchinSA = $\beta_0 + \beta_1$*IncofCon_ +

β_2*unemploySA + β_3*ViolenceinSA.

Data is collected from the World Bank Economic Indicators and Governance Indicators respectively. The income of five Asian rhino horn consumer countries, which according to official sources are – Vietnam, China, Hong Kong, Thailand and Malaysia (IUCN, 2009, p. 3; TRAFFIC, 2012, p. 6; Global Issues, 2014) is aggregated together as the major independent variable. The income proxy for the Asian consumer countries is the GNI per capita, PPP (current international $) World Bank (2014a**)** for the five countries. Unemployment in South Africa is also retrieved from the World Bank (2014b) worldwide governance indicators. And violence data for South Africa is retrieved from the World Bank (2013) worldwide governance indicators. Data were sourced as follows:

Table 1. Sources of data

Data & period	Source
Y [2002-2012]	Stop rhino poaching (2014) the many faces of rhino poaching: rhinos poached in South Africa, http://www.timbavati.co.za/timbavati-foundation/newsletters/doc_download/95-the-many-faces-of-rhino-poachingsrpfebruary-2014
x_1 [2002-2012]	World Bank (2014a) GNI per capita, PPP (current international $), http://data.worldbank.org/indicator/NY.GNP.PCAP.PP.CD
x_2 [2002-2012]	World Bank (2014b) South Africa: unemployment, total (% of total labor force) (modeled ILO estimate), http://data.worldbank.org/indicator/SL.UEM.TOTL.ZS?page=2
x3 [2002-2012]	World Bank (2013) worldwide governance indicators, http://info.worldbank.org/governance/wgi/index.aspx#reports

The regression output is as below:

Table 2. Statistical result

Summary output								
Regression statistics								
Multiple *R*	0.956939839							
R^2	0.915733855							
Adjusted R^2	0.879619793							
Standard error	77.56621283							
Observations	11							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	3	457677.2875	152559.1	25.35671	0.000390908			
Residual	7	42115.62161	6016.517					
Total	10	499792.9091						
	Coefficients	Standard error	*t*-stat.	*p*-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-3323.656676	663.4025026	-5.01002	0.001548	-4892.354322	-1754.959	-4892.35432	-1754.96
IncofCon	0.015734016	0.002679282	5.872475	0.000616	0.009398521	0.02206911	0.00939852	0.02207
UnemploySA	97.91841896	29.88623861	3.276371	0.013555	27.24869435	168.588144	27.2486943	168.5881
ViolenceinSA	182.1377369	393.7273621	0.462599	0.657688	-748.8795319	-748.8795319	-748.879532	1113.155

The model estimate from the above output is thus:

$\hat{Y}$ = -3323.656676 + 0.015734016x_1 + 97.91841896x_2 + 182.1377369x_3,

^R_PouchinSA = -3.32e + 03 + 0.0157*IncofCon + 97.9*unemploySA + 182*ViolenceinSA.

Table 3. Normality test

Frequency distribution for uhat5, obs 1-11 number of bins = 5, mean = -2.2348, sd = 78.7685				
Interval	Midpt	Frequency	Rel.	Cum.
< -49.012	-73.331	4	36.36%	36.36% **********
49.012 - -0.37523	-24.694	2	18.18%	54.55% ******
-0.37523 - 48.262	23.943	2	18.18%	72.73% ******
48.262 - 96.899	72.580	2	18.18%	90.91% ******
>= 96.899	121.22	1	9.09%	100.00% ***

Test for null hypothesis of normal distribution:

Chi-square(2) = 1.980 with *p*-value 0.37164

According to Graph Pad (2014) and iSixSigma (2014) a set of data passes the normality test if the *p*-value is greater than 0.05; thus from the above test, the data are not inconsistent with a normal distribution.

Table 4. Heteroskedasticity test

White's test for heteroskedasticity OLS, using observations 2002-2012 (T = 11) Dependent variable: uhat^2				
	Coefficient	Std. error	*t*-ratio	*p*-value
const	-2.66192e+06	1.88195e+06	-1.414	0.3918
IncofCon	-20.4286	4.95962	-4.119	0.1516
unemploySA	294189	168528	1.746	0.3312
ViolenceinSA	3.20506e+06	1.30804e+06	2.450	0.2467
sq_IncofCon_	5.34531e-05	1.66174e-05	3.217	0.1919
X2_X3	0.553879	0.193475	2.863	0.2139
X2_X4	1.06489	2.90598	0.3664	0.7764
sq_unemploySA	-7233.80	3760.22	-1.924	0.3052
X3_X4	-141820	61187.6	-2.318	0.2593
sq_Violencein	-460336	265172	-1.736	0.3327

Table 5. Heteroskedasticity corrected

	Coefficient	Std. error	*t*-ratio	*p*-value
const	-3211.28	785.786	-4.0867	0.00465***
IncofCon_	0.0156944	0.00279375	5.6177	0.00080***
unemploySA	93.6076	35.6912	2.6227	0.03427**
ViolenceinSA	214.3	485.187	0.4417	0.67204
Statistics based on the weighted data:				
Sum squared resid	16.72647	S.E. of regression		1.545799
R-squared	0.922193	Adjusted *R*-squared		0.888847
F(3, 7)	27.65541	*P*-value (F)		0.000296
Log-likelihood	-17.91336	Akaike criterion		43.82672
Schwarz criterion	45.41830	Hannan-Quinn		42.82345
rho	0.419178	Durbin-Watson		1.104525
Statistics based on the original data:				
Mean dependent var	160.0909	S.D. dependent var.		223.5605
Sum squared resid	43486.25	S.E. of regression		78.81828

Based on the above correction of heteroskedasticity the regression model is thus revised as follows:

Revised model:

$\hat{}R\_PouchinSA = -3.21e{+}03 + 0.0157{*}IncofCon\_ + 93.6{*}unemploySA + 214{*}ViolenceinSA$.

Tested at 0.05% significant level; thus at a probability of less than 0.01%, the above multiple regression statistics result indicates a positive significance relationship between income of rhino purchasing countries and rhino poaching in South Africa. This result is consistent with the literature assertions that rise in the economy and/or income of wildlife consumer Asian countries may lead to a greater demand for, and hence, more poaching, see for example Challender and Macmillan (2014). A tentative suggestion

thus may be that the rising income in the five Asian rhino horn consumer countries – Vietnam, China, Hong Kong, Thailand and Malaysia, contributes to the increasing cases of rhino poaching in South Africa. This finding thus adds to existing literature suggesting that regulation alone may not yield the desired result for rhino conservation. Since rising income incites rhino horn consumers to demand more rhino horns (Challender and Macmillan, 2014), the government of South Africa may have to look beyond regulation and seek for a joint effort with Asian countries to lunch a moral persuasion campaign in an effort to reduce the demand for rhino horn in the Asian consumer countries. Furthermore, although lesser in value in this analysis; at a probability of 0.03% (less than 0.05%), the statistical result also shows a significant positive relationship between unemployment in South Africa and rhino poaching, and this is also consistent with literature assertion that unemployment may contribute to poaching of wildlife (Kühl et al., 2009). This again, suggests the need for policy measures – beyond regulation, to stem the tide of unemployment and assist with rhino conservation. Rhino farming can be encouraged with financial and logistical support to communities and individuals in the rhino habitat. If rhino horn farmers are capacitated and given a competitive financial reward that may equate or near the gains of poaching, there is the likelihood that the impetus to poaching may plummet.

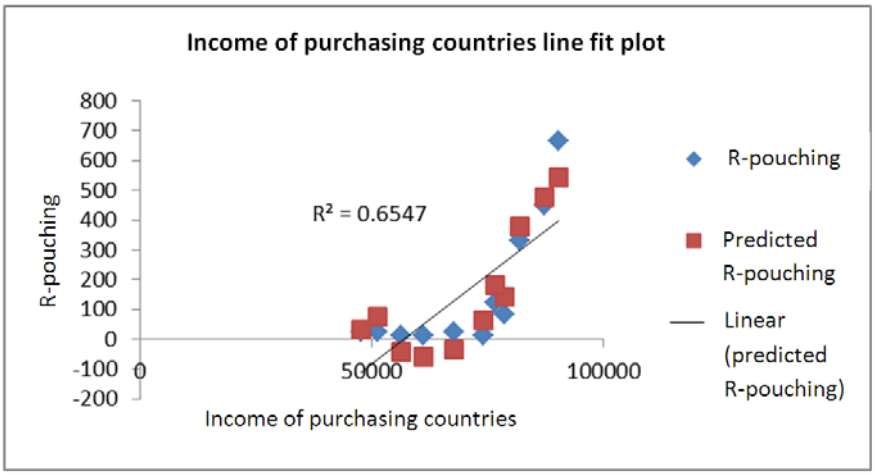
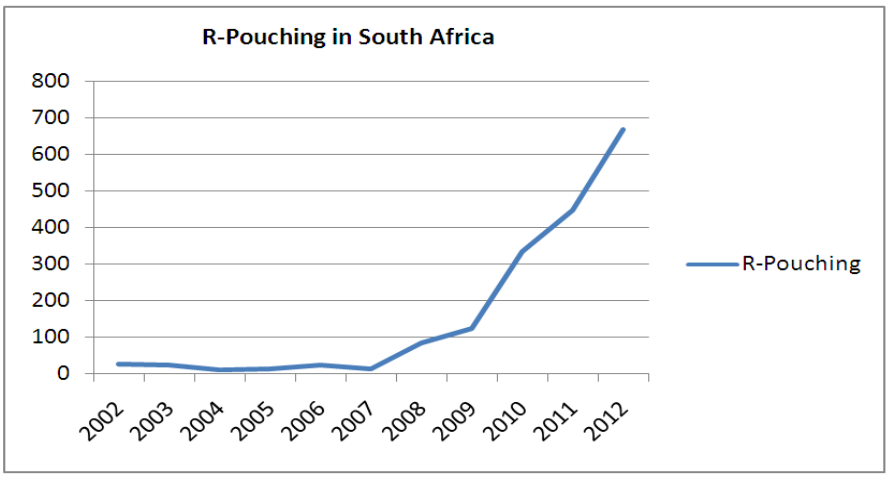


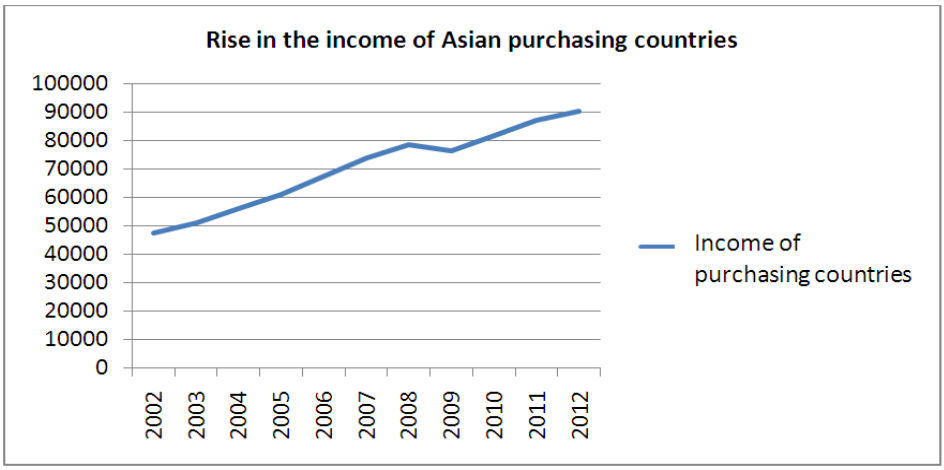
Fig. 3. Line fit plots between income of rhino horn consumer countries and rhino poaching in South Africa

Apart from the above test of significance between the income of rhino product purchasing countries and rhino poaching in South Africa, which shows a significance positive relationship to the value of less than 0.01; the above line fit plot also indicates a positive correlation between the income of rhino purchasing countries and rhino poaching in South Africa. A line graph is also presented below (Figures 4 and 5) to depict the rising rhino poaching in South Africa and the rising income in Asian consumer countries.



Source: Authors' graph with data from: Stop Rhino Poaching (2014) the many faces of rhino poaching: rhinos poached in South Africa. http://www.timbavati.co.za/timbavati-foundation/newsletters/doc_download/95-the-many-faces-of-rhino-poachingsrpfebruary-2014.

Fig. 4. Line graph of rhino poaching in South Africa



Source: Authors' graph with data from: World Bank (2014a) GNI per capita, PPP (current international $), http://data.worldbank.org/indicator/NY.GNP.PCAP.PP.CD (Vietnam, China, Hong Kong, Thailand & Malaysia).

Fig. 5. Line graph of rising income of asian rhino horn purchasing countries

The preceding findings suggest that, aside from other factors, the rise in income of Asian rhino horn consumer countries may somewhat be linked to increasing rhino poaching in South Africa. An important conservation policy implication is the need to create a locally tailored incentive that may decrease the appetite to poach and illicitly export rhino parts from South Africa. The paper suggests the need for the government of South Africa to initiate a process of incentivising communities around the rhino habitat to engage in rhino farming with enabling logistical and financial support from the government. Apart from rhino farming, Harihar et al. (2014) and Challender and Macmillan (2014) suggest that other forms of incentive may include payment to local communities that engage in conservation of rhinos, and payment may be based on species population count during the periods of incentive payments.

Conclusion

This article has made an attempt to adopt a slightly different view of an economic dimension of rhino demand and poaching and examined the likely relationship between the income of rhino horn consuming countries in Asia and the rise in rhino poaching in South Africa. The review of related literature indicates two important information factors about demand and poaching of rhino, namely that the purchase of rhino horn in Asia is a luxury and hence a status symbol, and that the rise in income may lead to an increase in the consumption of luxury goods of which rhino horn is one. Furthermore, the paper combines the review approach with data analysis using the multiple regression statistics. Findings from the multiple regression analysis suggests that the rise in consumer income of rhino horn consuming countries (Vietnam, China, Hong Kong, Thailand and Malaysia) has a positive significant relationship with the rise in rhino poaching in South Africa. The findings thus are important for improving rhino conservation policy management and research; in addition to local law enforcement, a more joint international rhino trading pact is desirable between South Africa and the rhino consuming Asian countries; a stronger agreement for border rhino trade monitoring, national stringent rhino trading regulations and enforcements should be sought by South Africa in the Asian consuming countries to abate rhino trading in these countries and to reduce rhino poaching in South Africa. A more effective immigration policy is also apposite regarding visitors from the consuming countries. Additionally, given that rising income in Asia tends to spur the demand for rhino horn – luxury goods in Asia, a moral persuasion strategy on the Asian consumers is urgently needed as regulation and enforcement does not seem to yield the desired goal. On the other hand, given also the relationship found between poverty and rhino poaching in this analysis, the paper recommends that government needs to consider the creation of a better opportunity cost of poaching by initiating competitive income earning opportunities around the rhino habitat communities. One of such opportunity is to encourage rhino farming by giving strategic, logistical and financial support to rhino farmers and to purchase rhinos from the farmers at an 'arm's length price'; this may make rhino farming to be lucrative and reduce the urge for poaching.

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