United States
Department
of Agriculture

Economic
Research
Service

Economic
Research
Report
Number 81

The Economics of Agricultural and Wildlife Smuggling

Peyton Ferrier

www.ers.usda.gov

Visit Our Website To Learn More!

www.ers.usda.gov/briefing/invasivespecies/

National Agricultural Library Cataloging Record:

National Agricultural Library Cataloging Record:

Ferrier, Peyton
The economics of agricultural and wildlife smuggling.
(Economic research report (United States. Dept. of Agriculture Economic Research Service) ; no. 81)
1. Smuggling—Economic aspects—United States. 2. Wildlife smuggling—Mexico. 3. Farm produce—China.
I. United States. Dept. of Agriculture. Economic Research Service. II. Title.

HJ6690

Photo credits: USDA/APHIS and U.S. Fish & Wildlife Service

United States Department of Agriculture

Economic Research Report Number 81

September 2009

A Report from the Economic Research Service

www.ers.usda.gov

The Economics of Agricultural and Wildlife Smuggling

Peyton Ferrier, pferrier@ers.usda.gov

Abstract

The United States bans imports of certain agricultural and wildlife goods that can carry pathogens or diseases or whose harvest can threaten wildlife stocks or endanger species. Despite these bans, contraband is regularly uncovered in inspections of cargo containers and in domestic markets. This study characterizes the economic factors affecting agricultural and wildlife smuggling by drawing on inspection and interdiction data from USDA and the U.S. Fish and Wildlife Service and existing economic literature. Findings reveal that agricultural and wildlife smuggling primarily include luxury goods, ethnic foods, and specialty goods, such as traditional medicines. Incidents of detected smuggling are disproportionately higher for agricultural goods originating in China and for wildlife goods originating in Mexico. Fragmentary data show that approximately 1 percent of all commercial wildlife shipments to the United States and 0.40 percent of all U.S. wildlife imports by value are refused entry and suspected of being smuggled.

Keywords: Smuggling, illicit trade, SPS, quarantine, endangered species, CITES

Acknowledgments

The author thanks Ron Komsa, Scott Sanner, Willy Harris, and Nolan Lemon of USDA's Animal and Plant Health Inspection Service and Craig Hoover of the U.S. Department of the Interior's Fish and Wildlife Service for assistance in understanding the statistics and regulatory structure described in this report. Thanks also for the helpful comments of Donna Roberts, Craig Osteen, and Barry Krissoff of USDA's Economic Research Service; Lori Lynch of the University of Maryland's Department of Agricultural and Resource Economics; and Holly Ameden of the University of California at Berkeley. Any errors are those of the author.

Contents

Recommended citation format for this publication:

Ferrior, Peyton. *The Economics of Agricultural and Wildlife Smuggling*, ERR-81, U.S. Dept. of Agri., Econ. Res. Serv. September 2009.

List of Acronyms

AMS	Agricultural Marketing Service (USDA)
APHIS	Animal and Plant Health Inspection Service (USDA)
AQAS	Agricultural Quarantine Activities System
AQIM	Agricultural Quarantine Inspection Monitoring
CBP	Customs and Border Protection (DHS)
CITES	Convention for the Trade of Endangered Species
DHS	U.S. Department of Homeland Security
EAN	Emergency Action Notice
ESA	Endangered Species Act
FDA	Food and Drug Administration (U.S. Department of Health and Human Services)
FWS	U.S. Fish and Wildlife Service (U.S. Department of the Interior)
GAO	Government Accountability Office
LEMIS	Law Enforcement Management Information System
OTA	Office of Technology Assessment
PPQ	Plant Protection and Quarantine
SITC	Smuggling Interdiction and Trade Compliance group (of APHIS)
SPS	Sanitary and Phytosanitary
USDA	U.S. Department of Agriculture
WADS	Work Activities Data System
WTO	World Trade Organization

Summary

The United States bans imports of certain agricultural and wildlife goods that may pose unique risks to the environment or the agricultural economy. Despite these bans, contraband is regularly discovered during inspections of cargo containers and found for sale in domestic markets. Very little is known about the size and scope of such smuggling.

What Is the Issue?

Banned agricultural goods can carry diseases, pathogens, foreign organisms, or contaminants that threaten the health of humans, animals, and plants; the environment; and the trade status of U.S. exports. Trade in banned wildlife goods may also endanger the survival of a species. Yet, banned goods still appear in U.S. markets. This study examines agricultural and wildlife smuggling—its specific characteristics, including estimations of its size and scope; its responsiveness to economic incentives; and regulations and efforts to reduce its risks.

What Did the Study Find?

Agricultural and wildlife smuggling primarily involves luxury items and jewelry made from animal parts; ethnic foods, such as szechuan peppers and tropical fruits; and specialty goods, including traditional medicines. These types of items are also likely to command high prices relative to their cost and size. Small amounts of smuggled goods occasionally move over pedestrian and personal vehicle pathways, but commercial volumes of smuggled goods are likely to be transported through international shipping channels.

Among all countries exporting to the United States, incidents of detected smuggling are more prevalent with goods shipped from Mexico (wildlife) and China (agricultural). However, both countries are major trade partners with the United States, and U.S. imports from both have increased dramatically over the last 25 years. Interdictions of meat products are particularly high from China. Inspections data reveal that Mexico has the highest amount of refused shipments of fruits and vegetables, though it is also the leading exporter of these products to the United States. Mexico and Russia have the highest rates of refusal of wildlife goods. Refused goods from Mexico typically include live animals, of which birds are a particular concern due to their potential for spreading diseases and pathogens. Differences in smuggling prevalence rates across countries are attributed to differences in the types of goods affected by trade prohibitions, the visibility of smuggled goods, and the targeting of enforcement resources.

Based on fragmentary inspections data, wildlife smuggling accounts for approximately 1 percent of commercial wildlife shipments to the United States and 0.4 percent of the total value of U.S. wildlife imports. Fragmentary interdiction data show that agricultural smuggling is small, accounting for 0.03 percent of total agricultural imports from China, the country with the highest reported proportions and volumes of smuggled

imports. Still, these figures, along with most widely reported estimates, are inexact due to the potential for bias in the data.

Smuggling is motivated by profits. Criminal penalties and fines represent a cost of smuggling, while the difference between the price of a smuggled good at its origin and at its (prohibited) destination represents its return. Governments may reduce the incentive to smuggle both by increasing the cost through higher penalties and tighter enforcement and by reducing its return. To reduce price disparities that encourage smuggling, governments may compensate producers affected by trade bans and eradication programs, ensure that close-substitute goods can gain legal trade access, and reduce the size of markets impacted by a trade ban through regionalization. A small but growing literature finds empirical support that smuggling responds to incentives related to enforcement, detection, and profitability.

How Was the Study Conducted?

The analysis is supported by data on random and targeted inspections of agricultural cargo from USDA's Animal and Plant Health Inspection Service, interdiction data from the U.S. Fish and Wildlife Service, and trade data from the U.S. Census Bureau.

Introduction

Between 1998 and 2007, the real values of U.S. agricultural and wildlife imports increased 70 percent (Census Bureau) and 108 percent (FWS, 2008), respectively. Agricultural and wildlife imports, however, can introduce invasive species or disease-carrying pathogens and thus pose unique risks to the domestic environment and the agricultural economy. Furthermore, trade in certain wildlife goods places pressure on natural stocks abroad and can endanger the survival of animal and plant species, including elephants, exotic birds, and whales.

To mitigate these risks, regulators rely on trade restrictions allowed under the World Trade Organization's (WTO) Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) and the Convention for the Trade of Endangered Species (CITES). In many cases, specific commodities are restricted based on country of origin, destination within an importing country, and time of year (for seasonal pests). Enforcement of these restrictions is multifaceted. Infrastructure and logistical constraints make the complete physical inspection of all imported shipments impractical. Instead, inspection occurs at different rates (the percentage of shipments actually inspected) and intensities (the proportion of goods in a shipment actually physically observed). Even the most thorough enforcement process may fail to prevent all restricted goods from entering commercial trade.

Smuggling, defined as the illegal import of contraband goods, is an ancient activity. However, only with the emergence of modern pathology and the progressive, environmental, and conservation movements since the late 19th century have trade restrictions been widely adopted for goods harming public health, agricultural productivity, and the environment. These trade restrictions and regulations may disproportionately harm some consumers by constraining consumption choices or artificially benefit some domestic producers if used to mask protectionist measures. International treaties and agreements constrain the extent to which the United States may ban agricultural imports without repercussion from trade partners. They also require that the United States ban certain wildlife goods. Smuggling circumvents those bans and, despite significant resources devoted to enforcement, banned and contaminated goods still appear in U.S. markets. Integrated global markets, lower transportation costs, and rising incomes have not only increased the levels of both total trade and imports but also allowed for the more rapid movement of exotic pathogens and plant pests across borders and ecosystems and increased the size of potential markets for limited wildlife resources.

The costs of agricultural and wildlife smuggling are difficult to quantify in specific terms. Interpol estimates that the value of the illegal global wildlife trade alone ranges between $7 billion and $20 billion annually and cites it as the second largest form of illegal trade (Interpol, 2006; 2008).[1]

No comparable estimate of the size of agricultural smuggling is available, but its consequences are acknowledged to be significant due to the large potential risk posed by very small amounts of biological material that may enter a country with the smuggled goods. For example, an outbreak of Exotic Newcastle Disease among poultry in California in 2003 is thought to have

[1]Exact sourcing of Interpol's reported estimates on this figure is unclear. Malik et al. (1997), for example, state that the total value of all trade in wildlife, not just illegal products, is $8 billion to $20 billion.

spread from smuggled game birds from Mexico. As a result, California poultry farmers incurred eradication costs of approximately $168 million. A 2005 shipment of 450 citrus cuttings carrying citrus canker was intercepted by U.S. Customs and Border Protection (CBP); if the disease had become established in the United States, potential costs to the U.S. citrus industry have been estimated at between $173 million and $890 million. For invasive species, the Office of Technology Assessment estimates the annual costs at $4.9 billion (OTA, 1993). During the 1990s, spending on emergency eradication programs for invasive species in the United States increased from $10.4 million to $232 million (Lynch and Lichtenberg, 2006). Moreover, the risks of wildlife and agricultural smuggling are interrelated as wild plants and animals are more likely to carry agriculturally significant pathogens than farm-raised animals or to become invasive themselves.[2]

Based on an analysis of data on shipment inspection and interdiction, this study examines the smuggling of agricultural and wildlife goods into the United States—including its specific characteristics and its responsiveness to economic factors.

[2]Karesh et al. (2005) show that contact with animals in illegal markets substantially encourages transmission of wildlife-to-livestock, wildlife-to-human, and wildlife-to-wildlife diseases, such as severe acute respiratory syndrome (SARS), avian influenza, (avian) paramyxovirus, monkeypox (in rodents), and chytriodiomycosis (in wild amphibians). Reed (2005) notes that illegally wild-caught boa constrictors are more likely to carry zoonotic diseases, such as *Salmonella* on hitchhiking ticks, and that wild species are also likely to be more invasive if accidentally released in the wild, as has happened with boa constrictors in the Florida Everglades. Endangered live plants (such as orchids, cacti, and cycads) are periodically wild-harvested and transported in native soils, which might themselves contain a variety of invasive species.

The Economics of Agricultural and Wildlife Smuggling

According to Naim (2005, p. 239), illicit trade is driven by high profits and not low morals. At its core, smuggling is a market phenomenon, and trade bans, by their very nature, encourage smuggling. Taxes, tariffs, and trade restrictions create gaps between the price that sellers receive and the price that buyers pay, the difference of which is the return to smuggling. Illicit trade is self-reinforcing because reductions in smuggling increase its profitability. The lost trade from this market disequilibrium represents that maximum amount of goods that might be smuggled in the absence of enforcement or legal penalty (Ferrier, 2008).

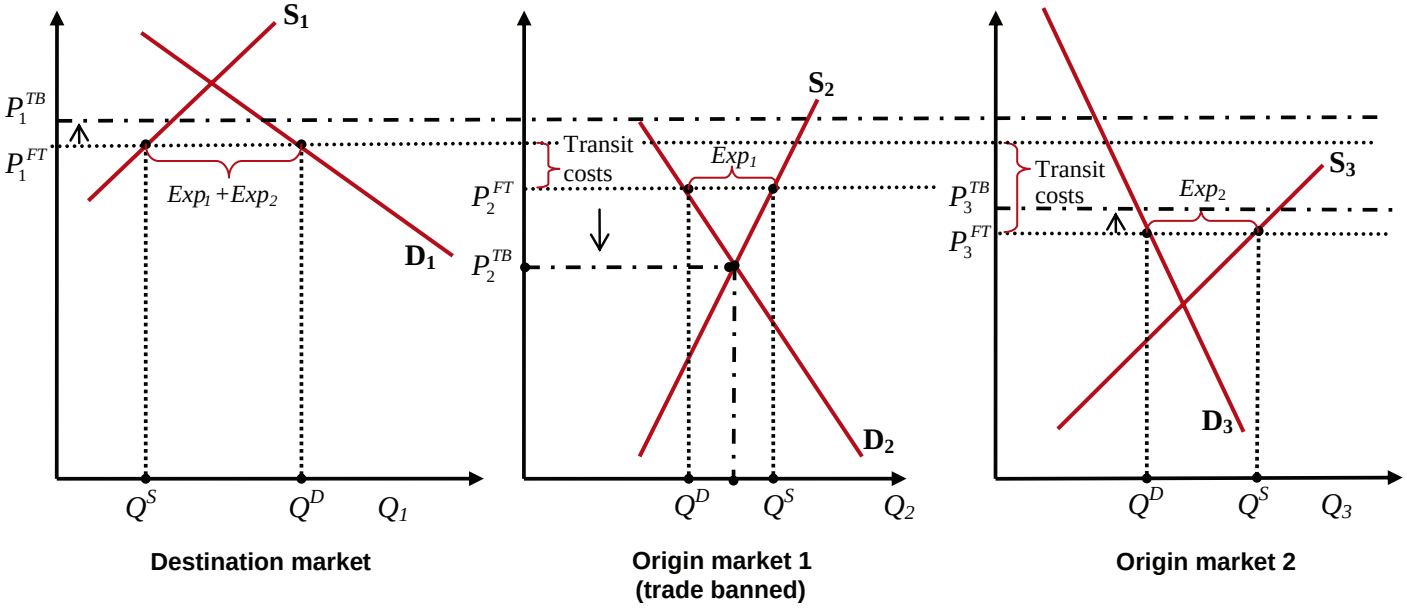
A Model of Smuggling

The market incentive for smuggling is the disparity between the price of a good at its origin and destination. Price disparities have been shown to encourage smuggling in the work of Fisman and Wei (2004) for tariff evasion generally; Thursby et al. (1991), Saba et al. (1995), and Goel (2004) for cigarettes; and Golub and Mbaye (2007) for sugar, wheat, and rice. A weak rule of law can lower the probability of penalty or apprehension and encourage smuggling as shown by Ivanova (2007) for ozone-depleting substances and Fisman and Wei (2004) for artwork. Von Hippel and Von Hippel (2002) show that the presence of substitutes, which may reduce demand and make it more elastic, also reduces smuggling in the case of wildlife goods. Yang (2008) shows that methods of smuggling to evade tariffs in the Philippines adjust when changes are made to inspection-targeting regimes.

In Ferrier's (2008) model of the illicit agricultural and wildlife trades, demand for smuggled goods is developed from trade theory while the supply of smuggled goods is developed from the economic model of crime first posed by Becker (1968). Several importers and exporters engage in competitive free trade (with several countries of *origin* exporting to one *destination*) and the price of traded goods differs only by transit costs. A trade ban for a single country of origin restricts that country's exports so that its markets would transact under autarky if no smuggling occurred. Figure 1 depicts a market where two origin markets export to a single destination. Under free trade, prices net of transit costs across the three markets are equal and the sum of exports from origins one and two is equal to total imports to the destination. When a trade ban blocks imports from origin one to the destination market, prices rise in both the destination and the (unrestricted) origin two from P_1^{FT} and P_3^{FT} to P_1^{TB} and P_3^{TB}, simultaneously raising origin two's exports and lowering the destination's total imports, until an equilibrium is reached where these two values are equal. Simultaneously, prices fall in origin one from P_2^{FT} to P_2^{TB}, where no exports occur. With the ban in place, a wedge emerges between the price at which a good is sold in origin one and the price at which a good is purchased in the destination market (net of transit costs). This price wedge represents the return to successful smuggling. The magnitude of the price wedge will influence its prevalence, and its size depends critically on several observable market factors, including market size, the magnitude of trade flow, the number of trade partners, and,

Figure 1

The free trade and trade ban equilibrium



Source: USDA, Economic Research Service.

most importantly, the relative elasticities of supply and demand. Generally, more inelastic supply and demand in the restricted origin leads to a larger price decrease, while more inelastic supply and demand in the remaining free trade areas leads to larger price increases. The price effects are not symmetric, however. A small number of trade partners in the free-trade area with elastic supply and demand can sufficiently adjust production to replace the lost supply of imports and mitigate price swings. In the restricted origin, the lack of alternative outlets for excess supply results in large extended price decreases. Goods likely to have inelastic demand include ethnic foods (certain spices, ethnic specialty goods), luxury food items (caviar), and medicinal items. As discussed later, the data show that these goods are all intercepted regularly.

The supply of smuggled goods depends on the willingness of risk-averse agents faced with an uncertain payoff to supply criminal trading services. Given the level of fines and the probability of apprehension, some level of fine makes traders indifferent in choosing to earn the lower price at the restricted origin or the higher price at the destination with the probability of incurring a fine and forfeiture of goods. In general, as the price wedge between the restricted origin and the destination increases, traders will smuggle goods in larger quantities. As more goods are smuggled, the price disparity falls. An equilibrium occurs when the increased amount of smuggling lowers the price disparity to make traders indifferent to smuggling additional goods abroad or selling in the legal, but lower priced, domestic market. Compensation to producers affected by trade bans and eradication programs, encouragement of the development of acceptable close substitute goods, and reductions in the size of markets impacted by trade bans through regionalization can reduce the price disparity that encourages smuggling.

Economic Literature on Smuggling

More generally, economists have typically considered several interrelated questions with regard to smuggling. First, what are the costs of smuggling and is smuggling ever beneficial to society? Given the historical orientation of countries toward protectionist trade restrictions, economists (Bhagwati and Hensen, 1973; Kemp, 1976; Norton, 1988; and Martin and Panagariya, 1984) have typically approached smuggling without consideration for externalities, —situations in which a market transaction imparts a cost or benefit to another individual in a way not reflected in market prices. On this score, smuggling is typically found to improve aggregate societal welfare as it moves the market closer to its efficient equilibrium occurring under free trade.

However, when restricted goods impart risks to security, public health, or the environment, smuggled goods create externalities. For example, smuggled goods can potentially introduce foreign plant diseases or pests that reduce agricultural productivity or require expensive eradication measures. These costs may be difficult to quantify, depending on the risk of the contraband goods entering the country, the amount entering, and the uncertain costs that will result if a pest becomes established. For wildlife goods, smuggling can endanger the survival of a species, entailing a loss of biodiversity and aesthetic beauty that is not easily quantified.[3] Because agricultural and wildlife smuggling involves external costs, it differs substantially from ordinary tariff-avoiding smuggling, in which the harm is measured as the lost revenue from the proportion of goods smuggled. The harm of agricultural and wildlife smuggling, alternatively, may increase exponentially with the proportion of goods smuggled if foreign pests are more likely to become established with larger exposure or if threatened species are more likely to become extinct as a result of increased poaching. Moreover, an increased volume of imports would require a falling proportion of goods smuggled simply to maintain the status quo level of exposure to smuggling's associated risks. Concern and regulation surrounding agricultural and wildlife smuggling may arise from human health effects, where the presence of smuggled goods lowers demand for legal goods (if, for example, smuggled goods present a health risk),[4] and stigma effects, where the underlying demand for an illegally traded good may fall due to social pressure.[5]

Other questions considered by economists include the following: how much smuggling occurs and how much does smuggling respond to market forces? Undoubtedly, trade restrictions foster smuggling. Little is known about the illicit agricultural and wildlife trade specifically, relative to other types of illicit trade. Significant differences in the patterns of illegal trade may emerge for two reasons. First, most agricultural and some wildlife goods are likely to be sold in ordinary commercial outlets operating otherwise legally rather than in concealed clandestine outlets (illegal markets).[6] Second, most agricultural and some wildlife goods have both legal and illegal sources. Identifying the relative proportion of legal and illegal trade is challenging due to the possible endogenous nature of enforcement. If contraband is sold in small quantities in legal markets, personnel in interdiction and inspection may be unaware of its occurrence. Alternatively, if contraband is sold openly and is commonly available, inspection and enforcement efforts may be limited in their effectiveness because complete enforcement is difficult.

[3]CITES and most sources on the illegal trade assume that smuggling is harmful *prima facie.* Hutton (2000), Martin (2000), Kremer and Morcom (2000), and Malik et al. (1997) argue that freer, sanctioned trade will create better incentives for developing countries to preserve sustainable harvests of wildlife in specific cases. This argument does not support illegal trade but argues for reduction in trade prohibitions.

[4]Health effects are likely to occur with meats, such as beef from countries with bovine spongiform encephalopathy (BSE) and poultry from countries with avian influenza. For plant products, most pests are not a threat to human health. Contamination and adulteration risk, primarily under the domain of the U.S. Food and Drug Administration, is still likely here, but these goods are more likely to be sold fraudulently rather than be smuggled (in an informed two-party transaction).

[5]Fischer (2004; 2003), Von Kooten (2006), and Heltberg (2001) all address stigma effects in their discussion of the illegal wildlife trade.

[6]Henry (2004) finds that approximately 50 percent of selected stores surveyed offered traditional Chinese medicines, products for medical use labeled as containing animal parts controlled under CITES or the Endangered Species Act.

Regulation

With regard to the risks posed by imports of agricultural and wildlife goods, the government performs three basic functions—*regulation*, to establish the conditions for legitimate imports, including treatments and product requirements; *inspection*, to ensure that those imports satisfy regulations; and *interdiction*, to recover illegally imported material and enforce subsequent penalties. Over time, separate Federal Government agencies emerged to address the regulation, inspection, and interdiction of U.S. imports for different types of risk (see box, "The Evolving Regulatory Structure"). After 2003, agricultural inspection operations (for invasive species) were moved to the newly formed U.S. Department of Homeland Security, while regulatory and interdiction authority of agricultural goods remained with USDA's Animal and Plant Health Inspection Service (APHIS). All three functions—regulation, inspection, and interdiction—of wildlife goods remained with the U.S. Fish and Wildlife Service (FWS).

Domestically, the Plant Protection Act of 2000 and the Animal Health Protection Act of 2002 delegate to APHIS the authority to promulgate SPS-based trade restrictions. The laws also designate APHIS as the scientific authority in cases where the restrictions are challenged by U.S. trade partners. For example, disputes may arise over the degree to which an invasive species is already established in a country. If a country already has an established pest that is actively controlled, the importing country may not ban trade based on that pest threat. Similarly, APHIS provides evidence to trade partners to defend U.S. exporters against unfounded claims that U.S. goods may carry a disease or pathogen. Internationally, the 1995 Agreement on the Application of Sanitary and Phytosanitary Measures governs disputes over claims that SPS restrictions violate free trade commitments under the General Agreement of Trade and Tariffs.[7] This agreement requires that trade restrictions designed to mitigate SPS risks follow two broad principles—that they not be used to disguise protectionism, and that the restrictions not be arbitrary or discriminatory. Evidence of harm and scientific risk assessment must be provided by an importing country to justify a restriction if challenged. If fumigation or cold treatment by an exporting country mitigates a pest risk or if certain exporting regions within a country can be determined to be pest free, then programs are to be put in place that address the remaining risk without halting all trade.

The harm from the importation of banned wildlife goods (that is, species loss or endangerment) is more diffuse, but certainly falls more squarely on the exporting country as species loss can result in less revenue from ongoing trade and tourism and the loss of a country's ecological distinctiveness. International treaties, therefore, are oriented toward enforcing restrictions on imports determined collectively by member countries. The primary U.S. law regulating wildlife imports is the Endangered Species Act (ESA), which is also the enabling legislation for U.S. participation in CITES.[8] CITES, however, also explicitly allows member states the discretion to enact "stricter domestic measures." As a result, imports of certain species restricted by ESA are not restricted by CITES.[9] Countries enacting discretionary restrictions of wildlife goods have occasionally been accused of being protectionist (Hutton, 2000).

[7]Members of the North American Free Trade Agreement (NAFTA) can appeal cases to NAFTA's independent dispute resolution mechanism before going to the World Trade Organization.

[8]The Lacey Act prohibiting "the import, export, transportation, sale, receipt, acquisition, or purchase of fish, wildlife, or plants taken, possessed, transported, or sold in violation of any Federal, State, tribal, or foreign law" is also typically invoked when illegal trade is actually uncovered.

[9]The General Agreement on Tariffs and Trade contains similar language allowing member countries to enact trade restrictions necessary for "conservation of exhaustible natural resources" while also requiring that they be nondiscriminatory. See Howse (2002) for a discussion of whether restrictions may be applied to production methods.

The Evolving Regulatory Structure

Prior to 2003, USDA's Animal and Plant Health Inspection Service (APHIS) performed regulatory, inspection, and interdiction functions for U.S. agricultural imports. After 2003, the agency's inspection responsibilities were consolidated into the newly formed U.S. Department of Homeland Security (DHS). APHIS retained its regulatory responsibilities for assessing pest risk, setting import protocols, and prohibiting certain goods from entering the country.

Following the 2001 terrorist attacks in the United States, information sharing across inspections functions was seen as essential for a comprehensive approach to addressing immediate risk. Customs and Border Protection, under DHS, would inspect imports posing immediate threats, while other existing agencies would inspect goods posing other, but not necessarily immediate, risks. For this reason, the Fish and Wildlife Service of the U.S. Department of the Interior retained both its regulatory and inspection responsibilities for most wildlife, except for some live plants and fish. Similarly, the Food and Drug Administration of the U.S. Department of Health and Human Services both regulates and inspects agricultural products for pathogens and adulterants by testing and approving pharmaceutical drugs, pesticides, and food production methods for their safety and effectiveness and by sampling cargo containers for proscribed material and contaminants. However, the Customs Service (previously under the U.S. Department of Treasury), which inspects imports for tariff assessment, property rights violations, illegal weapons and narcotics, and other restricted trade, was also moved to Customs and Border Protection under DHS.

CITES has three appendices that proscribe wildlife trade to different extents. Species listed in CITES appendix I are banned from trade entirely. Countries can transfer these species across borders only if the destination is a verified scientific institution or if the species was raised in captivity. Species listed in CITES appendix II can be traded only if the exporting country issues a certificate of origin and obtains a permit certifying that the product's harvest was not detrimental to the country's wild stock. Species listed in CITES appendix III can be traded only if all participating CITES members issue a certificate of origin to document that their exports are not from the country where the wildlife is threatened. The listing country must issue a permit certifying nondetrimental harvest. An exporting country may unilaterally add a species to CITES appendix III. Among all countries, CITES requirements are typically more important but also more burdensome for poor countries that have larger undeveloped regions and greater stocks of highly valuable but endangered wildlife. Relative to developed countries, these poorer countries have more limited infrastructure to enforce harvest regulation, higher returns to illicit exports, and fewer alternative industries for employment.

Methods of Smuggling

Small amounts of smuggled goods occasionally move over pedestrian and personal vehicle pathways, but commercial volumes of smuggled goods are likely to be transported through international shipping channels. To this end, cargo manifests can be falsified so that the product or country of origin is misrepresented or goods can be trans-shipped through countries that do not prohibit imports of the goods (APHIS, 2006). For example, Mexico allows grape imports from Chile as long as the grapes are free of fruit flies, but the United States requires imports of the same Chilean grapes to be fumigated with methyl bromide. However, U.S. imports of Mexican grapes can enter without treatment (Meissner et al., 2003, pg. 122). Trans-shipping of grapes would involve moving Chilean grapes through Mexico into the United States to misrepresent them as being of Mexican origin and avoid additional fumigation expenses. Similarly, nursery stock from China must remain in Canada for a year before it can be exported to the United States as a Canadian product. Trans-shipping would involve moving the foreign nursery stock into the United States via another country as a way to sidestep the waiting period. Hansen (2000, pp. 175-80) documents how collectors and researchers of rare orchids use trans-shipping to bypass CITES-based import restrictions.

More commonly, though, importers smuggle goods by incorrectly identifying contraband on cargo manifests. Prohibited agricultural goods may be relabeled as permitted goods, or endangered wildlife goods may be labeled as a nonthreatened species. For example, in 2004, APHIS found a prohibited shipment of frozen chicken feet from China that was labeled as frozen fish. CITES appendix I lists the entire orchid family and the parrot family, with the exception of three varieties, to help prevent the endangered family members from being "mismanifested" as similar looking but nonthreatened species (Roe et al., 2002, p. 27; Hansen 2000). Mismanifesting exploits the difficulties of physically inspecting cargo containers that are large and require space to unpack, especially if the cargo is refrigerated and labeled in a foreign language.

Whether goods are smuggled into the United States for commercial or personal purposes is directly relevant to the enforcement of trade regulations. Travelers smuggling goods for personal purposes may not readily recognize the extent of the trade prohibitions or the potential fines. Commercial importers, on the other hand, must submit manifests detailing the contents of shipping containers, interact more regularly with trade channels, and generally have obvious incentives to become knowledgeable with regulations. Criminal violations under the Endangered Species Act, the Plant Protection Act, and the Animal Health Protection Act may be punishable by fines ranging from $1,000 to $50,000 per occurrence, a year in prison, and the loss of the cargo.

Estimating the Size of Smuggling With Inspections Data

Smugglers seek to avoid discovery, which severely complicates any estimation of the size of smuggling and its responsiveness to regulatory policy. In theory, smuggling is revealed by inspection if three conditions are met. First, all cargo must enter the country through known, legal channels; second, all cargo must be inspected; and third, inspections must reveal perfectly whether imports are illegal. Because smuggled agricultural goods earn only modest markups and are difficult to transport, only a small portion are likely to arrive in noncargo conveyances that circumvent inspection points. This may not be the case for some wildlife goods (e.g., exotic parrots), which earn large returns. Agricultural smuggling is likely to go undetected owing to weaknesses in inspections involving the second and third conditions. Regulatory agencies can inspect all cargo entering the United States comprehensively, but it is prohibitively costly to do so. Comprehensive inspection may require several hours to unpack cargo containers (which may be refrigerated) and overwhelm the capacity of inspectors to process cargo (CBP, 2007b). Thus, some unregulated cargo is not inspected.[10] Moreover, even inspected cargo may contain unrevealed smuggled goods. The intent to smuggle goods may be unclear when goods are imported as when the documentation of a wildlife good's origin or an agricultural good's phytosanitary certificate is missing. More significantly, inspections occur with different levels of intensity. Less rigorous inspections may not always detect smuggling, especially when oriented toward detecting pest infestations rather than smuggling, and may involve only sampling or a visual inspection.

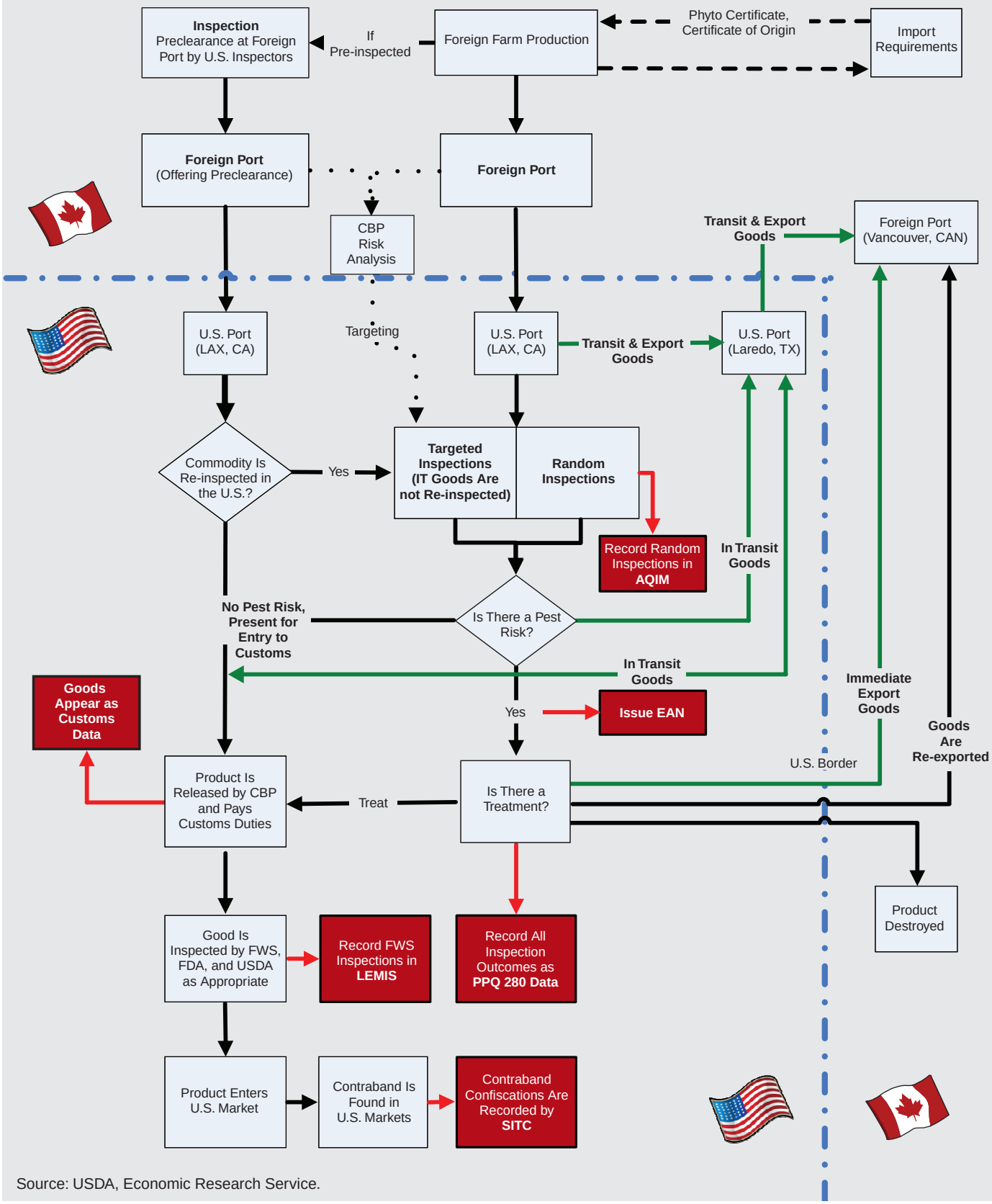
Despite these shortcomings in the inspection process and the potential for biases, this study's estimation of the size of smuggling is based in large part on data gathered in the inspection process depicted in figure 2 (see box, "Alternative Methods for Estimating the Size of Smuggling"). As shown in the figure, producers ship goods to a foreign port of disembarkation. Entry of these goods into the United States may require certification of a particular production process. For example, meats shipped from countries that have experienced outbreaks of BSE require a certificate of origin and a health or inspection certificate; wildlife sales may require similar certificates of origin and nondetrimental harvest. On average, international agricultural shipments require 46 separate documents (AMS, 2004, p. 16).

For U.S. imports, regulated cargo must be inspected for pest risk in the United States or abroad before being released. Goods found with pests are treated, destroyed, or re-exported to another country. When inspectors find a prohibited good or a good containing a pest, they issue an Emergency Action Notice (EAN) to legally document the pest and mitigating actions as well as inform other ports of the potential risk. Goods released for sale in the United States are then entered into customs data, and importers pay applicable duties. Having cleared CBP, the first line of U.S. inspections, the goods may undergo further inspection by FWS (in the case of wildlife goods), the U.S. Food and Drug Administration, or other regulatory agencies.

[10]Generally, regulated agricultural cargo must be inspected for pest risk to enter the United States, whereas unregulated cargo and cargo entering under the National Agricultural Release Program does not. Obviously, cargo that would be prohibited can be mismanifested as unregulated cargo.

Figure 2

Import Inspections Data Collection



Source: USDA, Economic Research Service.

Alternative Methods for Estimating the Size of Smuggling

Alternative methods for estimating the size of smuggling or its responsiveness to economic factors include those leveraging traceback data, those examining trade flow (or consumption) disparities, and those isolating the effect of anti-smuggling measures on stock prices. Traceback data are essentially an extremely rigorous inspection tool that helps determine the true origin or protected status of a good. For example, elephant tusks can be traced back to where they were harvested to determine whether they were poached. Random samples of ivory for sale can be traced to help estimate the percentage of ivory that is illegally harvested. This method has primarily been used with endangered species, including whales (Dalebout et al., 2002), seals (Malik et al., 1997), elephants (Wasser et al., 2004), and agricultural goods, such as peanuts, coffee, and garlic (Ryan, 1998).

Trade flows are often documented by both the country importing a good and the country exporting a good. Trade flow disparities arise when imports and exports do not match. Ordinarily, random discrepancies may result from innocuous data collection errors, but systematic disparity may suggest that one country may be concealing the actual volume of trade. Using data on trade flow disparities, Fisman and Wei (2004) found evidence that smuggling is used to evade tariffs on goods entering China from Hong Kong and that smuggling is larger for higher value goods and for goods in categories with similar-looking substitutes with lower tariffs that might be mismanifested. Similar methods of detecting smuggling have been employed by Golub and Mbaye (2007) for sugar, wheat, and rice; and by Thursby et al. (1991), Saba et al. (1995), and Goel (2004) for cigarettes. In each application, substantial amounts of goods are smuggled from specific geographic areas and traded between a relatively limited number of partners.

Law-abiding companies will see their stock prices fall when embargoes are placed on their goods or when anti-smuggling measures are strengthened. Alternatively, under these conditions, companies that smuggle will see their stock prices rise as the restrictions widen or extend the time period of the price wedge. DellaVigna and LaFerrara (2007) show mixed findings on the sensitivity of stock prices of weapons-producing companies that differ in their likeliness to smuggle in the face of U.N. embargoes on weapons sales to areas of civil conflict.

In addition to undergoing targeted inspections, goods are inspected randomly under the Agricultural Quarantine Inspection Monitoring Program (AQIM). Inspections data, covering both random and targeted inspections, represent the most comprehensive source of information on illegally imported goods. Other sources of data include the Pest ID data system, which records how pests found in shipments were identified, and the EAN database, which documents the alerts issued for the detection of prohibited goods or goods with pests. In all, four separate databases—PPQ 280 (USDA's record of agricultural cargo inspections outcomes), AQIM, Pest ID, and EAN—along with the Work Activities Data System (WADS) make up the Agricultural Quarantine Activities System (AQAS). This system is the primary tool for analysis of the risk posed by agricultural imports. USDA and CBP collect and share the data in real time.

Analysis of Agricultural and Wildlife Smuggling

Most analyses of illegal trade suffer from incomplete data, and, therefore, estimates of the size of illegal agricultural trade are subject to a great deal of error. For example, a TRAFFIC[11] source in Roe et al. (2002, pp. 10-12) writes:

> Any effort to describe the international wildlife trade must unfortunately begin with the recognition that this cannot be done with any accuracy.

and

> The true size of the illegal (wildlife) trade is anyone's guess.

Similarly, FWS (2005, p. 2) writes that:

> . . . though enforcement personnel know a great deal about what illegal trade activities occur locally, there is less understanding of illegal trade activity nationally, or what might be occurring at other ports that could influence how interdiction efforts could be improved locally.

USDA has no official estimate of the total scope of agricultural smuggling. Severe methodological challenges complicate the estimation of illegal agricultural and wildlife trade with current data sources and limit the extent to which it can be characterized in an unbiased manner.

[11]TRAFFIC is a joint program of the World Wildlife Fund and the World Conservation Union.

Analysis of USDA Random Inspections Data

USDA uses the AQIM program to improve the targeting of agricultural inspections and to assess the effectiveness of specific port operations. Under program protocol, ports are designated to randomly inspect certain goods received in large numbers and record the cargo's content, port of entry, origins, shipment contents, inspection method, pests found, and any indications of smuggling. AQIM inspections vary in levels of intensity. For example, an inspector might observe only the tailgate of a shipping container or truck, a proportion of the boxes drawn in a random sample, the entire contents of a part of the container, or the entire container's contents. These alternative methods of inspection may not reveal smuggling when it occurs. AQIM data have other limitations. First, many AQIM inspections involve goods that are not specifically agricultural, including floor tiles, machine parts, and wood packing material. Trade restrictions on these goods make them unlikely candidates for smuggling or for providing cover for other illicitly traded agricultural goods.[12] Second, AQIM inspections may not reveal smuggling even when performed correctly at the most rigorous level, especially in the case of goods having moved in trans-shipment. Also, actual inspection may be targeted toward the generally regular inspection goal of uncovering pests rather than smuggled goods. Third, AQIM inspections do not cover all agricultural goods, including, for example, meats. Fourth, a recent Government report indicates that some AQIM inspections in this time period may not have been conducted and recorded correctly (see OIG, 2007).

[12]Because machine parts and floor tile have carried hitchhiker pests in the past, they are randomly inspected for compliance with packaging protocols. The cargo containers carrying these goods are not refrigerated and are therefore unlikely to be suitable for the transportation of most agricultural goods.

Based on AQIM data (obtained through an interagency agreement with APHIS), inspections rarely revealed smuggling between March 2003 and January 2007. Smuggling was detected only once in 4,605 inspections of southern U.S. border cargo, twice in 4,894 inspections of manufactured goods, and zero times in the 2,473 inspections of air cargo and 2,858 inspections of northern U.S. border cargo. Given the infrequent detection of smuggling, little inference can be made surrounding the scope of agricultural smuggling from these data, although random sampling methods have been used successfully elsewhere.[13]

[13]Specifically, Jacob and Levitt (2003) used the method for re-testing and Feinstein (1999) used the method for auditing.

Analysis of USDA Interdiction Data

Interdiction refers to the detection of illicitly traded goods in markets after they have entered the United States. While large resources are expended on the interdiction of narcotics and guns, far less is devoted exclusively to interdiction of illegally traded agricultural and wildlife goods. The APHIS Smuggling Interdiction and Trade Compliance (SITC) group comprises approximately 110 employees nationally who serve to recover goods that represent an SPS risk and have entered the U.S. supply chain. SITC prosecutes violators either through administrative or criminal punishments. In some cases, SITC focuses its efforts on recovering risky material, such as Spanish floor tile in wood packing material that was found to contain harmful wood-boring beetles in 2004. In these cases, no criminal intent is presumed.

Data on criminal interdiction are published in SITC's internal quarterly reports for the period 2002-06 and were obtained through interagency agreement with APHIS. These reports record each seizure by type, quantity, category, relevant Code of Federal Regulations violation for which the smuggler was penalized, and estimated value. Four types of goods are classified in the data: Animal and Meat Products,[14] Other Plant Products, Fruit Products, and Federal Noxious Weeds. Over the data-collection period, SITC expanded in size and budget and, subsequently, the number of interdictions also increased. Based on the data alone, it is difficult to determine whether interdicted goods are being sold in a commercial setting or used for personal consumption. For this reason, shipments valued at less than $50 were excluded from the following analysis.

[14]The Animal Products and Meat Products categories were combined from the original data because their goods overlapped significantly.

Interdiction data are not random. Agents may target higher risk goods or exploit criminal networks, and they face administrative pressures to monitor certain goods more closely. As a result, data are likely to be biased toward easily observed, restricted goods that are obviously banned rather than goods that are regionally prohibited or easily misrepresented. Interdiction data are collected as part of ongoing interdiction efforts, and agents collect as much prohibited material as possible.

Tables 1-4 present interdiction data for the top five countries in each of these categories based on the number of interdictions between fiscal years 2002 and 2006. For the Fruit Products category and the Other Plant Products category, the three most commonly interdicted products for each country are identified. For Animal and Meat Products and Federal Noxious Weed categories, there is little difference across countries with regard to the types of identified goods.

In the Animal and Meat Products category, the data distinguish between pork, beef, poultry, or egg products with different levels of detail. Interdicted meat imports were particularly large from China, Japan, Korea, and India (table 1). Alternatively, the low monetary value of interdictions from Mexico suggests that shipments might have been oriented toward individual personal consumption (rather than distribution), which APHIS staff indicate is common prior to holidays when immigrants bring specialty meats across the southern U.S. border. For the Fruit Products category, interdictions were also high with imports from Mexico, China, and Thailand (table 2).

For the Other Plant Products category, China has a disproportionately high number of interdictions, primarily involving shipments of szechuan pepper and citrus-based spice (table 3). Both of these goods may carry a variety of diseases that threaten citrus fruit, which has been an area of specialized focus following an outbreak of citrus canker in Florida in the late 1990s.

SITC interdiction data reveal a high likelihood for interdicted goods to be nontraditional, ethnic goods (specifically, spices) and to have a high value relative to their size. This was evident in the Animal and Meat Products, Fruit Products, and Other Plant Products categories. Avocados represent an exception to this tendency, which is likely due to heightened political attention to avocado imports as trade of this product was liberalized over the period in question (APHIS, 2006).

Table 1
Animal and meat product interdictions by SITC, 5-year totals (FY 2002-06)

Rank	Country of origin	Frequency	Value	Weight
		Number	*Dollars*	*Pounds*
1	China	175	866,151	262,920
2	Japan	60	355,056	36,888
3	Korea	44	150,111	22,843
4	Mexico	44	17,473	4,867
5	India	42	165,031	70,286
	Total	861	3,374,009	1,073,207

Source: USDA, Economic Research Service using USDA, Animal and Plant Health Inspection Service, Smuggling Interdiction and Trade Compliance (SITC) Quarterly Report (2002-06).

Table 2
Fruit product interdictions by SITC, 5-year totals (FY 2002-06)

Rank	Country of origin	Frequency	Value	Weight	Top three items
		Number	*Dollars*	*Pounds*	
1	Mexico	60	94,426	69,840	Tejocotes, avocados, hog plums
2	China	32	75,044	39,437	Bael fruit, garlic,[1] ya pears
3	Thailand	26	8,047	2,776	Bael fruit, wood apple, krasang
4	Bangladesh	9	7,677	2,110	Satakora, citrus
5	Asia (unkown)	7	18,468	9,522	Citrus, longans, wood apple
	Total	190	556,447	209,049	Bael fruit, tejocotes, avocados

[1]In response to concerns that China was dumping low-priced garlic, the United States imposed a 377-percent tariff on Chinese garlic. Subsequently, interdictions periodically uncover trans-shipments of Chinese garlic (Kane, 2004).
Source: USDA, Economic Research Service using USDA, Animal and Plant Health Inspection Service, Smuggling Interdiction and Trade Compliance (SITC) Quarterly Report (2002-06).

Table 3

Other plant product interdictions by SITC, 5-year totals (FY 2002-06)

Rank	Country of origin	Frequency	Value	Weight	Top three items
		Number	*Dollars*	*Pounds*	
1	China	338	1,169,561	801,332	Szechuan pepper, citrus-based spice, burdock
2	India	140	116,842	51,895	Corn/millet, citrus-based spice, curcurbit
3	Mexico	125	192,462	33,098	Citrus-based spice, lemon grass, ruda
4	Thailand	64	69,263	71,932	Citrus-based spice, citrus, szechuan pepper
5	Korea	33	154,017	74,585	Corn/millet, lentil and citrus-based spice
	Total	897	2,193,803	1,170,664	Szechuan pepper, corn/millet, citrus

Source: USDA, Economic Research Service using USDA, Animal and Plant Health Inspection Service, Smuggling Interdiction and Trade Compliance (SITC) Quarterly Report (2002-06).

Table 4

Federal noxious weed interdictions by SITC, 5-year totals (FY 2002-06)

Rank	Country of origin	Frequency	Value	Weight
		Number	*Dollars*	*Pounds*
1	China	56	319,281	26,470
2	U.S. (domestic)	52	100,453	18,542
3	Thailand	29	46,505	9,743
4	Mexico	8	6,175	656
5	Vietnam	7	1,127	179
	Total	180	482,114	58,994

Source: USDA, Economic Research Service using APHIS-SITC Quarterly Report (2002-06).

Only a limited number of goods are considered Federal Noxious Weeds, a designation that indicates that the good's establishment and propagation make it an environmental threat by itself. For the countries in table 4, the top three goods for each were *solanum torvum* (turkey berry), *imperata cylindrical* (cogongrass, an ornamental grass), and *ipomea aquatica* (water spinach). Domestic transport accounts for a large share of Federal Noxious Weed interdictions, suggesting that internal trade is present. Given the infrequency of interdictions from Mexico and Vietnam, these observations are likely to be anomalous.

In terms of absolute monetary value, China is the largest source of interdicted material for trade, a finding that bears out over several product categories (table 5). In terms of the value of interdicted goods to its legal trade, China also has the largest percentage[15] of interdicted trade to legal trade (0.03 percent of total value), although the amount is not inordinately large relative to that for Japan, South Korea, and Taiwan. Although the percentages from each of the top 10 origin countries are small, it is important to

[15]Ivanova (2007) similarly finds that China is the largest source of illicit traded ozone-depleting substances prohibited under international agreement.

Table 5

Total interdicted material and total agricultural imports, 5-year totals (FY 2002-06)

Rank	Country of origin	Interdicted material from 2002 to 2006	Agricultural imports from 2002 to 2006	Interdicted to total value ratio
		Dollars	*Thousand dollars*	*Percent*
1	China	2,342,640	8,038,360	0.0291
2	Japan	374,562	2,063,320	0.0182
3	India	281,724	4,182,607	0.0068
4	South Korea	232,800	964,699	0.0241
5	Mexico	207,241	36,802,361	0.0006
6	Taiwan	184,844	904,963	0.0204
7	Thailand	136,705	5,171,291	0.0026
8	U.S. (domestic)	123,828	Not applicable	Not applicable
9	Canada	58,817	57,791,976	0.0001
10	Vietnam	56,261	1,731,613	0.0033

Source: USDA, Economic Research Service using USDA, Animal and Plant Health Inspection Service, Smuggling Interdiction and Trade Compliance (SITC) Quarterly Report (2002-06).

recognize that this figure represents only a minimum level because the interdiction process almost certainly fails to uncover all smuggled goods. Moreover, certain factors may help explain why these countries have higher detected levels of smuggling.

Asian countries, particularly China, have recently been recognized by the Federal Government as a source of potential invasive species because they have climates and habitats similar to those of the United States, they are home to a large variety of species that (unlike European species) have not been cultivated in the United States, and their volume of trade with the United States has increased significantly (Mack et al., 2002, p. 37). Based on the types of goods interdicted, it appears that illegally traded foods are most commonly discovered in ethnic food markets. The expansion of U.S. immigration in the 1990s, as well as the rise in food imports from China over the last 20 years, may have encouraged the growth of Asian ethnic food markets that support this trade.

The degree to which inspection and interdiction evidence is gathered is likely to depend on the ease with which smuggled goods are discovered. Inspectors and SITC officers may be more likely to identify contraband material if it is subject to a comprehensive ban based on the material's country of origin rather than just based on a region within a country. Frequently interdicted goods, such as szechuan pepper from China, fall under this criterion. Also, China has hosted two particularly large threats to U.S. agriculture—avian influenza and citrus diseases—that may have caused inspectors to pay closer attention to imports from China than from other countries.

Analysis of USDA Targeted Inspections Data

The outcomes of targeted agricultural inspections are collected in APHIS's PPQ 280 database, which is publicly available under the Freedom of Information Act. PPQ 280 data reveal the types of good, origin, quantity, and disposition code for plant agricultural goods physically inspected in the course of their importation to the United States. The disposition code indicates whether the shipment was inspected and whether pests were detected, but it does not indicate whether cargo concealed smuggled goods. Even if such distinctions were available, however, estimated percentages of goods that are smuggled would be biased upward because targeted inspections are oriented toward finding the maximum amount of prohibited material. Targeting factors and intensity of inspection efforts are not available in the data.

Using data from 1996 and 2006, this study isolates five disposition codes[16] that suggest that smuggling is being attempted,[17] including three codes for products that are prohibited and destroyed, returned, or assigned another action; one code for products destroyed due to a discrepancy with the shipment's phytosanitary certificate; and one code for products that are endangered species and sent to a rescue center.[18] The sum of these shipments is herein called refused shipments. To avoid aggregation problems,[19] the focus of this analysis is on refused shipments of fruits and vegetables only. Table 6 provides findings for the top five countries ranked in terms of cumulative refused shipments of fruits and vegetables.

While Mexico has the largest amount of refused fruits and vegetables, it is also the largest source of fruit and vegetable imports to the United States. Mexico and China lead other nations in the number of shipments refused. While the rate of refusal for China is noticeably larger than that for Mexico, it is actually smaller than that for Argentina and Brazil. Inspection data do not allow for a specific estimation of the size of smuggling but do indicate the types of goods that are refused because of suspected smuggling. These include citrus goods, tropical fruits (including papaya and mango), and ethnic foods (including szechuan pepper and ya pears). These varieties also overlap with the types of goods interdicted in markets as discussed in the previous section.

[16]These codes are DEPP, OTPP, and RXPP for the goods that were prohibited products; DEPD for the goods rejected for having phyto discrepancies; and ESRC for goods confiscated for being endangered species.

[17]Although APHIS staff indicate that attempting to import prohibited goods is suggestive of smuggling, import shipments may still receive these disposition codes when the goods are correctly manifested. Typically, APHIS does not consider goods as being smuggled unless there is intent to conceal the true contents.

[18]The relatively small number of endangered plant species include orchids, cacti, and cycads.

[19]Cut flower and propagative material imports are measured in stems and plant units rather than by weight and are difficult to interpret in terms of volume

Table 6
Total refusals of shipments of fruits, vegetables, and spices (FY 1996-2006)

Country of origin	Shipments refused	Quantity refused, 1996-2006	Quantity imported, 2006	Top three goods refused, by number of shipments
	Number	*Kilograms*	*Kilograms*	
Mexico	1,418	8,346,009	3,952,110,724	Papaya (104), pepper (98), mango (97)
China	433	2,345,872	275,379,712	Citrus (130), szechuan pepper (104), ya pear (80)
Argentina	84	896,885	78,688,222	Citrus (24), mango (10), pear (5)
Brazil	74	1,129,368	103,591,410	Mango (42), papaya (12), citrus (9)
Spain	70	563,572	82,275,346	Pepper (31), citrus (21), cucumber (10)

Source: USDA, Economic Research Service using USDA, Animal and Plant Health Inspection Service PPQ 280 data (1996-2006) and U.S. Census Bureau data (2006).

Analysis of U.S. Fish and Wildlife Service Targeted Inspections Data

FWS (2005) used goods refused at import to characterize illegally traded wildlife goods based on entries in FWS's Law Enforcement Management Information System (LEMIS) declaration subsystem during 2000-04. The study explicitly acknowledged the known biases previously mentioned with APHIS inspections data. Refusals consist of goods that were given the disposition codes of seized, abandoned, or re-exported. While abandoned and re-exported goods suggest that trade might have been inadvertent, inspectors indicate that these goods are actually being traded illegally. The data collected through LEMIS are divided into the following taxonomic groups: reptiles, mammals, birds, mollusks, fish, coral, insects, amphibians, echinoderms, arachnids, crustaceans, and invertebrates. LEMIS data contain records on the number of goods imported each year as distinguished by country of origin, intended purpose (personal, commercial, hunting), estimated value (when possible), species, and size of shipment. Unlike goods under the PPQ 280 system, where the pest risk may be unknown when the good is imported, goods refused under the LEMIS system are known to be prohibited from entry into the United States.

Total refusals of wildlife goods in LEMIS data are disaggregated by purpose as follows: 61 percent for personal, 33 percent for commercial, 5 percent for hunting, and less than 2 percent for other reasons. Though the share of personal shipments refused each year (24 percent) is considerably higher than that of commercial shipments (1 percent) (FWS, 2005, p. 133), FWS does not distinguish between commercial and personal shipments in its detailed data reporting. The average refusal rate for all wildlife shipments was consistent at around 2.5 percent per year between 2000 and 2004, which includes both personal and cargo shipments. Note that about 24 percent of all wildlife shipments are inspected.[20] From the LEMIS data, it is difficult to determine the SPS risks posed by illegally traded wildlife. Certain types of frequently traded wildlife goods, such as animal leather, bones, and shells, are likely to pose a relatively small threat. Conversely, nonthreatened wildlife entering the United States legally may pose an SPS risk without causing a resource risk because quarantine and disease inspection measures are inadequate (for example, deer transported by U.S. hunters returning from Canada[21]).

Based on refusals in LEMIS data, the wildlife goods entering the United States with the highest percentage of refused entry are reptiles, coral, birds, and echinoderms (including starfish and sea cucumbers) (table 7). High refusal percentages for these goods are associated with a small volume of imports. This suggests that importers refrain from trading goods with a high probability of detection.

Based on primary use of refused goods, the following is evident. First, refused goods tend to be goods that are high in value relative to their size and might be characterized as luxuries, such as boots and shoes produced with alligator or crocodile leather, jewelry, and traditional medicines. Caviar was recently added to the CITES list of restricted species after Caspian Sea stocks grew extremely depleted, and illegal trade in caviar has been particularly problematic. Second, for most animal categories (except birds), the meat and

[20]Isolating commercial shipments to arrive only from air cargo, ocean cargo, mail, rail, or truck changes this figure from 24 to 25 percent (FWS, 2005, pg. 137).

[21]USDA enacted several restrictions on Canadian wildlife imports after the 2003 discovery of bovine spongiform encephalopathy in a Canadian dairy cow.

live animal trade represents a relatively small portion of illegal trade, which is significant if these items have a greater SPS risk than other wildlife products, such as jewelry, leather, bone, and skin products.

Table 8 shows total refused wildlife imports as a proportion of total legal wildlife imports by country. The data do not distinguish between cargo and passenger shipments. Excluding the totals for Laos and Azerbaijan (whose wildlife trade is extremely small), Mexico is shown to have the highest rate of refusal of wildlife goods (and total number of refusals), but this finding is likely the result of the large amount of passenger travel between the United States and Mexico.[22] After China, the percentage refused falls to 4.8 percent for Vietnam, the 11th-ranked country, whereas the median refusal rate for all countries is 4.0 percent. In terms of total refusals, Mexico, China, and Russia rank first, third, and sixth, respectively. For Mexico and Nicaragua, refused goods typically include live birds and snakes and leather products made

[22]FWS (2005, p. 128) also notes that "the high number and rate of refusal (28.1 percent) for imports from Mexico is largely due to the strict prohibitions against export of most wildlife without permits, coupled with a vibrant trade in a variety of protected species products such as reptile skin boots."

Table 7

Number of wildlife shipments refused in FWS LEMIS data, 5-year totals (2000-04)

Category	Total cleared	Seized	Abandoned	Re-exported	Total refused	Total	Share refused	Primary uses of refused products
	Number						*Percent*	
Reptiles	85,379	3,255	1,267	641	5,163	90,542	5.7	Leather products, shoes
Coral	19,021	611	407	105	1,123	20,144	5.6	Raw and live coral
Birds	48,141	1,213	467	402	2,082	50,223	4.1	Live birds, feathers, trophies
Echino-derms	2,249	27	39	8	74	2,323	3.2	Bodies,* shells*
Mammals	218,353	3,146	1,322	528	4,996	223,349	2.2	Medicinals, skins, ivory
Fish	146,398	1,014	513	129	1,656	148,054	1.1	Caviar, live fish,* meat*
Mollusks	155,317	858	438	454	1,750	157,067	1.1	Shells for jewelry
All others	132,786	267	150	87	504	133,290	0.4	

*Most of these products were regulated under domestic and foreign laws other than the Convention for the Trade of Endangered Species or the Endangered Species Act.

Source: USDA, Economic Research Service using U.S. Fish and Wildlife Service (FWS), "U.S. Illegal Wildlife Trade" (2005, p. 6, table 7).

Table 8

Total refused shipments of wildlife by country of origin, 5-year totals (2000-04)

Rank	Country of origin	Cleared	Abandoned	Re-exported	Seized	Total	Total refused	Share refused
		Number						*Percent*
1	Laos	41	11	25	202	279	238	85.3
2	Azerbaijan	41	55	1	63	160	119	74.4
3	Mexico	9,641	1,743	229	1,800	13,413	3,772	28.1
4	Russia	2,149	252	13	297	2,711	562	20.7
5	Nigeria	1,415	151	7	165	1,738	323	18.6
6	Nicaragua	776	17	23	111	927	151	16.3
7	El Salvador	1,240	46	3	131	1,420	180	12.7
8	Unknown	904	61	49	14	1,028	124	12.1
9	Marshall Islands	844	2	2	98	946	102	10.8
10	China	15,555	264	178	696	16,693	1,138	6.8

Source: USDA, Economic Research Service using U.S. Fish and Wildlife Service, "U.S. Illegal Wildlife Trade" (2005, p. 129, table 35).

Table 9
Value of legal and illegal trade in wildlife

	Illegal trade			Legal trade			Total trade	
Year	Lines refused	Value refused	Share with no value	Lines cleared	Value cleared	Share with no value	All shipments value	Share of total refused
	Number	*Dollars*	*Percent*	*Number*	*Dollars*	*Percent*	*Dollars*	*Percent*
2000	4,510	5,371,562[1]	26.4	259,629	1,702,763,815	11.0	1,713,435,377	0.6
2001	4,352	6,607,599[2]	22.2	310,508	1,468,274,339	10.1	1,475,381,938	0.5
2002	4,467	4,467,893	21.8	340,300	1,356,102,306	8.8	1,360,570,199	0.3
2003	4,712	4,381,595	28.5	375,200	1,512,419,944	9.2	1,516,801,539	0.3
2004	4,824	4,056,743	27.1	378,524	1,766,764,399[3]	6.6	2,770,821,142	0.2
Total		30,685,392			8,806,324,803		8,837,010,196	0.4

[1]Excludes an outlier for ivory in 2000 valued at $5.3 million.
[2]Excludes an outlier for caviar in 2001 valued at $0.5 million.
[3]Excludes an outlier for a panda bear in 2004 value at $1 billion.
Source: USDA, Economic Research Service using U.S. Fish and Wildlife Service, "U.S. Illegal Wildlife Trade" (2005, p. 121, table 31).

from reptile skin. In these cases, the movement of live animals is of special concern, especially among birds, due to the potential of these animals to introduce diseases and pathogens into the United States. For China, refused goods often include traditional medicinal products made from a variety of animals as noted in Henry (2004) and Von Hippel and Von Hippel (2002). Refused goods from Russia often include caviar.

The proportion of the monetary value of the illegal wildlife trade to that of all wildlife trade is approximately 0.4 percent based on refusal data after correcting for data anomalies (table 9).[23] As with APHIS inspections data, if targeting occurs across the type of good imported, its origin, and its arrival conveyance, this estimate will be biased upward.

However, no further adjustment is made to correct for this potential bias for several reasons. Unlike agricultural inspections, wildlife goods inspections are more specifically directed at uncovering illicit trade, making the reported rates of interception much more reliable. Little correlation exists in refusal and inspection rates across transport methods, which indicate that alternative transports likely receive the same level of scrutiny. Based on the number of shipments, a larger percentage (around 1 percent) of inspected commercial import entries than personal entries is refused (FWS, 2005, p. 133). Finally, there is no obvious manner in which this bias might be corrected.

[23]In table 9, "lines refused" refers to shipment entries refused. "Share with no value" refers to the percentage of imports that have no recorded import value because they cannot be legally sold (FWS, 2005, p. 122).

The Characteristics of Agricultural and Wildlife Goods

This analysis supports three general conclusions. First, illegally traded agricultural goods are not those conventionally sold in supermarkets but tend to be specialty items with a high value relative to their size. Food items interdicted by APHIS are more likely to be ethnic foods and spices, such as szechuan pepper (a citrus-based spice), tejocotes (a Mexican crab apple), and ya pear (an Asian pear variety). Inspections data corroborate this finding somewhat, with szechuan pepper and ya pear being frequently found, along with citrus and high-value tropical fruits, including mango and papaya. Second, illegally traded wildlife goods are likely to be luxury items to be used for jewelry, reptile-leather shoes, and other products; caviar; and medicinal goods. Third, Mexico and China represent a large percentage of the detected illegal trade for wildlife and agricultural goods, respectively, though biological and geographical factors may help account for the different percentages across countries.

Conclusions

The recent passage of the Plant Protection Act and the Animal Health Protection Act reflects the ongoing concern in the United States over sanitary and phytosanitary concerns and resource risk in an era of increasing agricultural and wildlife imports and recent costly episodes of invasive species introductions. Inspections of imports play a crucial role in risk management, and U.S. inspection agencies have undergone significant consolidation since the creation of the U.S. Department of Homeland Security in 2003.

Several findings emerge from the examination of import refusals and interdiction data from APHIS and FWS. Illegal agricultural imports are driven primarily by specialty markets for ethnic foods and may reflect the general idiosyncrasies of agricultural trade prohibitions and enforcement. Illegal wildlife imports are driven by the trade in luxury items and jewelry, including leather products; culturally specific traditional medicines; ivory; caviar; and shell jewelry. These types of imports are also likely to command high prices relative to their cost and size, which is not surprising given the profit motive of smuggling.

Smuggling of wildlife into the United States is most prevalent with Mexico, and smuggling of agricultural products is most prevalent with China. Both countries are major trade partners with the United States, and U.S. imports from both increased dramatically over the last 25 years. Similarly, immigration may have increased the prevalence of ethnic food, traditional goods, and medicinal goods that seem to be especially associated with illegal trade. In terms of size, detected illegal trade seems to be a significant part of the total wildlife trade and a smaller but nontrivial part of the agricultural trade. Based on the fragmentary inspection evidence, the illegal wildlife trade is approximately 1 percent of commercial wildlife shipments and 0.4 percent of the total value of the wildlife trade. Based on fragmentary interdiction evidence, the illegal agricultural trade has a lower bound of approximately 0.03 percent of total agricultural trade for China, which had the highest reported proportions and volumes. Still, these figures, along with most widely reported public estimates, are inexact due to the potential for bias in the data.

Concerns over smuggling extend beyond risks surrounding invasive species or endangered wildlife. Expertise across different fields, including international law, criminology, economics, agricultural sciences, pathology, and environmental science, is necessary to formulate an impartial and comprehensive regulatory and enforcement regime. Idiosyncratic factors influence the need for individual regulations, yet the nature of inspections and border security has necessitated that risks from imports—SPS, resource, or other national security interests—be addressed in a unified manner. A better understanding of the incentives to smuggle goods is emerging and will aid further research efforts as markets and supply chains become more integrated.

References

Becker, Gary S. "Crime and Punishment: An Economic Approach," *Journal of Political Economy*, 76(1968)2:169-217.

Bhagwati, J., and B. Hensen. "A Theoretical Analysis of Smuggling," *Quarterly Journal of Economics*, 87(1973)2:172-187.

Bushway, S., and P. Reuter. "Economists' Contribution to the Study of Crime and the Criminal Justice System," in Michael Torny (ed.), *Crime and Justice, Volume 37: A Review of Research*, University of Chicago Press, 2008.

Caulkins, J.P., and P. Reuter. "Illicit Drug Markets and Economic Irregularities," *Socio-Economic Planning Sciences*, 40(2006):1-14.

Caulkins, J.P., and P. Reuter. "What Price Data Tells Us About Drug Markets," *Journal of Drug Issues*, 28(1998)3:593-612.

Convention on International Trade in Endangered Species of Wild Fauna and Flora. *Appendix I, II, and III*, http://www.cites.org/eng/app/E-Jul01.pdf, current as of July 2008.

Dalebout, M.L., G.M. Lento, F. Cipriano, N. Fubahashi, and C.S. Baker. "How Many Protected Minke Whales Are Sold in Japan and Korea? A Census by Microsatellite DNA Profiling?" *Animal Conservation*, 5(2002)143-152

DellaVigna, S., and E. La Ferrara. "Detecting Illegal Arms Trade," NBER Working Paper 13355, August 2007.

The Economist. "Easy Money," September 21, 2006.

Feinstein, J. "Approaches for Estimating Noncompliance: Examples from Federal Taxation in the United States," *The Economic Journal*, 109(1999)456:360-369.

Ferrier, P. "Illicit Agricultural Trade," *Agricultural and Resource Economic Review*, 37(2008):2.

Fischer, C. "The Complex Interactions of Markets for Endangered Species Products," *Journal of Environmental Economics and Management*, 48(2004):926-953.

Fischer, C. "Trading in Endangered Species: Legal Sales Versus Total Bans," *Resources*, 150(2003):12-14.

Fisman, R., and S. Wei. "Tax Rates and Tax Evasion: Evidence from 'Missing Imports' in China," *Journal of Political Economy*, 112(2004)2:471-496.

Fisman, R., and S. Wei. "The Smuggling of Art, and The Art of Smuggling: Uncovering the Illicit Trade in Cultural Properties and Antiques," NBER Working Paper 13446, 2007.

Goel, R.K. "Cigarette Demand in Canada and the U.S.: Canadian Cigarette Smuggling," *Applied Economic Letters,* 11(2004):537-540.

Golub, S., and A. Mbaye. "Colonial History, Regional Integration and Smuggling in South Africa: The Case of The Gambia," Swarthmore College Working Paper, June 2007.

Hansen, Eric. *Orchid Fever,* Random House Books, 2000.

Heltberg, R. "Impact of the Ivory Trade Ban on Poaching Incentives: A Numerical Example," *Ecological Economics,* 36(2001):189-195.

Henry, L. "A Tale of Two Cities: A Comparative Study of Traditional Chinese Medicine Markets in San Francisco and New York City," TRAFFIC North America: World Wildlife Fund, 2004.

Howse, R. "The Appellate Body Ruling in the Shrimp/Turtle Case: A New Legal Baseline in Trade and Environmental Debate," 27 *Columbia Review of Law* (2002) 489.

Hutton, J. "Who Knows Best? Controversy of Unilateral Stricter Domestic Measures," in *Endangered Species, Threatened Convention: The Past, Present and Future,* J. Hutton and B. Dickson (eds.), Earthscan Ltd., 2000.

Interpol. Personal communication, October 2006.

Interpol. *Wildlife Crime,* http://www.interpol.int, accessed April 10, 2008.

Ivanova, K. "Corruption, Illegal Trade, and Compliance with the Montreal Protocol," *Environmental Resource Economics,* (2007) 38:475-496.

Jacob, B., and S. Levitt. "Rotten Apples: An Investigation of the Prevalence and Predictors of Teacher Cheating," *Quarterly Journal of Economics,* 118(2003)3: 843-877.

Kane, L. "A Recipe for Scampi - How It Really Gets To Your Table," *Customs and Border Patrol Today,* December 2004, http://www.cbp.gov/xp/CustomsToday/2004/Dec/commoditytrail.xml.

Karesh, W.B., R.B. Cook, E.L. Bennet, and J. Newcomb. "Wildlife Trade and Global Disease Emergence," *Emerging Infectious Disease,* 11(2005)7:1000-1002.

Kemp, M. "Smuggling and Optimal Commercial Policy," *Journal of Public Economics,* 5(1976)3:381-384.

Kremer, M., and C. Morcom. "Elephants," *American Economic Review,* 90(2000)1:212-234

Levitt, S.D. "Using Electoral Cycles in Police Hiring to Estimate the Effect of Police on Crime," *American Economic Review*, 87(1997)3:270-290.

Lynch, L., and E. Lichtenberg. "Foreword: Special Issue on Invasive Species," *Agricultural and Resource Economics Review*, 35(2006)1:iii-v.

Mack, R.N., S.C.H. Barrett, P.L. deFur, W.L. MacDonald, L.V. Madden, D.S. Marshall, D.G. McCullough, P.B. McEvoy, J.P. Nyrop, S.E.H. Reichard, K.J. Rice, and S.A. Tolin. *Predicting Invasions of Non-Indigenous Plants and Plant Pests*, National Research Council, National Academy Press, 2002.

Malik, S., P.J. Wilson, R.J. Smith, D.M. Lavigne, and B.N. White. "Pinniped Penises in Trade: A Molecular-Genetic Investigation," *Conservation Biology*, 11(1997)6:1365-1374.

Martin, L., and Panagariya, A. "Smuggling, Trade and Price Disparity," *Journal of International Economics*, 117(1984)3:4:201-217.

Martin, R.B. "When CITES Works and When It Does Not," in *Endangered Species, Threatened Convention: The Past, Present and Future*, John Hutton and Barnabas Dickson (eds.), Earthscan Ltd., 2000.

Meissner, H., A. Lemay, T. Kalaris, J. Vila, R. Duncan, and R. Olive. *Mexican Border Risk Analysis*, Plant Epidemiology and Risk Analysis Laboratory, Center for Plant Health Science and Technology, 2003.

Min, H., M. Gopinath, S. Buccola, and P. McEvoy. "Rent-Seeking in Invasive Species Regulation: The Case of Noxious Weeds," *Land Economics*, 84 (2): 306-326.

Naim, M. *Illicit: How Smugglers, Traffickers and Copycats Are Hijacking the Global Economy*, Doubleday, 2000.

Norton, D. "On the Economic Theory of Smuggling," *Economica*, 55(1988)217:107-118.

Reed, Robert, N. "An Ecological Risk Assessment of Nonnative Boas and Pythons as Potentially Invasive Species in the United States," *Risk Analysis*, 25(2005)3: 753-766

Roe, D., Mulliken, T., and Milledge S. (eds.). *Making a Killing or Making a Living: Wildlife Trade, Trade Controls and Rural Livelihoods*, IIED and UCN, London, UK, 2002.

Ryan, M.A. "Finding Food Imposters: It's Not Just Peanuts," *Today's Chemist at Work*, 7(1998)6:63-66, http://pubs.acs.org/hotartcl/tcaw/98/jun/fin.html.

Saba, R.P., R.T. Beard, and R.B. Ekelund. "The Demand For Cigarette Smuggling," *Economic Inquiry*, 33(1995):189-202.

Strumpf, K. *Illegal Sports Bookmakers*, University of North Carolina Working Paper, 2003.

Thursby, M., R. Jensen, and J. Thursby. "Smuggling, Camouflaging, and Market Structure," *Quarterly Journal of Economics,* 106(1991)3:789-814.

U.S. Department of Agriculture, Agricultural Marketing Service (AMS). *Agricultural Export Transportation Handbook*, Agriculture Handbook 700, 2004.

U.S. Department of Agriculture, Animal and Plant Health Inspection Service (APHIS). Personal communication, USDA-APHIS-SITC Staff in Raleigh, NC, August 2006.

U.S. Department of Agriculture, Animal and Plant Health Inspection Service (APHIS). "APHIS Preclearance Programs," Revised March 24, 2004, on file with author and available at: www.aphis.usda.gov/import_export/plants/plant_imports/downloads/preclearance_chart.pdf.

U.S. Department of Commerce, Census Bureau (Census Bureau). *U.S. Imports of Merchandise*, various years.

U.S. Department of Homeland Security, Customs and Border Protection (CBP). "Customs and Border Patrol Press Kit: Agriculture," www.cbp.gov/xp/cgov/newsroom/fact_sheets/cbp_overview/press_kit/, accessed May 10, 2007a.

U.S. Department of Homeland Security, Customs and Border Protection (CBP). Personal communication, Port of Baltimore Agricultural Inspectors, September 21, 2007b.

U.S. Department of Homeland Security, Customs and Border Protection (CBP). "U.S. Customs and Border Patrol Interception of Illegal Citrus Cuttings Becomes First Felony Conviction in Violations of the Plant Protection Act of 2005," Press release dated September 9, 2005.

U.S. Department of the Interior, Fish and Wildlife Service, Office of Law Enforcement Intelligence Unit (FWS). *U.S. Wildlife Trade: An Overview for 1997-2003*, 2003, www.fws.gov/le/pdffiles/Wildlife Trade Overview Report.pdf.

U.S. Department of the Interior, Fish and Wildlife Service (FWS). "U.S. Illegal Wildlife Trade: LEMIS Data Analysis and Risk Assessment," Internal FWS Report, November 2005.

U.S. Department of the Interior, Fish and Wildlife Service (FWS). Personal correspondence regarding import/shipments recorded in LEMIS, December 2008.

U.S. Government Accountability Office (GAO). *Homeland Security Office: Management and Coordination Problems Increase the Vulnerability of U.S. Agriculture to Foreign Pests and Disease*, GAO-Report 06-664, 2006, www.gao.gov/new.items/d06644.pdf

U.S. Government Accountability Office (GAO). *Persistent Weaknesses in the In-Bond Cargo System Impede Customs and Border Protection's Ability to Address Revenue, Trade, and Security Concerns*, GAO-Report 07-561, 2007, www.gao.gov/new.items/d07561.pdf

U.S. Departments of Agriculture and Homeland Security, Offices of the Inspector Generals (OIG). "Review of Customs and Border Protection's Agriculture Inspection Activities," Report OIG-07-32, February 2007, www.dhs.gov/xoig/assets/mgmtrpts/OIG_07-32_Feb07.pdf.

U.S. Office of Technology Assessment (OTA). *Harmful Non-indigenous Species in the United States*, OTAF-F-565, 1993.

Von Hippel, F.A., and W. Von Hippel. "Sex Drugs and Animal Parts: Will Viagara Save Threatened Species?" *Environmental Conservation*, 29(2002)3:277-281.

Von Kooten, G.C. "A Dynamic Bioeconomic Model of Ivory Trade: Details and Extended Results," Working Paper #2006-03, University of Victoria, Department of Economics, Victoria, BC, Canada, 2006.

Wasser, S.K., A.M. Shedlock, K. Comstock, E.A. Ostrander, B. Mutayoba, M. Stephens. "Assigning African Elephant DNA to Geographic Region of Origin: Application to the Ivory Trade," *Proceedings of the National Academy of Sciences*, 101(2004)14847-14852, http://www.pnas.org/cgi/content/full/101/41/14847.

Yang, D. "Can Enforcement Backfire? Crime Displacement in the Context of Customs Reform in the Philippines," *The Review of Economics and Statistics*, 90(2008)1:1-14.