

Shedding Light on the Dark Side of Trade: Strategies for Analyzing the Extent and Impact of Illicit Imports

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Renee Berry, Dylan Carlson, Samantha Schreiber,
and Marin Weaver

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Abstract

This paper provides researchers with a flexible set of tools for measuring and analyzing illicit imports, defined here as imports of goods produced from illegal or otherwise unethical activity. Using estimation and modeling techniques originally developed during the U.S. International Trade Commission's factfinding investigation on illegal, unreported, and unregulated fishing, this paper shows how similar approaches can be used for different sectors and production practices. For researchers seeking to use these tools, the first step involves defining the scope of analysis, particularly the types of illicit activities to be analyzed. Scoping decisions are usually based not only on what a researcher considers to be illicit activity, but also the intended audience of the research and data availability. The second step involves estimating the extent of illicit production among possible import partners and then tracing that illicit product into import supply chains. Researchers can accomplish these estimation exercises using careful and deliberate data management techniques as well as a reasonable set of assumptions for gap filling, and these techniques are explored in great detail. The third step involves analyzing the impact that illicit imports have on domestic producers that compete directly with these imports. A flexible partial equilibrium modeling framework is presented that can accommodate different kinds of industries as well as different policies for reducing exposure to illicit imports. In order to demonstrate the potential applicability of these tools, the paper concludes with two case studies focused on known illicit trade issues within the forest products and cotton sectors, providing ideas for how research could be pursued within each sector.

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This paper represents solely the views of the authors and is not meant to represent the views of the U.S. International Trade Commission or any of its Commissioners. Please direct all correspondence to Renee Berry, Dylan Carlson, and Marin Weaver, Office of Industries, and Samantha Schreiber, Office of Economics, U.S. International Trade Commission, 500 E Street, SW, Washington, DC 20436, contact: Renee.Berry@usitc.gov (202-205-3498), Dylan.Carlson@usitc.gov (202-205-3457), Marin.Weaver@usitc.gov (202-205-3461), or Samantha.Schreiber@usitc.gov (202-205-3176).

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Introduction

Markets with substantial volumes of imports are exposed to the broad diversity of global practices used to grow, harvest, mine, manufacture, and process traded goods. The United States, which has long been the world's largest single country importer of goods, is one such market. In many cases, global production practices meet or exceed importers' standards and laws. However, some global production practices do not meet importing countries' domestic standards and norms, are considered unethical or environmentally unsustainable, and/or are illegal within the foreign producing countries themselves. Because of the extended nature of global supply chains and producers' incentives to hide or obscure these practices, there is generally limited direct visibility into whether imports were generated using these practices.

Nonetheless, importers, regulators, and consumers often have substantial interest in understanding the extent and impact of this trade. For example, in December 2019, the House Ways and Means Committee of the U.S. Congress sent a letter to the U.S. International Trade Commission (USITC) emphasizing that illegal, unreported, and unregulated (IUU) fishing around the world "contributes to the overexploitation of fish stocks, threatens the livelihoods of coastal communities, jeopardizes food security, harms marine ecosystems...[and] creates unfair competition for U.S. fishermen."¹ Given the Committee's interest in this problem, it asked the USITC to estimate the extent of IUU seafood imports in the United States, profile the main source countries for such imports, and quantify their effect on the U.S. commercial fishing industry. Preparation of the resulting report, published in February 2021 and referred to in this paper as *IUU Fishing*, led the USITC to develop methods for quantifying illicit imports and their impact on competing domestic industries.

The methods developed in *IUU Fishing* have application to other industries that are often in the news for illegal, unethical, or unsustainable production practices. A recent example of such an industry in the news is palm oil. That industry has long been associated with deforestation and other environmental problems, and more recently (in 2020 and 2021), several of its major firms were identified as using forced labor.² Lawmakers in the United States and Europe have consequently expressed interest in better understanding and curbing imports of palm oil produced using such practices.³ Other recent regulatory and legislative efforts have been undertaken by both major importers to target a broad variety of products that contribute to deforestation, while the U.S. Congress has pursued legislation to expand prohibitions on goods produced using forced labor in the Xinjiang region of China.⁴

This paper seeks to provide a roadmap for analyzing imports of goods produced using these types of harmful practices, which usually cannot be identified in official trade statistics as the product of such methods. Through a step-by-step approach, it details a flexible framework for measuring and analyzing

¹ USITC, "USITC to Investigate Extent of IUU Seafood Imports," January 27, 2020.

² CBP, "CBP Issues Withhold Release Order on Palm Oil," December 30, 2020; Butler, "In Secret Tapes, Palm Oil Execs Disclose Corruption, Brutality," October 9, 2021.

³ Ways and Means Committee, letter to Mark Morgan (Acting Commissioner, U.S. CBP), December 15, 2020; Sukumaran, "Malaysia Draws Battle Lines with EU over Palm Oil," January 31, 2021.

⁴ Pietsch, "E.U. Seeks to Block Import of Commodities That Drive Deforestation," November 17, 2021; Weiss, Shin, "Potential Implications of the FOREST Act of 2021 and Related Developments in Other Jurisdictions," November 8, 2021; Zengerle, "U.S. House Passes Measure Clamping Down on Products from China's Xinjiang Region," December 9, 2021; The White House, *The National Action Plan to Combat Human Trafficking*, December 2021.

imports of goods produced from illegal or otherwise unethical activity—in this paper, this trade is referred to as “illicit imports.”⁵ The authors’ hope is that this paper will serve as a reference to other researchers who may wish to apply this framework to additional industries and illicit production practices, thereby improving the information available to policymakers and others seeking to both deter illicit trade and address the underlying problems.

Although there is likely a wide range of products that could be measured and analyzed using the techniques described in this paper, this framework is particularly well suited to imported goods derived primarily from one or two upstream components rather than a complex array of parts. Also, while these approaches are designed to grapple with multi-tiered supply chains, they work best with supply chains that are not heavily extended or complicated. However, this paper also offers ideas for accomplishing estimation and impact analysis for diversified products or products passing through extended or complex supply chains.

Defining Illicit Imports

Defining illicit imports, particularly those that are produced using unethical but otherwise legal activities, is subjective and dependent upon the analysis being undertaken. Nonetheless, the spectrum of illicit imports could include:

1. Imports that the government of the importing country has laws and/or regulations in place to prevent from entering based on an identified practice, but which likely continue to enter that country. In the United States, these may include broad, unspecific production practices (e.g., products of forced child labor) or clearly identified production practices (e.g., cotton from China’s Xinjiang province that is subject to a Withhold Release Order).
2. Imports of products that were made using activities that are illegal based on producing countries’ own domestic laws and regulations or under international law, regardless of how the importing country’s law treats these products (e.g., IUU fishing).
3. Imports of products that have not been certified to meet international standards, such as those set by intergovernmental bodies or voluntary industry-set standards (e.g., imports of palm oil that is not certified by the Roundtable on Sustainable Palm Oil (RSPO)).
4. Imports of products that various non-governmental organizations (NGOs) or consumer groups consider unethical or unsustainable, or to which industry groups seek to limit exposure in the importing market (e.g., imports of cosmetics made with animal testing).

⁵ According to the World Economic Forum, “illicit trade involves money, goods or value gained from illegal and otherwise unethical activity.” WEF, *Illicit Trade*, 2012; WCO, *Illicit Trade Report 2012*, 2013. Illicit trade is a concept that can be used to refer to traded goods that involve illegal or unethical practices in the foreign industry itself and can also refer to goods that violate laws or norms in the importing country or elsewhere along the supply chain. Some previous reports concerned with “illicit trade” are primarily focused on trade that violates laws. See, e.g., Comolli, *Organized Crime and Illicit Trade*, 2018. However, this paper relies upon the broadest definition that includes “unethical practices” that may not be strictly illegal, since a similar set of analytical approaches can be used to measure and analyze trade generated from such practices.

Why Measure the Extent and Impacts of Illicit Imports?

Any method of quantifying illicit imports that enter markets through formal channels—i.e., pass through customs—must address the challenge that the original production practices used to generate imports are not typically captured within tariff classifications or on any formal import documentation.⁶

Measurement and modeling of illicit imports within formal supply chains are important, however, because these analyses may support efforts by various market actors to reduce the prevalence of such products in importing markets. Estimations of the extent of illicit imports can help with identification of where market exposure is most acute, including which specific products and partner countries represent the greatest concentrated risk of exposure. Similarly, analyses of the domestic economic impacts of such illicit imports can help shed light on the ways in which competing domestic producers and workers are affected by these traded goods.

Using this information, governments can target their enforcement efforts (such as with penalties or border measures) and other market participants, such as NGOs, can focus their voluntary or informal efforts (such as certification schemes or consumer awareness campaigns) at identifying and reducing illicit U.S. imports where they are most concentrated. Taken together, these efforts can create pressure on foreign countries and industries to address illicit production practices and better comply with importing countries' policy objectives. In some cases, these changes may be reinforced by commitments countries make to address illicit production practices under free trade agreements (FTAs) or multilateral environmental agreements (MEAs). In addition, if illicit imports are reduced, consumers and importing businesses can have greater confidence that the products that they purchase were not made from practices that they consider immoral or unsustainable. This has become increasingly important in many industries as consumers have gained greater awareness of the undesirable production practices used to make some of their favorite products. In addition, domestic producers within importing countries that comply with domestic laws and industry standards could face reduced competitive pressure from such imports, particularly if the illicit practices otherwise depress prices or increase import supply.

Brief Summary of Literature

Many studies have estimated quantities of illicit production covering a wide variety of sectors, regions, and specific illicit practices; however, relatively few studies have estimated the quantity of U.S. or other countries' imports of illicit products. For example, there are a substantial number of studies that have provided estimates of IUU fishing within fisheries around the world, as well as larger IUU fishing studies that combined specific estimates into global or regional estimates.⁷ However, only two studies have

⁶ Measurement and analysis of the impacts of goods that are smuggled into import markets and are not reflected in official trade statistics, such as illegal drugs, is also highly challenging. This paper does not address smuggling of such illegal goods, as the emphasis of this paper is on illicit products that predominantly compete in formal markets. Similarly, the focus of this paper is on products that are considered illicit due to production practices that occur in foreign countries, as opposed to products that are illicit due to violations of Customs rules (e.g., goods imported subject to fraudulent reporting practices at the border).

⁷ USITC, *Seafood Obtained via IUU Fishing*, February 2021, Appendix E.

estimated the extent of U.S. imports generated through IUU fishing.⁸ Other examples of studies that estimated the extent of illicit imports exist in the wood products sector.⁹ Because few studies estimate imports of illicit products, studies that have estimated the economic impact of such imports on domestic sectors have been similarly rare; for example, only two studies have analyzed the impact of IUU fishing on the U.S. economy, while one study has analyzed the impact of illegal logging on the U.S. wood products sector.¹⁰

Common approaches among these import-focused studies involve 1) combining and triangulating illicit production estimates using multiple underlying existing sources, accounting for high levels of uncertainty surrounding these estimates; 2) linking these estimates of illicit production with trade data to perform a supply chain analysis that incorporates assumptions about how goods move through third-country markets; and 3) measuring the impact of illicit imports on competing domestic industries, which constitutes the primary adverse economic impact of this illicit trade. These concepts underpin the approach outlined within this paper.

Structure of this Paper

This paper identifies flexible strategies and basic necessities for analyzing the extent and impact of illicit imports that enter markets through official channels. Although a common framework is presented for examining this trade, there is unlikely to be a one-size-fits-all approach. For this reason, the paper also brainstorms possible workarounds and operating assumptions that can be employed when key ingredients in the framework are missing, and explains tradeoffs related to these decisions. The purpose of discussing these tradeoffs and workarounds is to underscore that valuable analysis is possible even

⁸ In *IUU Fishing*, the USITC produced an estimate of the extent to which IUU fishing is imported into the United States, as well as a quantitative analysis of the economic impact of IUU imports on U.S. commercial fishermen and U.S. commercial fishing production, trade, and prices. This report in the seafood sector provides the direct inspiration for this paper, which seeks to explain a framework that extends the methodological approaches from that study to other sectors. A prior 2014 study by Pramod et al. also estimated the extent of U.S. seafood imports of IUU-related products. USITC, *Seafood Obtained via IUU Fishing*, February 2021; Pramod et al., “Estimates of Illegal and Unreported Fish,” 2014. A similar group of authors conducted a similar analysis with respect to Japanese imports. Pramod, Pitcher, and Mantha, “Estimates of Illegal and Unreported Seafood Imports to Japan,” October 2019.

⁹ Two major studies by Chatham House have estimated not only global output of forestry products, but also the extent to which those products are imported by major processing and consuming countries. Lawson and MacFaul, “Illegal Logging and Related Trade,” 2010; Hoare, “Tackling Illegal Logging and the Related Trade,” July 2015. In addition, a 2004 study by Seneca Creek Associates and Wood Resources International produced estimates of wood products from suspicious sources (i.e., wood that may have been illegally produced) by country, inclusive of domestic and imported sources. Seneca Creek Associates and Wood Resources International, “‘Illegal’ Logging and Global Wood Markets,” October 2004. Other studies have looked at the impacts of the U.S. Lacey Act, including a study on how the law impacted U.S. imports from low- and high-risk countries (UCS, 2015) and a statistical analysis of the impacts of these laws on overall U.S. imports and prices of wood products. UCS, “The Lacey Act’s Effectiveness in Reducing Illegal Wood Imports,” October 2015; Prestemon, “The Impacts of the Lacey Act Amendment of 2008 on U.S. Hardwood Lumber and Hardwood Plywood Imports,” January 2015.

¹⁰ In addition to the USITC’s IUU fishing study, a 2016 study by the World Wildlife Fund relied on estimates from the Pramod et al. study to estimate the impact of IUU fishing on U.S. fishers. WWF, *An Analysis of the Impact of IUU Imports*, 2016. The Seneca Creek study analyzed the competitive impacts of illegal wood trade on the U.S. wood products industry. Seneca Creek Associates and Wood Resources International, “‘Illegal’ Logging and Global Wood Markets,” October 2004.

when data are incomplete or imperfect. The tools described in this paper could apply to any import market; however, this paper demonstrates these concepts by focusing on the U.S. market given its size, range of imported products and partner countries, and availability of detailed trade data.

In the first section, “Defining the Scope of Analysis,” a set of guidelines are discussed for researchers seeking to define the conceptual boundaries of the illicit trade being analyzed. The second section, “Estimating the Extent of Illicit Imports,” provides a set of tools for developing a database of illicit production estimates and for translating illicit production estimates—whether developed or derived from other sources—into estimates of illicit U.S. imports using supply chain analysis. The third section, “Modeling the Impact of Illicit Trade Flows,” describes a modeling framework for analyzing the impact of these estimated illicit U.S. imports on U.S. industries. This section discusses important considerations when modeling the impact of illicit imports on domestic industries that a researcher should assess to estimate realistic effects. The fourth section provides two case study scoping exercises involving wood products and cotton that illustrate how these frameworks might play out in actual analyses.

Defining the Scope of Analysis: Which Illicit Activities are Covered?

As described above, the concept of “illicit trade,” which can include illegal and/or unethical practices, is largely dependent upon the perspective of the observer. Supply chains serving import markets can incorporate multiple production processes that could be considered illegal or unethical. For example, global cocoa cultivation reportedly includes practices such as forced labor and child labor, deforestation, and ineffective land management.¹¹ Illegal gold mining is defined by INTERPOL as an environmental crime, but it also relies upon a criminal supply chain that involves smuggling, human trafficking, and corruption and can also fund internal conflict in the countries engaged in production.¹² Researchers seeking to measure and analyze illicit trade in any sector therefore need to make decisions about the types of illicit activities they plan to cover. Answering the following three questions can help with these scoping decisions:

How will the analysis be used? An audience interested in sustainability or illegality in a general sense may find most useful a broad scope that includes various types of illicit practices. Otherwise, if a scope is set too narrowly to include only one of several illicit activities that are prominent within the sector, these readers may inadvertently “give a pass” to industries that are highly unsustainable, illegal, or unethical in other ways. By contrast, if the analysis is designed to support existing or prospective government policies or industry efforts dedicated to limiting import market exposure to specific illicit production practices, then the scope of analysis should be circumscribed within those bounds. Similarly, if the analysis is meant to build on an existing body of literature focused on a well-defined type of illicit

¹¹ USDOL, ILAB, *2020 List of Goods Produced by Child Labor or Forced Labor*, September 2020; Food Empowerment Project, “Child Labor and Slavery in the Chocolate Industry,” October 28, 2021; Pearce, “The Real Price of a Chocolate Bar,” February 21, 2019.

¹² INTERPOL, “Project ENACT Strategic Assessment: Illegal Gold Mining in Central Africa,” May 2021; USDOL, ILAB, *2020 List of Goods Produced by Child Labor or Forced Labor*, September 2020.

activity, such as IUU fishing as defined by the FAO,¹³ then it can be useful to use this common reference point as the scope of analysis for illicit trade.

Which illicit production practices are possible to measure? As described in later parts of this paper, it is likely that some types of illicit activities occurring in specific industries are more measurable than others. The scope should be set in a way that avoids analytical paralysis caused by insufficient information related to specific practices. In addition, information gaps may result in a narrower geographic scope and/or product scope, focusing only on specific products and source countries for which information is more readily available (as illustrated within the case studies below). Notwithstanding these limitations, research to fill gaps and recognition of uncertainty are likely necessary for measuring all kinds of illicit production activities.

Is the analysis focused on illicit production practices at multiple stages of the supply chain, and if so, to what extent will these illicit production practices overlap within a supply chain? Even when the illicit production practices at multiple stages of the supply chain are identified and measured, they often cannot be simply aggregated. It is likely that at least some illicit downstream processes in downstream operations use raw materials that were also generated using illicit methods. For example, a tuna cannery engaging in illegal labor practices may also be using tuna that was harvested illegally or was caught using forced labor on the fishing vessel. Therefore, any analysis that attempts to combine such practices within a single set of quantifications would need to contend with this overlap.

Estimating the Extent of Illicit Imports

Estimating the extent of illicit U.S. imports involves developing estimates of illicit production within source countries, and then using a supply chain analysis to determine the extent to which illicit products are ultimately imported into the United States. The first part of this section describes the necessary components and strategies for developing illicit production estimates at the source, while the second part of this section describes the supply chain mapping system. These two components form the primary approach to estimating illicit U.S. imports—an approach that is referred to as the **specific estimate approach**—that is covered in this paper. The third part of this section describes a simpler alternative to the specific estimate approach, referred to as the **broad estimate approach**.

This section uses a common hypothetical example throughout, based on illicit coffee trade. Specifically, the example assumes that the analysis will measure U.S. imports of coffee that was cultivated and harvested using forced child labor (FCL). The estimates provided for illicit coffee trade are used for illustrative purposes only and are not based on research into these practices. More detailed scoping exercises that incorporate existing literature are provided at the end of the paper, covering imported wood products and cotton.

Estimating Illicit Production at the Source

Estimates of illicit production, accompanied by measures of non-illicit production and total production, are the foundation of analyses of the extent of illicit U.S. imports. In this framework, production data is gathered to measure the value or quantity of output occurring at the point in the supply chain that most

¹³ FAO, “What Is IUU Fishing?,” accessed December 2, 2020.

closely corresponds with the illicit activities being measured. For example, if the objective of the analysis is to analyze illicit activities in coffee growing, then production data would be gathered for the output of coffee farms—unroasted green coffee beans—and not for further downstream products. Production data is further divided into estimates of illicit and non-illicit production. **Illicit production** refers to production that uses illicit activities as defined by the scope of analysis (in this case, forced child labor), where all output that relies on those illicit activities is considered illicit production. **Non-illicit production** refers to production that does not use those illicit activities. Both illicit and non-illicit production estimates can be expressed as a share of total production or in terms of their absolute value or quantity.

Production data and illicit production estimates can be gathered by specific parameters. These could include **source countries** that produce the in-scope product; **product groups**, which can be used to harmonize product descriptions across various data sources; time of production, which is often measured in years; and other variables that can be used to further subdivide production, such as industrial sector, subnational region of production, or method of production. **Production units** are the specific combinations of source country, product group, and/or other parameters for which production data and illicit production estimates are collected. A **production database** is a collection of production data and illicit production estimates, where each observation shows the quantity or value of total and illicit production across production units.

Building the Production Database

In order to develop illicit production estimates, a good starting place is to first develop a production database that shows where total (or official reported) production is occurring, what specific products are being generated, and in what quantities. The production database serves two purposes. First, the production database provides a comprehensive landing zone for all necessary illicit production estimates. (Approaches to populating these estimates are described in the next section). Total production quantities for each detailed production unit also lend necessary context and weight to illicit production estimates, particularly when those estimates are generated as a share of total production. Second, estimates of illicit and non-illicit production within the production database are a necessary input within the supply chain analysis.

The source country, product group, and other parameter inclusion within the production database is dictated by the scope of analysis. Certain analyses may be focused on U.S. imports of specific commodities from all source countries, and in these cases, production data should be gathered for all source countries that could potentially be the original producers of U.S. imports of those products (whether or not they were the ultimate exporting partner country—many products may be processed in a third country before being exported to the United States). Other analyses may only need to cover a narrower subset of producing source countries. Likewise, the product group coverage may be detailed, with one or more differentiating features, or may be broad. Analyses of U.S. imports with longer supply chains generally will need production data for both U.S. partner countries as well as those countries' trading partners, and may also require more complicated product groups. Availability of production data (described below) may also dictate the scope of analysis or the level of product detail included within analyses.

Once the bounds of the production database are established, the next step is to actually develop the data for each production unit. This may be a straightforward task if country-specific production data is

available from a single, internationally focused source, like the Food and Agriculture Organization (FAO) or United States Department of Agriculture (USDA) for many agricultural products or the United States Geological Survey (USGS) for mineral products.¹⁴ Alternatively, many national governments have detailed information about their own countries' production of specific products. Regardless of whether data are collected from international or source country specific data sources, they should be harmonized comprehensively within the production database. Harmonization steps can be illustrated using table 1, which provides a simplified example of a production database for coffee prior to any inclusion of illicit production estimates. Each row in the table represents a production unit for which an illicit production estimate (measured as a quantity of illicit production or as a share of total harvest) can be gathered (here, represented by "TBD").

Table 1 Example production database for coffee

Source country	ISO-3	Product group	Year (local marketing year)	Green coffee production (1,000 60 kg bags)	Illicit production estimate
Brazil	BRA	Arabica Coffee	2020/21	49,700	TBD
Brazil	BRA	Robusta Coffee	2020/21	20,200	TBD
Colombia	COL	Arabica Coffee	2020/21	14,300	TBD
Colombia	COL	Robusta Coffee	2020/21	0	TBD
Ethiopia	ETH	Arabica Coffee	2020/21	7,600	TBD
Ethiopia	ETH	Robusta Coffee	2020/21	0	TBD
Indonesia	IDN	Arabica Coffee	2020/21	1,300	TBD
Indonesia	IDN	Robusta Coffee	2020/21	9,400	TBD

(rows continue, covering all countries and products)

Source: Foreign Agricultural Service, Official USDA Estimates (accessed August 17, 2021).

Note: TBD = To be determined by the researcher as part of developing a production database.

Harmonization steps used in production database creation include:

- Source countries (and other non-state territorial designations) included within the database should be organized within an internationally consistent nomenclature system, such as the ISO 3166-1 alpha-3 ("ISO-3") code system, that allows for easy translation of these source country designations across data sources (including the trade data sources covered in supply chain analysis).¹⁵ In table 1, the database is divided by source country, where each source country is also matched with an ISO-3 code for ease of reference alongside other data sources, such as trade data used within the supply chain analysis.
- The same level of product group detail, ideally at a level that is analytically useful, should be used across all data.¹⁶ There are two ways in which product group detail can be useful: first, because the product groups allow for more detailed and accurate estimates of illicit activities to be developed; and second, because the more detailed product groups allow for more accurate

¹⁴ FAO, FAOSTAT Database, accessed November 5, 2021; USDA FAS, PSD Online, accessed November 5, 2021; USGS, "International Minerals Statistics and Information," accessed November 5, 2021.

¹⁵ UNSD, "ISO 3166-1 Alpha-3," accessed November 5, 2021.

¹⁶ Even with production databases that are derived from internationally focused data sources, it may be the case that production data is not broken out on a detailed product basis for specific countries despite being broken out for most other countries. In these circumstances, it may be possible to break apart production data falling within broad product designations for individual source countries based on the global weighted mix of underlying detailed products.

supply chain mapping as a result of their correspondence with global trade data. The supply chain analysis is described in greater detail below. In table 1, product groups correspond with the two main varieties of coffee plant, which are Arabica and Robusta. These product groups were chosen in this hypothetical example because (1) they are readily available within the USDA data used to generate this database and (2) because there may be distinctions in the illicit production estimates for each variety depending on the source country.¹⁷

- If there is variation in how time periods are defined (e.g., use of a mixture of calendar, marketing, and/or fiscal years covering different overlapping annual periods), this should be harmonized or at least identified to the extent possible as well. In table 1, the production database was only gathered for a single year; however, the USDA data gathers this data by local marketing year, which is clearly identified in this database.¹⁸
- Production data should be expressed based on the same unit of quantity or value measure. Quantity measures (e.g., metric tons or kilograms) are ideal within specific product categories, but value measures are also acceptable as long as there is not a significant variation in product mix (with widely ranging unit values) across production units.¹⁹ In table 1, production data are expressed based on the same unit of quantity, which is 1,000 60 kg bags of green coffee.
- For all production units, production data should be gathered for the total output of goods that most closely correspond with the illicit activities being measured. In table 1, green coffee production is the measure of output that most closely corresponds with the illicit activity within the scope of that hypothetical analysis (FCL within coffee growing and harvesting).²⁰

Populating Illicit Production Estimates

Estimation of illicit production must contend with the fact that most official production data that rely on self-reporting, surveys, or census-taking do not specify whether these products were generated using illegal or unethical practices. Therefore, estimates of illicit production are at best reasonable but uncertain findings regarding activities that the producers themselves—or their associated industry associations or national governments—often do not want to be more broadly witnessed and measured. These estimates are based on the best information available, and are usually incomplete, indirectly derived, or inconsistent across studies. Most bodies of research on the extent of illicit production in individual sectors consist primarily of studies that have reached such estimates for specific geographies using a combination of specialized or local knowledge and imperfect research techniques. Regional or

¹⁷ Whether these product breakouts are possible within global and U.S. trade data is also a relevant aspect of defining product groups, as discussed in greater detail below in the section entitled “Building Data Translation Systems for Supply Chain Analysis.”

¹⁸ Local marketing years differ depending on the country, which means that production data corresponds to different months overlapping with these years. Within agricultural markets, this differentiation is important to recognize and presents additional challenges within supply chain analysis, which involves use of trade data that may not correspond with marketing years.

¹⁹ Note that if a time series of data is being collected, unit values may shift with price changes substantially over time, which will reduce comparability of production data across production units over time.

²⁰ Although green coffee production is a processing step that occurs after coffee growing and harvesting, these activities generally take place near one another. Espresso International, “Coffee Cultivation,” accessed November 8, 2021.

global estimates are rare, and often rely on combinations of multiple ad hoc smaller-scale estimates, which themselves may rely on a variety of techniques.

As described above, this paper is primarily focused on the process of translating illicit production estimates into estimates of illicit U.S. imports. Therefore, rather than describing the many methods that could be used to generate illicit production estimates from scratch, a broad discussion of original research techniques is provided as well as options for how to use existing literature, databases, inferences, and risk data to develop illicit production estimates. For any given estimation exercise, the specific approach to populating illicit production estimates will likely vary depending on the industry, scope of analysis, and data availability.

Original Research Techniques

Many approaches have been taken to estimating the extent of illicit production across various bodies of literature. In general, methods for estimating illicit production fall into two broad categories: “bottom-up” and “top-down” approaches.²¹ Bottom-up approaches essentially refer to techniques that compile a variety of granular data points to construct aggregated estimates of illicit production for specific products, countries, and/or other parameters. These data points may include direct observation of illicit production by enforcement bodies that are then extrapolated to produce broader estimates; indirect observation of illicit production using remote sensing technology, like satellites and aircraft; or surveys or interviews of industry participants.

Top-down approaches use available data to extrapolate estimates of illicit production. For example, comparisons of reported production data with trade data may reveal that a country is exporting more of a product than it produces, which could suggest that a significant amount of unreported production is occurring. Similarly, scientific surveys of species populations or habitat coverage can help to identify unaccounted for gaps in output that could represent illicit production.

There are several factors that can complicate the use of original research to generate estimates of illicit production in support of estimation of illicit U.S. imports. Original estimates are often for highly specific regions and products and require substantial first-hand experience with the sector and/or knowledge of practices on the ground within those localities. Even where a researcher has that level of expertise, the same knowledge and approaches used may not be applicable across a breadth of source countries and product groups covered in a production database. Based on the resources, time, and experience of the researcher, it may still be possible to incorporate original research despite these factors; however, this paper also provides several approaches below for using estimates or assumptions from other sources.

Existing Studies

Populating illicit production estimates using quantifications from existing studies may be the best approach for developing these estimates across multiple production units. In particular, studies or databases that offer illicit production estimates on a global or regional basis can provide a broad range of estimates across ranges of product groups and source countries based on uniform methodologies and

²¹ This general description of the methods used to estimate illicit production is derived from a literature review within *IUU Fishing*, which looked at the broad variety of techniques used to estimate IUU fishing in various fisheries. USITC, *Seafood Obtained via IUU Fishing*, February 2021, Appendix E.

concepts. However, use of existing illicit production estimates derived from literature requires careful consideration of the basis for those findings. Several questions that researchers may consider when using existing estimates include:

1. What were the methods for generating illicit production estimates? What were the limitations of those methods? What approaches can be taken to mitigate or incorporate uncertainty created by those limitations?
2. Are there multiple studies that provide estimates covering the same production units? Are the multiple findings self-reinforcing, or are they contradictory?
3. How do the definitions of illicit production derived from existing studies compare with those illicit activities targeted within the scope of analysis?
4. How do the methods, scopes, or definitions compare across the studies being relied upon to populate the illicit production estimates in the production database? Are estimates comparable on an apples-to-apples basis across production units?

Use of Inferences

Depending on how illicit production is defined within the scope of analysis, inferences can be used to estimate the extent of illicit production within specific countries. For example, if specific firms or regions are implicated as using illicit practices and if there is any way to determine their representativeness or position within national-level industries, then the extent of illicit production within a country can be estimated. This approach may be particularly useful for estimating the extent of production subject to U.S. government enforcement actions, such as U.S. Customs and Border Protection (CBP) Withhold Release Orders (WROs).²² Additionally, this approach could be used if non-governmental or journalistic investigations tie illicit production practices to major producing firms or regions.

Risk Data

Risk data are qualitative measures of the likelihood that illicit production is occurring, and may be on numeric scales (e.g., from 1 to 10) or grouped into descriptive buckets (e.g., “very high risk,” “moderate risk,” etc.). In some cases, risk data may be more readily and comprehensively available than quantifications of illicit production for the coverage of production units within the production database. Risk data are often constructed by outside organizations based on a uniform aggregation or weighting of underlying criteria. Such criteria can be inherently quantitative measures (e.g., number of government seizures due to illegal practices) or qualitative measures that can be expressed quantitatively such as binary variables (e.g., whether or not certain types of laws are on the books in a country) or subjective but consistently applied qualitative scores (e.g., scores assigned based on perceived regulatory strength by a watchdog organization). Researchers can also construct their own risk data based on criteria that better match their needs.

Risk data can be used as a basis for estimating the quantity of illicit production for individual production units. One way that this can be achieved is to associate a share of total production that is likely to be illicitly produced for each gradation of risk along a scale (e.g., low risk = 5 percent of total production is

²² CBP WROs seek to limit U.S. imports of products produced by forced labor by detaining shipments of products from specific firms or regions in foreign countries that are reasonably suspected of engaging in forced labor practices. CBP, “Forced Labor,” accessed December 14, 2021.

illicitly generated, medium risk = 10 percent, etc.). This can be done using relatively simple methods, such as cross-referencing well-supported estimates of illicit production for specific production units with those production units' risk measures, and then using the same estimates (expressed as a share of total production) for all production units with similar risk. Alternatively, if there is a known statistical relationship between specific risk measures and shares of illicit production, this can be used to generate comprehensive estimates of illicit production across all production units for which risk data are available.

Using similar principles, risk data can be used as a basis for adjusting illicit production estimates. Adjustments can include:

- **Time-series risk data as a basis for adjusting static illicit production estimates:** Illicit production estimates may be rare except for in certain years, whereas risk data may be more regularly updated across years. Changes in risk across time may be used as a basis for updating estimates of illicit production across a time series or updating older estimates of illicit production to adhere to more recent realities.²³
- **Gap filling:** Illicit production estimates may be available from literature review or a database pull for most production units within a production database, but not all (particularly for countries or products that are not as heavily focused on within the literature). Missing illicit production estimates can be populated based on a more ad hoc version of the comprehensive risk-based estimation approaches described above.
- **Triangulation of resources:** Because illicit production estimates, which capture activities that are difficult or impossible to measure directly, are subject to significant uncertainty, risk data can be used to “shore up” existing illicit production estimates. If a production unit has illicit production estimates that are high as a share of total shipments, and that production unit also has high risk of illicit production, then these data are mutually supportive. Alternatively, if a production unit has mismatched illicit production estimates and risk data, it may be the case that the illicit production estimate should be adjusted to fit within a more normal range for production units of that risk profile.²⁴
- **Upward adjustments to capture additional illicit production activities:** If risk measures capture an aspect of illicit production that is not captured within existing illicit production estimates, then they may form a basis for systematically increasing the illicit production estimates if specified risk thresholds are met for production units. For example, if the defined illicit production within the scope of analysis includes both environmental and labor-related illegality, then measures of illicit production based on environmental illegality could be adjusted upward for production units with elevated risk of labor-related illegality. The nature of this upward

²³ This approach is consistent with the “anchor point and influence” approach used in several global studies of the extent of IUU fishing. See, e.g., Pitcher et al., “Estimating Illegal and Unreported Catches from Marine Ecosystems,” 2002; Ainsworth and Pitcher, “Estimating Illegal, Unreported and Unregulated Catch,” 2005; Agnew et al., “Estimating the Worldwide Extent of Illegal Fishing,” 2009; Pramod et al., “Estimates of Illegal and Unreported Fish in Seafood Imports to the USA,” 2014; Pauly and Zeller, “Catch Reconstruction,” 2015.

²⁴ This approach was used within the estimation of marine capture IUU fishing within USITC’s *IUU Fishing* study. USITC, *Seafood Obtained via IUU Fishing*, February 2021.

adjustment would ideally take into account the extent of overlap any inherent relationship between the two types of illicit activity.²⁵

Alternatively, rather than use risk data as a basis for estimating the quantity of illicit production, the risk data could be used to characterize total production within the database into various risk buckets. The subsequent supply chain analysis (described below) would essentially determine the extent of U.S. imports subject to elevated risk of illicit practices, without actually identifying the imports as illicit products.²⁶

Box 1 Final Considerations within the Production Database

After a production database is created and populated with illicit production estimates, a few final adjustments and considerations may be necessary.

Catching False Zeroes: In certain cases, illicit production estimates may be populated within the production database for all but a handful of production units. If that is the case, missing estimates for those production units may be inadvertently interpreted as zeroes (i.e., zero production using illicit activities) within later steps. In these cases, it may be possible and worthwhile to populate illicit production estimates based on rough assumptions (such as the assumption that the global average illicit production estimate, on a percentage basis, applies to that production unit).

Adjusting Production: As illicit production estimates are populated within the production database from various sources, they may be expressed as a share of total production, as a share of officially reported production, or as absolute quantities or values. To be used in supply chain analysis, however, illicit production estimates should be presented in absolute terms alongside non-illicit production, which sum to total production. In order to accurately calculate these two measures, however, the relationship between illicit production estimates and total production data should be examined, which may result in further adjustments. For example, the production data derived from official sources within the production database may only cover the extent of non-illicit production, rather than a sum of non-illicit and illicit production. This could occur if all illicit production occurs within informal or grey-market economies that are not observed by authorities and/or captured within official statistics. In these cases, estimates of illicit production should be added to preliminary production data to equal final total production measures.

²⁵ This approach was used to incorporate labor violations within estimates of marine capture IUU fishing within the USITC's *IUU Fishing* study, since labor violations were not traditionally included within existing estimates of IUU fishing that were otherwise relied upon for that study. USITC, *Seafood Obtained via IUU Fishing*, February 2021.

²⁶ Two studies on illegal wood production used similar approaches. The 2004 Seneca Creek Associates study produced estimates of wood products from suspicious sources (i.e., wood that may have been illegally produced) by country, inclusive of domestic and imported sources. Seneca Creek Associates and Wood Resources International, "Illegal Logging and Global Wood Markets," October 2004. The 2015 UCS study estimated U.S. imports from low- and high-risk countries. UCS, "The Lacey Act's Effectiveness in Reducing Illegal Wood Imports," October 2015.

Supply Chain Analysis

The Supply Chain Mapping System

Supply chains consist of the links between companies which interchange materials and information necessary to transform unprocessed raw materials into finished goods sold to end users.²⁷ Analyses of illicit U.S. imports need to extend the length of the supply chain between, at the furthest upstream, the operations where the foreign illicit production activities could occur, and at the furthest downstream, the point of U.S. importation. As an example of this, consider a simplified depiction of the coffee supply chain below (figure 1).

Figure 1 The coffee supply chain



Sources: Compiled by authors based on Wallach, “From Bean to Brew,” August 7, 2020; Espresso International, “Coffee Cultivation,” accessed November 8, 2021.

In this simplified version of the supply chain for coffee, each step represents a process that results in the output of an intermediate or final good. Step 1 is the generation of agricultural inputs, including fertilizers, water, electricity, and seeds. All of these have their own upstream production processes. Step 2 is the growing and harvesting of coffee berries, which are unprocessed products. Step 3 is the wet or dry processing and milling that produces semiprocessed green coffee beans. These processes occur almost exclusively within the same area as the growing and harvesting process. Step 4 includes the roasting and commercial grinding processes that result in output of roasted coffee and solubles—these are considered processed products that are ready to be sold to retailers, restaurants and cafes, and downstream producers of other kinds of processed foods that use coffee as an ingredient. Step 5 is the sale of final packaged ground, bean, soluble, or prepared coffee to final consumers.

If the goal is to measure the extent of U.S. imports of coffee that contain the products of forced child labor (FCL) practices on coffee farms, the furthest upstream point of interest in the supply chain analysis is step 2 in the figure above, which is the growing and harvesting of coffee berries. This is the production stage that corresponds with the point where illicit activities within the scope of analysis may occur, and also is the production process for which a production database should be created. The United States imports coffee at two later stages of production: green coffee for further processing and roasted coffee for final consumption or use in other food processing.²⁸ For U.S. imports of green coffee, the furthest

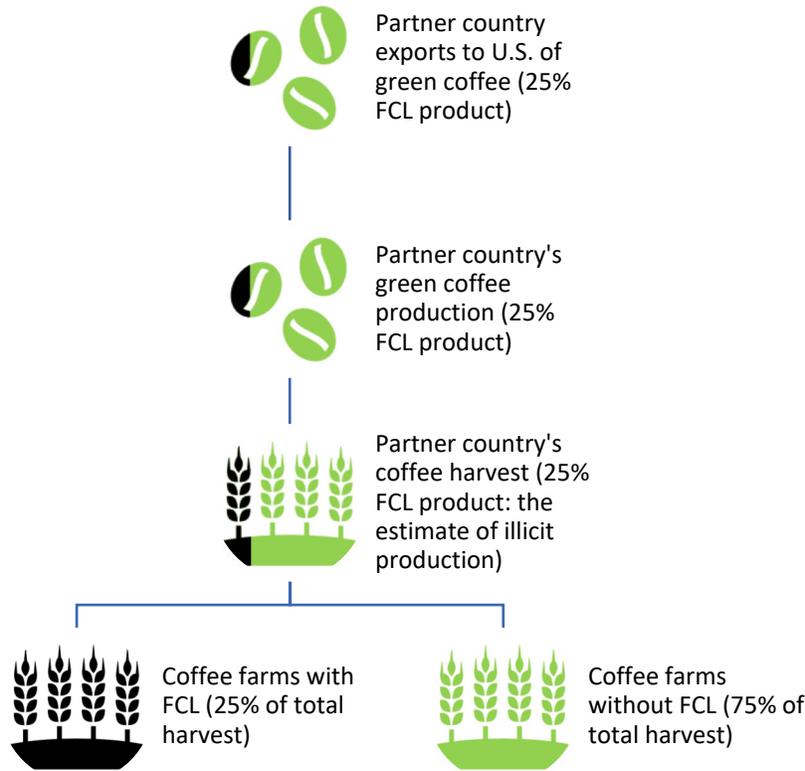
²⁷ Jones, Demirkaya, and Bethmann, “Global Value Chain Analysis: Concepts and Approaches,” April 2019, 3.

²⁸ The United States imports a variety of processed coffee products that extend beyond the roasting stage, including whole bean and ground coffee as well as soluble coffee (e.g., instant coffee) in a variety of packaging options. “Roasted coffee” is used as a shorthand term in this paper for all of these products.

downstream point of analysis necessary is step 3 in the figure above (wet or dry processing and milling that produces green coffee beans). For U.S. imports of roasted coffee, step 4 (roasting and commercial grinding processes) is the furthest downstream point of analysis required within the analysis.

Supply chain analysis within this framework traces an estimate of illicit production from the upstream production to the U.S. imports at subsequent stages of processing. The illicit status of an input is conferred downstream within goods processed from that input, such that those products are also considered illicit products. For example, green coffee produced using berries harvested using FCL is also the product of FCL. Roasted coffee produced using FCL-derived green coffee inputs are similarly illicit product.

In many markets, products within the same group will likely be highly commoditized and mixed regardless of their other attributes, with little or no segregation of illicit product from non-illicit product. This expectation forms the basis of the **proportionality** assumption that is a key feature in the supply chain analysis: under this assumption, downstream processing operations will use inputs of the same product group that have a mixture of different attributes, including whether or not they are illicitly produced. The proportions of each attribute within that mixture are consistent with the proportions of each attribute within the available supply of inputs for that product group. For example, under this assumption, green coffee producers will source a mixture of berries from farms that use FCL and from farms that do not use FCL, such that the extent of FCL practices from all input sources will carry forward proportionally into green coffee production (see figure 2). Similarly, roasted coffee will have a proportional mix of illicit and non-illicit product consistent with processors' inputs, based on where these processors source their green coffee from. (As described below, the proportionality assumption can be adjusted on an ad hoc or systematic basis for different steps along the supply chain to account for markets that are less clearly commoditized or that are subject to specific preferences.)

Figure 2 Share of illicit product within green coffee production and exports

Source: Authors.

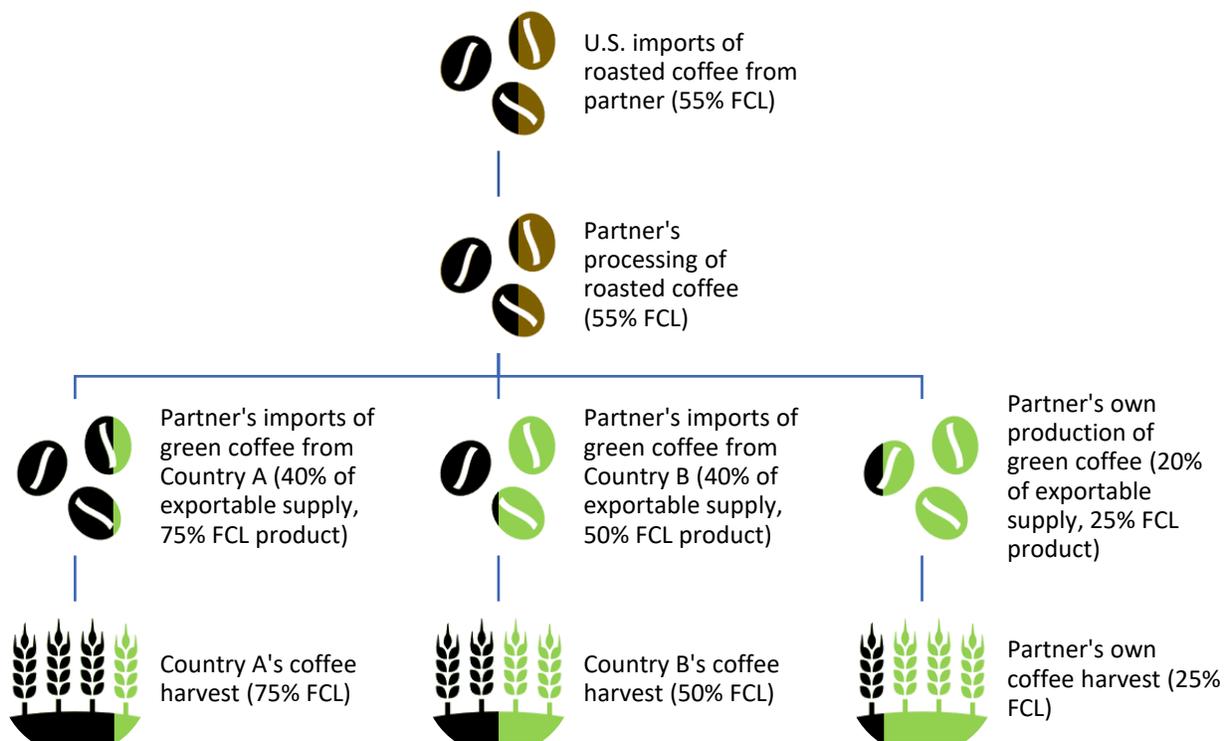
For U.S. imports of products that have likely undergone no additional processing (like coffee berries, although these are not traded extensively) or exclusively local forms of processing (like green coffee), the only source country supplying the partner country's **exportable supply** (supply of inputs available for processing activities that generate exports to the United States) of those products is the partner country itself. Therefore, the extent of illicit activities within the partner country's own production operations carries through proportionally into its exports to the United States and any export destinations. For example, if 25 percent of a country's harvest of coffee berries is generated from FCL, then 25 percent of green coffee produced in that country is also the product of FCL as well as 25 percent of that country's exports to the United States (see figure 2). Therefore, the data needs for conducting U.S. supply chain analysis for such unprocessed or locally processed products are simple: only the estimate of illicit production (expressed as a share of total production) and U.S. import data are required.²⁹

Other U.S. imports are of products (like roasted coffee) that have been processed in partner countries using inputs that could have been sourced by industries in the partner country itself or from their own imports. The partner country's exportable supply of those products is the proportional mix of (1) its own production of illicit and non-illicit upstream products; and (2) its imports of illicit and non-illicit upstream products. Therefore, the extent of illicit activities within these combined sources carries through into the

²⁹ In analyses that only involve such unprocessed or locally processed goods, production data such as that compiled within the production database step of this framework, described above, may not be necessary.

partner country’s exports to the United States. Such analyses require partner countries’ import data (often available through global trade data sources) and partner countries’ production data in addition to illicit production estimates for all source countries and U.S. import data. As an example, consider a case where a partner country sources 40 percent of its green coffee supply from foreign source country A, 40 percent from foreign source country B, and 20 percent from its own coffee growing and green coffee production. These sources generate green coffee using harvests that rely on FCL for 75 percent, 50 percent, and 25 percent of output, respectively. On this basis, 55 percent (30+20+5 percent) of the partner country’s exportable supply of roasted coffee would be the product of FCL, which would carry forward proportionally into its exports to the United States (see figure 3).

Figure 3 Share of illicit product within roasted coffee processing and exports



Source: Authors.

Additional Supply Chain Considerations

Building Data Translation Systems for Supply Chain Analysis

Once the data needs within the supply chain analysis are established and relevant data collected, a strategy needs to be developed for these data to actually translate across the various sources: in other words, the data sources need to “talk” with each other. There are relatively straightforward but important (and sometimes time intensive) parts of this process. As noted in the production database

discussion, countries and territories should be harmonized across data sources, as should the time periods covered (e.g., if fiscal years or crop years need to be translated into calendar years).³⁰

In analyses involving different products, the most complicated aspect of the data translation process is likely to be in assigning product groups that apply across data sources. Production data and trade data are organized by product categories, but these categorizations will differ across data systems. Therefore, creating concordances (tools that compare product groups side-by-side across data sources) involves a balancing act between two goals: (1) data specificity that provides useful analytical information and (2) data comparability across all data sources needed in the supply chain analysis. Although it can be tempting to aggregate data for each system into a “common denominator” basket category (which may not be very detailed), maintaining greater levels of product differentiation can strengthen the overall analysis.

In the coffee example, global production data, global trade data, and U.S. import data have product groupings that allow for identification of coffee. Global production data is available for green coffee. Global trade data is roughly broken into semiprocessed products (green coffee) and processed products (roasted coffee and soluble coffee extracts such as instant coffee). These basic levels of detail allow for the supply chain analysis shown in the figures above. Under these analyses, any subnational estimates of illicit coffee production would be aggregated and applied to all subsequent parts of the supply chain. Also, estimates of illicit production for coffee harvesting would carry forward and apply to all detailed import product categories.

However, all of these data sources also have greater levels of detail for coffee products and maintaining and using these levels of detail may be desirable if possible. For example, global production of green coffee and U.S. imports of green coffee are broken out into Arabica and Robusta varieties. Within analyses of U.S. imports of green coffee, maintaining these varietal differentiations could allow for more accurate estimates of illicit product within U.S. imports of green Robusta or Arabica coffee if it is possible to reach different estimates of illicit production for these varieties within individual countries. These more nuanced estimates would also be useful in analyses of the longer supply chains of processed products, even though trade data for processed categories do not differentiate between Robusta and Arabica. In these extended supply chain analyses, the distinct estimates for Robusta versus Arabica coffee could be applied to processed products on a weighted basis.

Other product differentiations might be useful only within the context of a single part of the supply chain. For example, U.S. imports have coffee categories that are broken out by whether or not the coffee is certified organic. Although other production and trade data do not have these designations, the organic status of certain U.S. coffee imports may be useful in determining whether or not those imports should be representative of the exportable supply of that partner (i.e., they may have disproportionately lower illicit products included because they face monitoring from organic certification bodies).

³⁰ In many cases, it may be challenging or impossible based on data availability to overcome the lack of harmonization between marketing year, fiscal year, and calendar year. Even where all data sources are organized using the same annual systems, it may be the case that trade occurs in the year or two after production occurs, which also attenuates the temporal relationship between international trade data and production data. Where these limitations cannot be overcome within data development, they should be recognized.

Conversion Factors

The weight and value of products change as they move downstream along supply chains, often becoming lighter (as waste and byproducts are removed) and more expensive (reflecting the value-added activities that have occurred). For example, green coffee beans lose approximately 16 percent of their weight when processed into roasted coffee and 61.5 percent when processed into soluble products.³¹ The exportable supply calculation for each stage of the supply chain should be based on the same units, which may require use of conversion factors to ensure that unprocessed raw inputs are expressed on the same basis as semiprocessed products. As a hypothetical example, it could be the case that a partner country that exports roasted coffee to the United States has data for its own production of coffee berries from farms and data for its own imports of green coffee from other countries. Because green coffee weighs less, bean for bean, than coffee berries, the coffee berry production would need to be weighted downward using a conversion factor to a green coffee basis to be comparable with import data.³² Using these comparable data, that partner country's exportable supply for roasted coffee could be compiled from the various data sources.

Bending the Proportionality Assumption

Within commodity markets that experience substantial mixing of goods, it makes sense that a downstream product's material inputs are reflective of the range of like input products available in that market. This principle underpins the proportionality assumption that is the foundation of the supply chain analyses described above. However, there are many reasons why this assumption may not hold across various supply chains. Even in commodity markets, some goods may not meet commodity standards and are produced primarily for local consumption; alternatively, some goods exceed commodity standards and enter more discrete supply chains. Processors and importers along the supply chain may have vertical integration and tracing mechanisms that limit mixing of supply from all possible producers in source countries. Final consumers in importing markets, particularly wealthier consumer markets like the United States, may have certain product preferences that differ from the total available supply of products. Within the context of illicit supply chain analysis, governments or market actors along the way may take steps to reduce exposure to products generated from illicit practices.

Practically, these types of qualitative findings suggest that there should be a quantitative adjustment to input concentrations such that certain types of products will be exported disproportionately less or more from source countries to partner countries, or from partner countries to the United States. Such quantitative adjustments can take the form of a "foot on the scales" approach by uniformly increasing the concentration of that product over alternatives by a certain likelihood percentage, which still allows sources with an overwhelming proportion of the other product to continue to send that product into the supply chain model. Or there could be a basis for "hardwiring" in certain concentrations of specific products from specific sources based on clearer quantitative information available.

³¹ International Trade Centre, *The Coffee Guide*, October 2021.

³² In reality, coffee production and traded unprocessed/semiprocessed coffee are measured most frequently at the more highly commodified green coffee level, so this hypothetical example may not be very common for the coffee industry.

Shifting the Analysis Downstream

Most of the examples used in this paper concern the production of primary intermediate goods, which characteristically are products of primary sectors of the economy, like farming, forestry, fishing, and the extractive industries, or products that have undergone minor additional processing steps.³³ Similarly, most of the U.S. imports used as examples are of products that mostly are composed of the primary intermediate goods themselves.

It could be the case that researchers want to measure illicit activities that occur in downstream processing operations rather than in the primary sectors. This could simplify the analysis, as long as there is a basis for estimating illicit activities within processing, because the analysis can be truncated at a later stage along the supply chain. For example, analyses of illicit activities in coffee roasting and packaging operations would not require any supply chain analysis involving coffee harvesting or green coffee production, unless the analysis was seeking to combine illicit activities at multiple stages of the supply chain.

On the other hand, analyses that include imported products that are further downstream may require even greater extensions of the supply chain analysis. For example, the analyses depicted above with respect to coffee concern supply chains that involve activities in, at most, two countries before being exported to the United States. If analyses involve additional downstream processing steps that occur in three countries before being exported to the United States, the processing of the penultimate inputs within those final exporting countries needs to be measured in order to assess those partner countries' exportable supply.

Additionally, some downstream products may incorporate other ingredients or materials that can complicate the analysis. While coffee, even roasted, remains primarily a one-ingredient product, further downstream products such as sweetened coffee-based beverages and candies have more complicated supply chains. Keeping in mind that the United States imports items such as coffee beverages and candy that are made from chocolate, sugar, and other ingredients in addition to coffee, the supply chain analysis for these further downstream coffee products would need to either (1) diversify the exportable supply calculation to include other types of inputs (thereby diluting the extent of illicit inputs within these diversified products); or (2) clearly define illicit U.S. import estimates as being derived solely from the upstream products at issue.

Simplifying Estimation of Illicit U.S. Imports: The Broad Estimate Approach

Certain markets and products lack the data specificity or availability needed to produce detailed estimates of illicit production or to perform the supply chain analysis necessary to connect these source practices to U.S. imports. Tying broad estimates of illicit production directly with U.S. imports—an approach described here as the **broad estimate approach**—provides a simpler and less detailed option for estimating illicit U.S. imports.

³³ United Nations, *Classification by Broad Economic Categories, Rev.5*, June 11, 2018, 16.

A broad estimate approach consists of an estimate of illicit production covering all countries as a share of global production, which may be more readily available or approximated than production unit-specific estimates.³⁴ Because these broad estimates do not have country-specific information, the supply chain analysis (which mixes and re-mixes goods based on where they originate) is not necessary. Broad estimates will not capture nuances associated with the variation of country-specific production practices, and these distinctions could be important if the United States imports products originating in certain major source countries but not others. However, the broad estimate approach may be well-justified if the United States is a major importer from many countries around the world, suggesting that the original origin of these products is dispersed and largely representative of global production. The simplicity of this approach may also make it more useful for generating illicit import estimates in analyses that are focused more on the impact of such imports on domestic industries. As described below within the “Modeling the Impact of Illicit Trade Flows” section, such impact analyses generally rely on aggregated rather than source-specific import estimates.

At its simplest, a broad estimate approach finds, approximates, or aggregates more specific estimates into a global estimate of illicit production for specific product groups, expressed as a share of total global production of those product groups. This share is then applied directly to U.S. imports of the product groups, which can then be used to estimate the value and quantity of U.S. imports of these products that are considered illicit. However, this analysis can also be extended—or modified with elements of the specific estimate approach—in multiple ways, such as those described below:

- **Use of multi-country groups of estimates:** Because illicit production is intrinsically difficult to measure and estimate, certain sectors do not have a wide range of available estimates of illicit output on a country-specific basis; however, authors may be able to develop estimates that apply to different groups of countries rather than a single global estimate. This approach would then use a supply chain analysis consistent with the specific estimate approach to connect country-specific estimates (derived from the multi-country groupings) to U.S. imports from various production units. For example, this may be possible if certain countries are known to be “good actors” based on research, have prevalent third-party certification schemes, or have low risk factors. Such an approach would make sense if the United States imports a disproportional quantity of products from countries known to have relatively low or high levels of illicit product within their supply chains.
- **Hybrid specific and broad estimate approach:** It could be the case that specific estimates are available for all production units in the production database, but the supply chain analysis needed to map those estimates to U.S. import flows is challenging. Supply chain constructions used in the specific estimate approach can be complexified by the number and variation of links along the supply chain, lack of transparency, and/or major uncertainties regarding proportionality of imported versus domestic product within exportable supply calculations. Notwithstanding these complexities that may exist, it may be the case that certain major U.S. import partners have simple or well-understood supply chains allowing for tracing back to the original source country for these products, allowing for use of nuanced production unit-specific

³⁴ Note that the idea of a “broad estimate” could be one country’s illicit production as a share of all global production, if only one country is the subject of the analysis. For example, an analysis seeking to understand U.S. exposure to products generated from one country’s illegal mining practices could estimate that country’s illicit production as a share of global production.

estimates. For U.S. import partners without clear supply chains, global estimates (consisting of aggregated illicit production estimates from the production database) can be used.

- **Distinguishing illicit content by imported product:** In certain cases, supply chain analysis may be complicated because imported products consist of complex intermediate and final goods that include many component parts, including variable amounts of the product group under analysis. (This is described above in the “Shifting the Analysis Downstream” section). While this presents an analytical challenge, it also presents an opportunity to extend global estimates into differentiated estimates by product. If the value-added or weight-added content of various U.S. imported goods can be divided between (1) the components consisting of products under analysis and (2) all other component parts, then the global share of illicit content within the products under analysis can be used to further differentiate the amount of illicit content within these different types of U.S. imports.

Modeling the Impact of Illicit Trade Flows

It is useful to policymakers and researchers to understand the extent of illicit trade flows, as described above. Also important to the discussion, however, is the negative *impact* that these illicit flows have on domestic industries. Limiting illicit trade flows from the domestic market may be beneficial to both domestic businesses and workers, and also have positive environmental or social implications.

Imports generated by illicit activities affect domestic producers primarily through price effects. In particular, an increase in the volume of imports will lower demand for domestic varieties that compete with those imports by basic laws of supply and demand. Illicit products also typically have lower prices because of lower operating costs, causing domestic producers to have to compete with these lower prices.³⁵ Though not a focus in this paper, illicit activities can further impact domestic producers in the export market by lowering the price received for products exported to other countries.³⁶ The negative impact of illicit imports on domestic producers can be measured with an economic model, as described in the sections below.

First, a practical approach to model the impact of estimated illicit flows on domestic industries is presented. The next section discusses important considerations when designing a modeling approach, such as how to think about the policy change and what features may be most important to build into the model to capture realistic model outcomes. Finally, a series of illustrative simulations are presented to show example model results under different assumptions about inputs.

Modeling Approach

There are a few different approaches a researcher could employ to estimate the impact of illicit trade flows on domestic industries, each with their own benefits and challenges. First, a researcher may want to estimate the effect of illicit trade flows on domestic prices using econometric methods with a series

³⁵ Lower operating costs of illicit producers can be a result of forced labor violations or noncompliance with regulations or quotas.

³⁶ One example of modeling the effects of illicit trade in the exports market can be found in the Seneca Creek Associates report referenced earlier. Seneca Creek Associates and Wood Resources International, “‘Illegal’ Logging and Global Wood Markets,” October 2004.

of panel data, but a long panel of estimates of illicit trade may not be available or too time consuming to estimate. Also, an econometric model may not be able to provide effects on a wide variety of outcome variables, such as operating income, employment, downstream production, or on related products. Moreover, there may be significant endogeneity concerns to address to untangle effects.³⁷ A second option is a financial impact assessment that relies on literature estimates of industry-specific elasticities to understand how changes in trade flows impact the domestic market. However, the elasticity estimates from the literature may be outdated, or imperfect, measures of responsiveness for that product, and the method would not capture important industry considerations like constraints on domestic producers or substitution effects.

A partial equilibrium modeling framework is a reasonable method to capture the impact of illicit trade flows on the domestic industry, and is the primary framework relied upon in this paper due to the limitations described above for other methods. A model can be set up to simulate the effects of illicit trade on prices, domestic production, total trade, operating income, and employment. The modeling framework is highly customizable to include capacity or natural resource constraints, substitution to related products, linkages to the processing sector, or other features that are important to the industry being modeled. Such a modeling approach is outlined in the rest of this section, including a discussion on why some of these features may be important to include in the modeling approach.

A partial equilibrium model is a set of equilibrium equations that characterize the domestic industry. In the framework presented here, consumers imperfectly substitute the domestic variety with competitive imports through a series of constant elasticity of substitution (CES) functions. It is assumed that illicit and non-illicit products are indistinguishable, that upon inspection of the product, a border agent cannot tell the difference between the two types of products and that they enter at the same price. The model is built and calibrated with total imports, including both the non-illicit and illicit trade flows that are present in the trade data.³⁸ The model then exogenously removes the illicit trade flow estimate (calculated based on methods described in a previous section of this paper) and imposes replacement rate parameters that determine how much of the illicit trade is replaced by non-illicit trade in the policy change scenario.³⁹ The model simulates what the domestic industry would look like without the illicit import estimate as a source of supply.

³⁷ If the data is available, the researcher could regress domestic shipments on illicit trade flows to understand the impact on the domestic industry. There may be several endogeneity issues with this approach. One example is that illicit imports impact domestic prices, but domestic prices also impact illicit imports, causing a simultaneous equations bias. For example, if there are stronger environmental regulations that cause higher domestic prices, the country may attract more low-cost illicit imports.

³⁸ As noted above, the model uses total imports as a substitutable variety to domestic production and requires an estimate of total illicit imports to estimate the effects of illicit trade on the market. This is one reason why the broad estimate approach, described in “Estimating the Extent of Illicit Imports” above, is a useful method to employ.

³⁹ This model uses replacement rates to understand how the total volume of imports changes, so total imports are exogenous. The replacement rate is a parameter input, specified by the model user, that exactly describes how non-illicit imports replace the illicit import estimate. Instead, the model user could define a supply function for non-illicit products if they have a good estimate of the import supply elasticity. In most cases, it is more difficult to pin down a supply elasticity than to choose a data-driven replacement rate parameter. Additional thoughts on replacement rates can be found in the “Modeling Considerations” section below.

The data requirements of the model are domestic production values and quantities, import values and quantities, export quantities (to isolate the domestic production consumed in the focus country), and the illicit trade import estimate in quantity terms. The equation parameters in the model are either chosen qualitatively, calibrated to market data, or econometrically estimated. First, the supply elasticity and industry price elasticity of demand should be chosen based on the literature and knowledge of the industry. The substitution elasticities, that describe how the product sourcing changes after a relative shift in prices, can be estimated using the trade cost method described in Riker (2020).

Modeling Considerations

Border policies versus policies at the point of harvest

The model will estimate the impact of illicit flows by simulating a counterfactual scenario where the illicit flows are removed from imports. The assumed policy change in the counterfactual matters. If the policy change is to stop illicit product from being generated (a “harvest policy”), by stronger policing, international agreements, or other detection mechanisms, then the global supply of the illicit product is eliminated. If the policy change is to identify illicit product at the importing country border and block entry (a “border policy”), the illicit product is still being generated. In this latter case, producers of the product will send their illicit goods to countries with more lax border policies and send their legal trade to the country that enacted the border policy. The degree of trade diversion impacts the simulation, as there is some replacement of illicit products with non-illicit imports in the policy scenario.

Replacement rate parameters are used in the model to specify the level of trade diversion.⁴⁰ If the modeler wishes to consider a harvest policy, and they want to reflect the eradication of illicit products from global supply chains, it may be suitable to use a replacement rate of zero. This may be appropriate because if the illicit goods are removed from global supply, producers of these goods can no longer divert trade to other countries. Therefore, the estimate of the illicit products in imports is removed from the model and there is no replacement of illicit products with non-illicit goods. There may, however, be non-zero replacement of illicit products with a harvest policy for certain products. If the model is simulating the effects of removing slavery as a source of labor for cotton harvest, for instance, then the product may still be harvested under non-illicit means, and a non-zero replacement rate may be more appropriate.

If the modeler is instead considering a border policy, they can choose the non-zero replacement rate that best fits their understanding of trade diversion. The non-zero replacement rates under a border policy scenario may depend on several factors. First, the size of the illicit trade estimate matters. If the illicit trade estimate is large, then it may be more difficult to replace all of those imports with other, non-illicit sources of supply. For example, it may not be difficult to replace 100 kilograms (kg) of illegally caught fish imports but replacing 1,000,000 kg of illegal product may require significant effort. Second, if imports to the country of focus constitute a large share of global imports, there is less non-illicit supply in circulation to replace the illicit products. If the focus country is already consuming a significant portion of global trade of the product, it may be difficult to find other locations of non-illicit imports. The same

⁴⁰ The approach described in this paper is a single country partial equilibrium model. Replacement rates are used because the flow of imports is treated as exogenous. It would be possible to endogenously model trade diversion with a multi-country model but would require significantly more data inputs.

logic applies for the number of suppliers. If there are relatively few suppliers of the product, there are fewer sources to draw from, so trade diversion is less likely. These factors should be analyzed when choosing replacement rates.

In addition to the factors listed above, historical evidence may be used to pin down the replacement rate magnitude. One useful place to look is at past anti-dumping (AD) and countervailing duty (CVD) cases for the same or similar products, where duties were imposed to reduce trade flows from offending partner countries. This is relevant because AD/CVD duties are often substantial—sometimes more than 100 percent on an ad valorem basis—and have the impact of significantly removing trade from a specific source. The flow of trade before and after the AD/CVD duties, from offending countries to non-offending countries, can give an indication on the likelihood of replacement. An example of this type of analysis can be found in the modeling appendix of the USITC’s report on IUU fishing.⁴¹

Effects on Harvesters Versus Processors

In many of the examples considered throughout this paper, it is often the case that the activities that generate illicit imports occur at the point of harvest or production of a primary good. For example, illegal fishing and logging occur at the point of harvest, and eventually weave through supply chains and into processed goods. Cotton produced with forced and/or child labor is used as an input into textile production. The modeling approach described here can provide separate economic effects on domestic harvesters and domestic processors, recognizing that low market prices associated with illicit products can impact upstream and downstream producers differently. The approach can estimate the effect of illicit trade in intermediates that are processed into final goods by domestic processors. The approach can also estimate the effects of illicit trade in both intermediate and final products.

For analyses where there are both intermediate and final imports from illicit activities, it is important to capture the multiple effects on domestic processors. Consider a scenario where both intermediate and final goods markets face competition from illicit imports, and the illicit trade is removed from the model. If domestic processors use inputs from domestic sources, and those domestic sources compete with illicit imports, then the processor will experience higher input costs after removing illicit intermediates from the model. This is because of a positive demand shift towards the domestically produced intermediate good, increasing the price of the domestic product and therefore, the price of the input. At the same time, the domestic processor also competes with illicit imports of processed products. If the illicit processed products are removed from the model, then there will be a positive demand shift towards the domestic processed variety. This creates two opposing forces: the higher input costs lower domestic processing production, and the positive demand shift increases domestic processing. Domestic processing production may either decline or increase, depending on which opposing effect is larger. The model can separate out these effects.

Capacity or Natural Resource Constraints

It may be important to constrain the ability of the domestic producers to scale up production after the hypothetical removal of illicit imports. Often the domestic producers face regulations, quotas, or physical or natural resource constraints for industries where illicit trade is an issue. In the case of IUU fishing, domestic fishermen often face binding catch constraints that are designed to curb overfishing

⁴¹ USITC, *Seafood Obtained via IUU Fishing*, 2021.

and stock depletion. Similarly, timber harvesting must follow established forestry management plans to avoid overharvesting. With gold mining, there may be a limited number of gold deposits available that could replace lower imports of gold. The model approach outlined in this paper can achieve limited supply responses through either low supply elasticities or capacity constraints.

If the model user can obtain data on capacity, then including the capacity data in the model as a hard cap on domestic supply is the best way to realistically limit domestic producer's ability to scale up production. If this information is not available, but the modeler has reason to believe that domestic producers have limited ability to scale up supply, a low supply elasticity may be used. If the product is listed as protected or endangered but there is no established constraint at the national level, for example, then the model user may want to use a low supply elasticity.

Cross-Product Substitution

Partial equilibrium models focus on one specific industry and assume prices are held constant for industries not modeled. If the model user wishes to model several disaggregated products and has reason to believe that the products are interrelated, it is important to link the related products. Both IUU fishing and illegal logging are examples – if a researcher is simulating the effects of removing illegal tropical woods, they might want to include other wood types that may be substitutable with the tropical varieties.

This is important because the existence of a related product mutes the economic effect of illicit imports. For example, consider two products that are similar, A and B. The model removes an estimate of the illicit trade flows associated with product A. Demand shifts to the domestic variety of product A, and prices of A increase. Consumers respond to this price increase by substituting across products to product B, which is considered a close substitute to A. Because of this cross-product substitution, the price of product A does not increase as much as a model scenario where A is modeled separately.

Box 2 Considerations When Conducting an Impact Assessment

Is there a domestically produced product that is substitutable with the imported product with illicit flows?

Is the illicit product an intermediate or a final good? Is it used as an input in a processed product, and is it important to measure the effects on just the domestic producers who compete directly with the product, or also on the processors who use the product as an input? Does the product generated from illicit activity enter the country as both an unprocessed and processed product?

What type of policy change is most realistic to eradicate the illicit import flows – a policy at the country border, that identifies and stops the illicit products from entering the country, or a policy at the point of harvest, that stops the generation of illicit activity?

To what degree can domestic producers respond to price changes and change production levels?

Relatedly, are there constraints in the domestic market, such as environmental regulations or quotas, that limit the producers' ability to scale up production of the product?

Are there interrelated products in the industry, where a change in the trade flows of one product will likely change consumer purchasing of the other product?

Illustrative Model Simulations

Basic PE Model with Exogenous Change in Import Flows

The goal of this section is to illustrate how some of the modeling considerations in the previous section affect model outcomes.⁴² This first set of illustrative simulations uses a basic version of the model with two differentiated products: the domestically produced variety and the imported variety. Imports are reduced by the illicit import estimate, and replacement rates are applied to add back in the non-illicit products that replace the illicit imports. This set of simulations is only intended to illustrate how the model works and is not based on real data. Model inputs are reported in table 2.

Table 2 Model inputs

In percent.

Model input	Value
Elasticity of substitution	5
Industry price elasticity of demand	-1
Price elasticity of supply – domestic production	3
Initial market share of domestic production	50
Initial market share of imports	50

Source: Authors.

Four cases are considered to illustrate how the basic model works: the first simulation has a low illicit import estimate, the second simulation has a high illicit import estimate, the third simulation has a high replacement rate, and the last simulation is intended to show results for domestic producers that are capacity constrained (table 3).

Table 3 Simulation details

In percent.

Model input	Sim 1: Low illicit estimate	Sim 2: High illicit estimate	Sim 3: High replacement rate	Sim 4: Capacity constrained
Illicit import estimate	5	30	5	5
Illicit replacement rate	0	0	50	0
Capacity constraints	No limits on increases in domestic production	No limits on increases in domestic production	No limits on increases in domestic production	Domestic producers are at capacity

Source: Authors.

⁴² The models used in this section to generate illustrative simulation results can be found in the USITC's model release for the *IUU Fishing* report, located here: https://www.usitc.gov/sites/default/files/publications/332/iuu_fishing_models.zip.

Table 4 Illustrative model results

Percent (% change).

Model output	Sim 1: Low illicit estimate	Sim 2: High illicit estimate	Sim 3: High replacement rate	Sim 4: Capacity constrained
Price of domestic production	0.73	4.94	0.36	1.99
Price of imports	2.20	15.59	1.09	3.06
Quantity of domestic production	2.16	13.48	1.08	0.10
Quantity of imports	-5.00	-30.00	-2.50	-5.00

Source: Authors.

Table 4 shows a variety of findings. In simulation 1, imports are reduced by the illicit import estimate of five percent, with no replacement of illicit imports with non-illicit imports. Because of this exogenous reduction in import supply, import prices increase and consumer demand shifts towards the domestic variety. Both domestic production prices and quantities increase as more consumers buy the domestic product. In simulation 2, imports are reduced by a larger illicit import estimate of thirty percent. This magnifies the effects, compared to simulation 1, with a larger exogenous reduction in import supply and greater consumption of the domestic product. In simulation 3, the illicit import estimate is back to five percent but now increase the replacement rate to fifty percent, so total import supply only declines by 2.5 percent. Effects are smallest under this set of parameter assumptions. Finally, in simulation 4, a capacity constraint on domestic producers is added, so the decline in import supply can only translate to increased domestic prices and not increases in domestic quantities. When compared to simulation 1, the domestic producer price more than doubles and there is almost no change in domestic production quantity.

Model Extension with Intermediate and Final Goods

In this second set of model simulations, the basic model is expanded from the previous section to include linkages to a processing sector. Illicit imports may cross the border as either an intermediate good that competes with domestic harvested products, or a final good that competes with domestic processed products. Both intermediate and final import flows in the model are exogenously reduced by their illicit import estimate simultaneously. There is zero- or partial replacement of illicit products with non-illicit products, as defined by the model user. The domestic harvested product is either consumed as a primary good or sent to a domestic processor for conversion into a final good to compete with final goods imports. The price of the domestic processed product is a fixed markup over the price of the primary harvested good. Illustrative model inputs are reported in table 5.

Table 5 Model inputs

In percent.

Model input	Value
Elasticity of substitution	5
Industry price elasticity of demand	-1
Price elasticity of supply – domestic production	3
Intermediate goods market:	
Initial market share of domestic production	50
Initial market share of imports	50
Final goods market:	
Initial market share of domestic production	50
Initial market share of imports	50
Markup (processed/unprocessed prices)	2

Source: Authors.

Three cases are considered to illustrate how the customized model works: the first simulation has low illicit import estimates in both intermediate and final goods markets, the second simulation has high illicit import estimates in both markets, and the last simulation has a high estimate in the intermediate goods market and zero illicit trade in the final goods market (table 6). This latter simulation is intended to show an example where domestic processing production actually declines after the policy changes are implemented.

Table 6 Simulation details

In percent.

Model inputs	Sim 1: Low illicit estimate, both markets	Sim 2: High illicit estimate, both markets	Sim 3: High intermediate, no final
Illicit import estimate – intermediate good	5	30	0
Illicit import estimate – final good	5	30	30
Illicit replacement rate	0	0	0

Source: Authors.

Table 7 Illustrative model results

Percent (%) change.

Model output	Sim 1: Low illicit estimate, both markets	Sim 2: High illicit estimate, both markets	Sim 3: High intermediate, no final
Intermediate goods market:			
Price of domestic production	0.94	6.45	4.08
Price of imports	2.75	19.48	17.77
Quantity of domestic production	2.80	17.90	11.66
Quantity of imports	-5.00	-30.00	-30.00
Final goods market:			
Price of domestic production	0.94	6.45	4.08
Price of imports	2.35	16.75	2.69
Quantity of domestic production	1.80	11.11	-6.51
Quantity of imports	-5.00	-30.00	0.00

Source: Authors.

Comparing modeling results for simulation 1 and 2, it is clear that the higher the illicit import estimate, the larger the economic effects for both intermediate and final goods markets. In simulation 3, there is no positive demand shock in the final goods markets from the removal of processed illicit products. This means that the domestic processors only experience prices via higher input costs, so domestic processing declines by 6.5 percent (table 7).

In summary, there are many important questions for the researcher to consider when modeling the impact of illicit imports on the domestic industry. The researcher should determine the most important aspects about their market to include in the model so that estimates are realistic. Modeling considerations are further explored in the two case studies below.

Specific Estimate Approach Case Study: Forest Products

This section will briefly review considerations for building an illicit import estimate using a product example where there is existing research on the topic: wood products. Much like illegal fishing, there have been efforts to quantify illegal logging and associated trade, mostly involving NGOs such as Chatham House, the Environmental Investigation Agency, the Union of Concerned Scientists (UCS), and the World Wildlife Fund. However, as with many other sectors, because conducting primary research on illicit activity is difficult, there is a tendency for these analyses to rely on older underlying data and to potentially become out of date as a result. In addition, many analyses focus primarily on the prevalence of illegal production and do not examine the supply chain that connects that production to U.S. imports. There is therefore an opportunity for new research that contributes to the literature by using the methods described above to conduct new analysis.

Scope of Analysis

Because there has been some prior work done on illegal timber production and associated trade (unlike many other industries, where previous estimates are often scarce or non-existent), one way to contribute to the literature would be to define the scope differently than past analyses have done. This could involve decisions about any of three different scoping areas: illicit activity scope, geographic scope, or product scope.

Defining the Scope of Illicit Activity

Illicit trade in wood products has typically been thought of as the international trade of wood products derived from illegal logging. Illegal logging is frequently considered to include harvesting of wood without proper authorization, harvesting in excess of government-imposed limits, unreported logging, and violations of international agreements.⁴³ However, as in many other industries, illegal logging often overlaps with other illegal or illicit activities such as the use of forced labor. A group of NGOs has estimated that up to 50 percent of illegal logging activity is carried out using forced labor.⁴⁴ Including these types of labor violations in an analysis of illicit trade in wood products could be an important step in broadening the scope of analysis.

Existing information about labor violations in the forestry sector is mostly either very broad (such as the overall 50 percent figure cited above) or very specific (for example, focused on a single country or forest). However, by combining sources, a researcher could arrive at reasonable estimates of the extent of labor violations in various countries' logging industries. Comparable analysis was done in the *IUU Fishing* study by evaluating source countries' risk for forced and child labor in fishing using sector-specific information from the U.S. State Department's *Trafficking in Persons* report and the U.S. Department of Labor's *List of Goods Produced by Child Labor or Forced Labor*. IUU seafood production estimates were adjusted upward for countries that had high or moderate risk of these labor violations in their fishing sectors. Both reports, which are updated regularly, also cover labor violations in logging and could be combined with other sources to generate estimates using similar approaches. Examples of such additional sources include the detailed case study information about labor violations in logging that have been published for Brazil, Burma, Mozambique, and Peru.⁴⁵

After country-specific estimates of the prevalence of labor violations in the logging sector are generated, however, a difficult task for any analysis that seeks to analyze multiple types of illicit activity is to assess the degree of overlap between these activities (i.e., between illegal logging and the forced labor used to conduct it). As was reported by the USITC in *IUU Fishing*, the degree of overlap between various types of illegal activity is generally believed to be high. The two case studies conducted by Verité in Burma and

⁴³ Some analyses may incorporate other types of illicit behavior, such as violations of national or subnational regulations related to harvesting methods. Seneca Creek Associates and Wood Resources International, "Illegal Logging and Global Wood Markets," October 2004, 4.

⁴⁴ KnowtheChain, "Investor Snapshot: Forced Labor in Forestry," November 2019, 1.

⁴⁵ Burma and Mozambique case studies by Verité, *Exploring Intersections of Trafficking in Persons Vulnerability and Environmental Degradation*, August 2020. Brazil case studies by Repórter Brasil, available from press release at "Investigation Reveals Slave Labor Conditions in Brazil's Timber Industry," March 15, 2017. Peru case study by EIA, *Moment of Truth*, February 2018.

Mozambique offer insights into the degree of overlap between illegal logging and forced and child labor and human trafficking and could help guide a decision about how to account for such overlap.

Defining the Product Scope

Much of the prior work on illicit trade in wood products focuses on violations that occur at the point of harvest (i.e., illegal logging), as described above. Because of this focus on the beginning of the supply chain, prior publications tend to analyze mostly primary products, which include logs and lumber. Far less research has been done on secondary products like furniture. This is likely due to the complexity that arises when tracking an illegal product through the supply chain as the length of the chain increases, as described above and below. However, extending the supply chain analysis to include secondary products would likely be a significant contribution to the literature, even if it was necessary to limit the scope of the analysis in other ways (such as geographically) in order to find reliable information about such products. An analysis of illegal wood imports by the UCS found that wood furniture from China and Vietnam likely made up about 23 percent of all U.S. imports of illegal wood products in 2013, and other secondary products from China (such as trim and flooring) made up another 26 percent.⁴⁶ The same analysis, however, also found that trade data and shipment records alone do not provide the necessary level of detail about these secondary products to draw conclusions about the risk of illegality.⁴⁷ A methodical supply chain analysis that tracks inputs and outputs for particular processing countries, as described below, would likely be necessary.

Related to product scope, availability of data on wood products by species would also need to be considered in defining the scope of the analysis. Different species of wood often have different end uses, with the most valuable wood being used in specialty applications such as high-value furniture and musical instruments. The prices of these valuable woods can make them more vulnerable to illegal harvest.⁴⁸ Tropical hardwood species have been a particular focus of research to quantify illegal logging in the past, due mostly to these species' prevalence in countries with fewer measures to curb illegal activity. However, temperate species are also vulnerable in some regions and countries (e.g., Russia).⁴⁹

In considering product scope, the researcher may also want to consider the available trade data based on the Harmonized Tariff Schedule (HTS). As was done in *IUU Fishing*, it is possible to analyze illicit trade without all the product-level detail in the trade data that would be useful, but it requires additional time and research effort to disaggregate data—this should be a consideration in determining scope. For wood products, HTS breakouts by species are more common for upstream products such as logs than for downstream products (except for plywood, as noted below), and tropical species tend to be broken out more often than temperate species. For example, the HTS lists fewer species breakouts for wood flooring than for unfinished wood, and those that exist for flooring are mostly for tropical species. Some items, such as wood furniture and finished building products, have few or no HTS breakouts by species. The UCS report cited above found that plywood was the only wood product that had HTS breakouts that were sufficiently detailed to be able to analyze illegal trade flows based on trade data alone.⁵⁰

⁴⁶ UCS, "The Lacey Act's Effectiveness in Reducing Illegal Wood Imports," October 2015, 14.

⁴⁷ UCS, "The Lacey Act's Effectiveness in Reducing Illegal Wood Imports," October 2015, 10.

⁴⁸ Gan et al, "Quantifying Illegal Logging," December 2016, 38.

⁴⁹ Gan et al, "Quantifying Illegal Logging," December 2016, 51.

⁵⁰ UCS, "The Lacey Act's Effectiveness in Reducing Illegal Wood Imports," October 2015, 9.

Defining the Geographic Scope

Logging is conducted in many countries around the world, and wood from one country can be readily substituted for wood from another. There is evidence that efforts to curb illegal logging in one country may result in expanded illegal production in other countries. For example, when China enacted stricter limits on logging, this reportedly increased demand from processors for illegal timber from Russia.⁵¹ The geographic focus in literature from NGOs and law enforcement agencies has often shifted over time, as new violations come to light. Because of this, choice of geographic scope would be a key consideration for a researcher undertaking an analysis of illicit trade in wood products.

One option is to use a global approach, similar to the one used in *IUU Fishing*. While there is no globally comprehensive database of production of illegal logs, which would be comparable to the underlying database used in that study, there are numerous country- and region-specific estimates which could be updated and, potentially, extrapolated to countries with similar risk profiles.

Alternatively, a researcher might need to limit the geographic scope because of an expanded scope in either of the two areas described above. For example, if a researcher is including forced labor in the selected scope of illicit activity, or incorporating secondary wood products in their product scope, it may be necessary to limit the geographic scope in order to find supporting information for these other expansions. An example of a scope that could be interesting would be to limit the geographic scope to Russia and build the supply chain for that source of illicit trade (including secondary products), particularly through processing in China. A researcher doing this analysis could use the details available through the Lumber Liquidators case⁵² as well as a 2019 analysis by a UK environmental NGO that exposed a particular illegal logging operation and estimated that up to half of production in Russia's Far East could be illegal.⁵³

Estimating Illicit Production Activities at the Source

Estimates of illegal logging are fairly well-developed compared to some other sectors, but some of the most widely used estimates may be out of date. In particular, the two estimates that provide data on the greatest numbers of individual countries were published in 2004 (Seneca Creek) and 2006 (World Bank), with the 2006 estimate relying heavily on the 2004 estimate.⁵⁴ More recent estimates have been published in 2015 by Chatham House and in 2012 by INTERPOL, but the INTERPOL analysis relied on data from the 2004 and 2006 studies. Many of the assumptions in these analyses, while valid at the time, may no longer hold since patterns of illegal logging can change relatively quickly. For example, Brazil was reportedly successful in implementing measures to address illegal logging between 2004 and 2012,

⁵¹ Hall, "From Trees to Tigers," November 10, 2015.

⁵² In 2016, Lumber Liquidators was sentenced to a \$13 million fine for importing hardwood flooring that was manufactured in China using illegal raw materials from the Russian Far East, in violation of the U.S. Lacey Act, USDOJ, "Lumber Liquidators Inc. Sentenced," February 1, 2016.

⁵³ The analysis focused on the supply chain for IKEA furniture. Earthsight, *IKEA's House of Horrors*, 2019.

⁵⁴ Gan et al., "Quantifying Illegal Logging," December 2016, 44.

rendering older analyses less useful, but illegal logging increased dramatically again in 2019 and 2020.⁵⁵ Meanwhile, illegal logging has reportedly increased in a group of countries that includes Laos, Cambodia, Burma, and Russia.⁵⁶ As a result, any data used to estimate illicit production may require updating, given how quickly wood product supply chains can shift.

Existing estimates have tended to combine both “top down” and “bottom up” approaches. For example, Chatham House combines analysis of trade data discrepancies with field interviews.⁵⁷ Trade data discrepancies alone are often unreliable because of data inconsistencies, for example between official production statistics and trade data.⁵⁸

In evaluating existing production estimates, a researcher would also need to consider that much of the illegally harvested wood in some countries may not be exported. Informal logging, which may reach export supply chains but is often for domestic use, can be very common in some countries.⁵⁹ Because it is difficult to observe and measure production in the informal sector, it has been excluded from most of the past estimates of illegal production, even though informal logging often violates local laws. A bigger challenge, particularly for major processing countries like China, might be separating domestic “consumption” of raw materials by downstream processors (e.g., furniture manufacturers) into production for the domestic market and for the export market. These additional steps to separate domestic and export markets are part of the supply chain analysis described below. However, it is important to note that, due to the opacity of the supply chain for some secondary products such as furniture, some of the foundational estimates of illegal wood production (e.g., Seneca Creek) have excluded these downstream products from their analysis.

Mapping Illicit Supply Chains to U.S. Imports

In mapping the supply chain for illicit trade in wood products, it would be necessary to account for the greatly expanded role of third-country processors, namely China. Since 2000, China has quickly increased its wood processing activity, and just as with seafood in *IUU Fishing*, large-scale, export-oriented processing can obscure the illegal origins of raw materials. China is by far the largest importer of tropical hardwood logs, and its share of global imports of these rose from 25 percent in 2000 to 78 percent in 2020.⁶⁰ There are three primary reasons for this shift, all of which are potentially relevant in constructing the supply chain analysis: growing domestic demand for wood products in China as consumer incomes rise, limited supply of raw materials for the processing sector due to restrictions on domestic logging, and diversion of raw materials away from countries with strict regulations in place to address illicit trade (e.g., the United States and the European Union (EU)).⁶¹ At the same time, however, there is some information suggesting that while China has expanded and consolidated its role as a wood

⁵⁵ Tacconi, Rodrigues and Maryudi “Law Enforcement and Deforestation,” November 2019; Escobar, “Illegal Deforestation in Brazil Soars,” August 5, 2020.

⁵⁶ Gan et al., “Quantifying Illegal Logging,” December 2016, 51.

⁵⁷ Hoare, *Tackling Illegal Logging*, July 2015, 59–60.

⁵⁸ Gan et al., “Quantifying Illegal Logging,” December 2016, 53.

⁵⁹ Lippe, Cui, and Schweinle “Estimating Global Forest-Based Employment,” September 2021, 1.

⁶⁰ IHS Markit, Global Trade Atlas database (global import data for tropical species classified under Harmonized System heading 4403 (wood in the rough)), accessed November 5, 2021.

⁶¹ Gan et al., “Quantifying Illegal Logging,” December 2016, 42.

processor, it has also increasingly sourced its raw materials from lower risk supplier countries, which in turn decreases the likelihood of U.S. wood product imports from China being of illegal origin.⁶²

In general, trade diversion away from countries that have border measures is a challenge that complicates supply chain mapping for illicit wood products and makes estimates of illicit trade more likely to become outdated over time. For example, Chatham House estimates that between 2006 and 2013, exports of illegally harvested wood to China, India, and Vietnam increased 50 percent, while exports to the EU decreased by 50 percent and exports to the United States decreased by 30 percent.⁶³ An analysis of the Vietnamese supply chain would be particularly useful because the UCS analysis suggests that Vietnam has increasingly become a destination for illegal raw materials from throughout the southeast Asian region (particularly Laos), and Vietnam is an important producer of wood products, particularly furniture, shipped to the United States.⁶⁴ In some instances, it may be replacing China as a destination for illegal raw materials that are then further processed.⁶⁵ This type of continual trade diversion away from countries with border measures to address illicit wood products trade makes an up-to-date supply chain analysis critical to further research in this area. It also underscores the importance of choosing a product scope that will permit accurate supply chain mapping.

Modeling the Economic Impact of Illicit Trade

If estimates for illicit imports of wood products are produced using steps similar to those described above, a further step could involve quantifying the impact of estimated illicit imports on a domestic industry. The first step in this process would involve defining which domestic markets to model, based on a consideration of the types of illicit imports and domestic industries that exist. In the wood products sector, the United States both imports and produces wood products at various stages of processing, including further upstream products like sawn lumber or further downstream products including hardwood plywood, paper and paperboard, and furniture.⁶⁶

Because wood products are produced and imported in the U.S. market at multiple stages of the supply chain, certain product categories (such as hardwood plywood and furniture) might lend themselves toward a model that is extended to allow for both intermediate and final goods. Another consideration involves the extent to which domestic products are substitutable for imported goods: despite being of similar product types, wood products made from tropical species are not always directly substitutable for similar products made from temperate species. Another step involves identifying whether domestic or imported products face capacity or natural resource constraints, such as the availability of sawmill and pulp manufacturing capacity and any significant environmental constraints that limit the ability to scale up harvesting of timber.

Finally, the modeling approach presented earlier estimates the economic effects of illicit imports on domestic producers by simulating a hypothetical scenario where illicit imports are removed from total imports. The researcher should consider what hypothetical policy change would be most realistic to

⁶² UCS, “The Lacey Act’s Effectiveness in Reducing Illegal Wood Imports,” October 2015, 8.

⁶³ Gan et al., “Quantifying Illegal Logging,” December 2016, 46.

⁶⁴ UCS, “The Lacey Act’s Effectiveness in Reducing Illegal Wood Imports,” October 2015, 9.

⁶⁵ Recently, this shift has also been affected by U.S. tariffs. See, e.g., Turton, “Vietnam’s Furniture Sector,” June 28, 2021.

⁶⁶ York Saw and Knife, “Sawmills in the USA,” accessed January 3, 2022.

remove illicit import flows in the forestry market. If the most realistic policy is to stop illegal logging from occurring in the respective source countries, such as through stronger enforcement of measures to curb illegal logging, then the global supply of illicit forestry products is eliminated. Along with the assumption that illegal logging would not be replaced with expanded legal logging, such a cessation of global illegal logging would imply a near zero replacement of illicit imports with non-illicit imports. If the more realistic policy is to block entry of imports from countries that are known suppliers of illegal timber, a non-zero replacement rate should be chosen because of trade diversion. As imports from illicit sources are reduced, consumers will substitute those products with non-illicit sources. This latter assumption (of a border measure rather than a curb on illicit production) may be more appropriate for many analyses, given that U.S. policymakers have been particularly focused on enforcement of the Lacey Act (a border measure).

Broad Estimate Approach Case Study: Cotton

In this second case study, we consider cotton produced with illicit labor practices. This supply chain is likely better suited to use the broad estimate approach to quantify illicit imports entering the United States. Cotton is an upstream input of the complex (multi-stage) global fabric and apparel supply chain. Cotton itself is grown in more than 75 countries globally, although the majority of production is highly concentrated.⁶⁷

There is a long and well-documented history of serious labor abuses in cotton production (i.e., the cultivation and harvesting of cotton).⁶⁸ The U.S. Department of Labor (USDOL) identified seventeen countries using forced labor and/or child labor in their cotton production in 2020.⁶⁹ For many years, Uzbekistan was a notorious example of forced labor and child labor problems in cotton production because of its government-mandated compulsory participation in the cotton harvest by students and many professionals (e.g., government workers, teachers, and doctors).⁷⁰ After years of international attention, the situation there has greatly improved to the point where child labor is no longer used and the use of forced labor has dropped dramatically and is no longer systemic.⁷¹ However, as is the case with many products where illicit activities occur, new problems have appeared in other places. One such case to recently make headlines is China's use of forced labor, primarily using workers from the Uyghur ethnic group, in cotton production in Xinjiang province.⁷²

⁶⁷ The top three growers—India, the United States, and China—accounted for about 63 percent of global cotton production during 2016/17–20/21: the top 10 for 88 percent. USDA, FAS, PSD Online: Cotton, accessed May 24, 2021.

⁶⁸ See e.g., USDOL, ILAB, *The Department of Labor's List of Goods Produced by Child Labor or Forced Labor*, September 10, 2009, 4–5, 23; ILO, *Child Labor in Cotton*, 2016.

⁶⁹ The USDOL, identified six of these countries used both child labor and forced labor: Benin, Burkina Faso, China, Kazakhstan, Tajikistan, and Turkmenistan. USDOL, "List of Goods Produced by Child Labor or Forced Labor," September 30, 2020; U.S. Department of Labor, *2020 List of Goods Produced by Child Labor or Forced Labor*, September 2020, 20–24.

⁷⁰ See e.g., Human Rights Watch, "Uzbekistan," January 25, 2013; School of Oriental and African Studies (SOSA), *Invisible to the World?*, 2009.

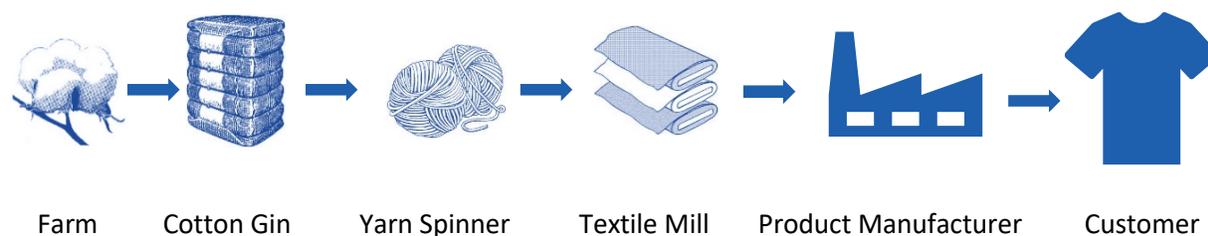
⁷¹ ILO, "Systemic Forced Labour and Child Labour Has Come to an End in Uzbek Cotton," January 29, 2021.

⁷² U.S. Customs and Border Protection (CBP), January 13, 2021; U.S. Department of Labor, *2020 List of Goods Produced by Child Labor or Forced Labor*, September 2020.

Introducing the Complexity of the Supply Chain

Cotton textile and apparel supply chains are generally complex, involving many stages of production. A simplified supply chain involves five major processing steps (often referred to as tiers by the industry) (figure 4). Each step of the supply chain can involve products crossing borders, and there are often intermediaries involved between major processing steps. For example, product manufacturers may have subcontractors doing certain processes or suppliers for certain pieces.⁷³ There are other factors which could complicate the supply chain and, as a result, estimation attempts. These include the use of cotton of different staple length and quality in different fabrics.⁷⁴ For example, as of 2012, Uzbekistan primarily produced upper medium-length high quality cotton primarily used in fabrics such as knits, twills, towels, denim, and corduroy.⁷⁵ The practice of blending different types of fibers (e.g., cotton and polyester) to create fabric is also widespread in the industry, complicating analysis.⁷⁶ The origin of cotton is usually tracked by yarn spinners (who produce yarn and thread). However, after that step, cotton origin is not systematically tracked through conventional supply chains, making it challenging to trace the original harvesting country.⁷⁷ In addition, cotton and its intermediary products like yarn and textiles are durable goods which can be held in stock, which could potentially complicate efforts to track cotton through the supply chain.

Figure 4 Simplified cotton-containing textile and apparel supply chain



Sources: Compiled by authors based on EJF, *Somebody Knows Where Your Cotton Comes From*, 2009, 6; Fair Labor Association, “From Field to Consumer,” no date; USITC, *Textiles and Apparel*, January 2004, G-40-44.; NCTO, *The Textile Journey of a Pair of Pants*, accessed August 27, 2021.

Scope of Analysis

Considerations of the scope of illicit activity, products, and producing countries to cover in an analysis would likely be made in tandem and be iterative. Key issues to consider in each of these scope choices are outlined below.

⁷³ See e.g., EJF, *Somebody Knows Where Your Cotton Comes From*, 2009, 6; Donaldson, “Cambodia Faces Alarming Threat of Garment Sector Subcontracting,” May 30, 2017; ILO, “Garment Sector in Cambodia,” May 30, 2017.

⁷⁴ Staple lengths categories for cotton are short, medium, and long.

⁷⁵ Responsible Sourcing Network, *From the Field: Travels of Uzbek Cotton Through the Value Chain*, 2012, 11.

⁷⁶ See e.g., Textile School, “Blended Fabrics,” March 17, 2018; Smeader, “Cotton and Poly Cotton Fabric,” June 2010.

⁷⁷ EJF, *Somebody Knows Where Your Cotton Comes From*, 2009, 7. Fair Labor Association, “From Field to Consumer: Cotton Production and Supply Chain in Turkey,” no date.

Defining the Scope of Illicit Activity

Defining the scope of illicit activities covered by the estimate as well as where along the supply chain to focus is a key initial step. Activities that violate U.S. and international labor standards and norms can be found throughout the textile and apparel supply chain, from the cotton field to manufacturing facilities and are the focal illicit activities in this case study.⁷⁸ For example, there is evidence from 2020 and 2021 of Uyghurs being forced to work in manufacturing plants, including those related to garment production, both inside and outside of their home province of Xinjiang.⁷⁹ A researcher could take an expansive approach and try to estimate illicit labor activities at each stage of the supply chain, or have a more narrow focus on one point in the supply chain such as illicit labor activities in cotton production (i.e., during the cultivation and harvesting of cotton). In making this decision, the researcher will want to consider the availability of comprehensive information on illicit labor activities and the ability to use that information to develop an estimate of illicit activity for each major step in the supply chain. Due to the complexities of the cotton supply chain, assessing illicit activity only at a single stage of production rather than in multiple tiers may be the most practical approach. For the sake of simplicity, the remainder of this case study focuses on labor violations within cotton production rather than in downstream operations (e.g., in apparel factories).

In addition to a decision about which stages of the supply chain to focus on, a researcher would also need to determine which types of labor violations to analyze. The availability of information to estimate the extent of these illicit activities within production would be an important factor to consider. Illicit labor practices are a broad concept that can encompass a range of issues from serious ones, such forced labor and child labor, to arguably less serious labor violations, such as a single company's one-off violation of local labor laws. In the cotton sector, there are reliable resources that comprehensively track certain types of illicit labor practices across countries based on clear definitions, providing a reasonable and relatively systematic basis for establishing where certain types of illicit labor practices are occurring globally. For instance, annual reports by the U.S. Department of Labor (USDOL) provide a strong basis for determining whether forced labor and/or child labor exist by country across many years within the cotton sector. In its 2020 list, USDOL identified 17 countries using forced labor and/or child labor in their cotton production (table 8).⁸⁰ Similarly, the U.S. Department of State has globally focused annual reports on human rights violations, which may include labor violations, providing a systematic global assessment of such violations as well as on human trafficking.⁸¹

⁷⁸ See e.g., U.S. Department of Labor, *2020 List of Goods Produced by Child Labor or Forced Labor*, September 2020; Xu et al., *Uyghurs for Sale*, March 1, 2020. 78 FR 39949; ILO, Working Conditions in Bangladesh, accessed June 11, 2021.

⁷⁹ Xu et al., *Uyghurs for Sale*, March 1, 2020; Chua, "‘Every Supplier,’ ‘Every Tier,'" May 27, 2021, 9.

⁸⁰ USDOL, identified six of these countries used both child labor and forced labor: Benin, Burkina Faso, China, Kazakhstan, Tajikistan, and Turkmenistan. U.S. Department of Labor, September 30, 2020; U.S. Department of Labor, *2020 List of Goods Produced by Child Labor or Forced Labor*, September 2020, 20–24.

⁸¹ See e.g., USDOS, *2020 Country Reports on Human Rights Practices*, March 31, 2021; USDOS, *2021 Trafficking in Persons Report*, June 2021.

Table 8 Top 10 cotton sources: Total production and percent (%) share of MY 2020–21

Source country	USDOL identified FL/CL	Cotton production (1,000 480 lb. bales)	Share of global production (%)
China	Yes	29,500	26.4
India	Yes	27,600	24.7
United States	No	14,608	13.1
Brazil	Yes	10,820	9.7
Pakistan	Yes	4,500	4.0
Uzbekistan	Yes	3,500	3.1
Turkey	Yes	2,900	2.6
Australia	No	2,800	2.5
Benin	Yes	1,450	1.3
Greece	No	1,400	1.3
All other	Yes	12,626	11.3
Global Total	^a	111,704	100.0

Sources: USDA, PSD Online, Cotton, accessed January 28, 2022 USDOL, 2020 List of Goods Produced by Child Labor or Forced Labor, September 2020, 2024.

Notes: Production for local marketing years for 2020/2021. FL=forced labor, CL =Child Labor.

Identifying other types of illicit practices across countries outside of such systematic reports can be challenging. Other comprehensively available information may provide an indication of whether certain labor conditions exist, although establishing these as illicit activities may be more subjective. For example, the International Labour Organization (ILO) has a wealth of information on working conditions and labor rights (e.g., freedom of association, collective bargaining rights, etc.).⁸² However, opinions may vary as to whether low reported rates of certain labor rights equate to “illicit” activity.⁸³ Industry groups, non-profits including labor advocacy groups, or other resources may provide knowledge of illicit activities occurring based on ad hoc reporting. However, it can be challenging to use ad hoc information to determine how widespread an illicit activity is across all countries and therefore if it should be included in the scope of illicit activities. Some such information may be better suited to qualitative discussion but deemed outside of the scope of illicit activities established for purposes of the estimate. Ultimately, a researcher needs to clearly present the activities they have deemed illicit for purposes of their estimate as well as the information they used to identify these activities across countries, and acknowledge the impact that these scope choices may have on their analysis.⁸⁴ For purposes of simplicity in this example, the scope of illicit activities is cotton produced using forced labor and/or child labor.

Defining the Product Scope

At the outset, a researcher would also need to establish what traded products their analysis will cover. A simple analysis could look only at cotton. However, such an analysis would not be particularly useful as

⁸² ILO, Home, accessed June 11, 2021; ILO, Statistics and databases, accessed June 11, 2021.

⁸³ For instance, low collective bargaining levels does not necessarily mean there are labor law violations or other illicit actions impacting workers. ILO, ILOSTAT: Statistics on Collective Bargaining, accessed September 28, 2021.

⁸⁴ For instance, if, as this example does, a researcher chooses not to estimate illicit labor activity occurring downstream and there are known downstream illicit labor activities (as there are in apparel manufacturing), they should acknowledge that their calculations underestimate the amount of illicit activities in imported finished products.

the United States, the largest global exporter of cotton, has minimal imports of cotton (table 9).⁸⁵ Examining imports of cotton yarn and thread would also be of limited interest because the United States is not a major importer of these products. A more interesting analysis could focus on U.S. imports of cotton-containing textiles and/or apparel. During 2016–20, the United States was one of the top five importers of woven cotton fabric and was the world’s largest importer of apparel, accounting for roughly one-fifth of all imports during 2016-20.⁸⁶ For purposes of simplicity, this example will treat apparel (HS chapters 61 and 62) as the scope of finished goods under consideration.⁸⁷

Table 9 Top 5 Global importers of cotton, cotton yarn and thread, and cotton fabrics, 2016-20
Percent (%) share of value of total global imports

Cotton importers	Share of global imports	Cotton yarn and thread importers	Share of global imports		Share of global imports
			Cotton yarn and thread importers	Cotton fabrics importers	
China	27.8	China	46.4	China	6.4
Turkey	15.3	Hong Kong	5.0	Indonesia	6.4
Indonesia	11.2	Turkey	5.0	United States	6.1
Pakistan	8.8	South Korea	4.0	Italy	5.6
India	8.2	Portugal	3.1	Sri Lanka	4.3
Total of top 5 importers	71.4	Total of top 5 importers	63.5	Total of top 5 importers	28.7

Source: IHS Markit, Global Trade Atlas HS subheadings 5201-5212, accessed August 27, 2021.

Notes: Cotton (raw, carded and combed) = HS subheadings 5201-5203; Cotton thread and yarn = HS subheadings 5204-5207; Cotton fabric (including cotton blends) = HS subheadings 5208-5212.

Defining the Geographic Scope

As noted in the forestry example, a researcher must also decide the geographic scope of their analysis taking into account a range of factors such as where the illicit activities being examined are occurring, availability of data, and policy interest. A global geographic scope would attempt to capture all in-scope illicit activity across the world, which could be useful for a product like cotton produced all over the world. For cotton, this would be facilitated by the availability of production data for all countries and the existence of labor violations in this sector across many regions. However, a researcher may choose to limit their geographic scope to focus only on the illicit activities occurring in one or several countries, such as those five countries that account for a global majority of cotton production (table 8). Even among the major producers, certain countries may be of more interest to policymakers than others. For example, currently China is of particular interest for its the high-profile use of forced labor and a 2021 law prohibits U.S. imports made with forced labor from Xinjiang effective June 21, 2022.⁸⁸ It is also the

⁸⁵ USDA, FAS, PSD Online: Cotton, accessed September 27, 2021.

⁸⁶ IHS Markit, Global Trade Atlas HS chapters 61 and 62, accessed September 27, 2021.

⁸⁷ Imports under HS subheadings 61 and 62 cover all apparel including apparel which contains no cotton, which are outside of the scope of this example. IHS Market Kit GTA, accessed September 27, 2021. In addition to woven cotton containing fabrics in HS subheading 52, a range of non-woven fabric, some containing cotton, are covered under HS woven cotton containing fabrics in HS subheading 58-60. In addition, there are non-apparel cotton-fabric contacting products including certain footwear, rugs and carpets, and furniture. If an in-depth analysis on cotton to be executed, researchers would be encouraged to capture as many these cotton-containing products as feasible.

⁸⁸ See e.g., Barrett and McGregor, “Reports of Forced Labor Are Driving Brands to Abandon Chinese Cotton,” July 18, 2021; CBP, “CBP Issues Region-Wide Withhold Release Order on Products Made by Slave Labor in Xinjiang,” January 13, 2021; Public L. N. 117-78, 135 Stat. 1525 (2021); Uyghur Forced Labor Prevention Act of 2021 (UFLPA),

largest producer of cotton globally, potentially exposing major import markets such as the United States to cotton products made with forced labor. A researcher could decide to focus their research on estimating the amount of Xinjiang cotton entering the United States since this would likely be of particular interest to policymakers and industry. In addition, using a narrow geographic scope may allow a researcher to use the specific estimate approach rather than the broad estimate approach. Although the supply chain analysis would remain complex, assessing global exposure to product originating in one country would lessen some of these challenges.

Estimating Illicit Production at the Source

The first step in creating the illicit production database is to identify the stage of production where the illicit activity is occurring. In this example, the illicit activity is labor violations (forced labor and child labor) on cotton farms. Data on cotton production by country are readily available, including from the U.S. Department of Agriculture (USDA) and the Food and Agricultural Organization (FAO) of the United Nations.⁸⁹ Unlike forestry or fisheries, there does not appear to be a question about the overall quantity of cotton in the market.⁹⁰ As such, there is not a need to adjust official data for levels of unknown production. However, a researcher still needs to determine the share of cotton produced with the illicit labor activities in order to divide those total production quantities into illicit vs. non-illicit production subtotals. For this example, these are estimates of the prevalence of forced labor and/or child labor (PFL/CL) in cotton production. In this case, ad hoc information can be useful and provide a sound basis for an estimate of illicit production at the source for individual trading partners. One approach to populating these PFL/CL estimates for each country could be to combine reputable existing studies, adjusting as necessary. For example, the ILO has estimates on the prevalence of forced labor in Uzbek cotton harvest: 4 percent in 2020, down from about 14 percent in 2015.⁹¹ As noted above, the ILO has determined that Uzbekistan no longer systemically uses child labor.

Estimates derived from reputable studies, however, are not available for most cotton source countries, requiring the use of other techniques to populate estimates for those countries. One reasonable approach is to use inferences to estimate the PFL/CL. For example, a jumping off point for China would be the share of cotton produced in Xinjiang (87 percent of China's total, as of marketing year (MY) 2020/21).⁹² A researcher would then want to decide whether to use 87 percent as a proxy for the PFL/CL estimate for China, or attempt to refine this estimate by identifying the share of the cotton production in Xinjiang that was deemed to be produced with forced labor using qualitative information or risk-related data to determine how substantial this problem is in that region. In the case of cotton produced in China, the former approach may be preferable given that all Xinjiang cotton is subject to a withhold

Pub. L. No. 117-78, 135 Stat. 1525; USDOS et al., "Risks and Considerations for Businesses and Individuals," July 13, 2021.

⁸⁹ USDA, FAS, PSD Online; FAO, FAOSTAT, The International Cotton Advisory Committee (ICAC) also maintains data on, among other things, cotton production, some of which is free and some available for purchase. International Cotton Advisory Committee (ICAC), "About ICAC," accessed June 3, 2021; International Cotton Advisory Committee (ICAC), "Data Portal," accessed June 3, 2021.

⁹⁰ The statistics of some countries are more reliable than others and estimates are used for some countries' production, however, this is not an issue specific to cotton.

⁹¹ ILO, "Systemic Forced Labour and Child Labour Has Come to an End in Uzbek Cotton," January 29, 2021.

⁹² USDA and FAS, *Cotton and Products Annual*, April 1, 2021, 3.

release order (WRO) by U.S. Customs and Border Patrol (CBP).⁹³ For other countries, the latter approach of refining the estimate may be more precise. For countries without available study-based estimates of PFL/CL or other bases for making inferences, the use of risk-related metrics would have to be evaluated as a foundation for estimating PFL/CL, with reasonable estimates associated within specific markers of risk (such as listing within the USDOL report, etc.).

One challenge that researchers may face in estimating illicit production is accounting for any overlap between types of illicit activities (e.g., forced child labor). Overlap may, to a certain extent, be expected: those engaging in one type of illicit behavior may be more like to engage in others. For example, IUU fishing and illicit labor practices are known to overlap, although the extent of the overlap is unknown.⁹⁴ As a result of this overlap, a researcher may need to adjust certain estimates to prevent double counting. For example, there may be instances of reputable sources providing separate estimates of the rate of different illicit activities (e.g., separate estimates for forced labor and child labor). In such cases, a researcher would want to try to ascertain if such estimates were capturing overlapping groups of workers and, if so, adjust the estimates downward to account for that overlap. There may also be situations where it is possible to estimate one type of illicit activity (e.g., forced labor) but harder to obtain information on another activity (e.g., child labor). In such cases, one option is to adjust existing estimates (such as those available for forced labor) upward using a standard adjustment based on an assessment of the extent of the additional illicit behavior likely to not be captured (e.g., child labor).⁹⁵ Alternatively, another option is to adjust the scope of illicit activity being estimated in order to focus on one activity (e.g., forced labor) rather than multiple illicit activities. Creating illicit trade estimates is an iterative process, where the availability (or lack of) information will impact the refinement of the scope of a project and the related estimates.

Mapping Illicit Supply Chains to U.S. Imports

Cotton is a product where the broad estimate approach is likely more suitable than the specific estimate approach described above. In addition to the highly complex supply chain for cotton described above, the United States imports apparel (HS 61 and 62) from over 200 trading partners.⁹⁶ To use the specific estimate approach, a researcher would need substantial resources and information to trace cotton from the field through the apparel supply chain for all these trading partners.

Under the broad estimate approach, supply chain mapping simply involves finding a reasonable method for linking a worldwide estimate of illicit production (described above) to U.S. imports. For cotton, a general estimate (based on assumptions that U.S. imports are representative of global supply) is facilitated by the availability of data on the share of the types of fiber being produced globally. For

⁹³ U.S. Customs and Border Protection (CBP), January 13, 2021; U.S. Customs and Border Protection (CBP), “Xinjiang Uyghur Autonomous Region WRO Frequently Asked Questions,” October 20, 2021.

⁹⁴ USITC, *Seafood Obtained via IUU Fishing*, February 2021, 100–102.

⁹⁵ This would be similar to the Commission’s adjustment of IUU marine capture estimates based on evidence of labor violations. USITC, *Seafood Obtained via IUU Fishing*, February 2021, 100–102. A researcher may want to employ a sensitivity analysis to check the robustness of these types of estimates.

⁹⁶ Based on imports during 2016–20. During that period, two countries—China and Vietnam—supplied for about 47 percent of U.S. imports in that period: 20 countries supplied another 46 percent of U.S. imports. The remaining imports were supplied by roughly 200 trading partners. USITC Dataweb/Census, HS subheading 61 and 62, accessed September 28, 2021.

example, in 2019, the total fiber market was about 111 million mt, of which cotton accounted for 23 percent (about 26 million mt).⁹⁷ Illicit U.S. imports of apparel under this approach could then be estimated by multiplying the worldwide illicit production estimate for cotton by the share of cotton in the world fiber market. Alternatively, a more refined analysis could be used to better reflect the content of illicit cotton content within U.S. textile and apparel imports. This would involve calculating the share of cotton as an input within imports based on the trade data itself. One way of doing this would be to utilize the designation of fiber type within the Harmonized System's six-digit subheading level for most textile and apparel products.

Modeling the Economic Impact of Illicit Trade

Estimates of the extent of illicit cotton within U.S. imports can be used to quantify the impact of those imports on a domestic industry. It is important to first define what industries to model and at what point of the supply chain the illicit products cross the U.S. border. As described above, U.S. cotton production is substantial while U.S. imports of cotton and cotton yarn and thread are minimal, suggesting that a model focused on imports of these intermediate goods in addition to final goods would be unnecessary. By contrast, U.S. imports of textile and apparel derived from cotton are substantial and are the focus of the hypothetical import estimates in this case study. Determining how to structure within the model the small U.S. domestic industry that competes with these imports is an important step: if the researcher thinks that imported apparel varieties are not directly substitutable with domestic production, the researcher could either use a low substitution elasticity in the model or leave out domestic production all together.⁹⁸ If the domestic industry could not easily ramp up production, to gain market share after eliminating imports generated from illicit activities, the researcher could use a low supply elasticity to capture that attribute.

Finally, the modeling approach presented earlier estimates the economic effects of illicit imports on domestic producers by simulating a hypothetical scenario where illicit imports are removed from total imports. The researcher should consider what hypothetical policy change would be most realistic to remove illicit import flows in the apparel market. If the most realistic policy is to stop forced and child labor from occurring in the respective source countries, by stronger policing or by international measures to curb labor violations, then the global supply of cotton produced by forced labor is eliminated. Under this approach, a researcher would have to determine the likelihood of suppliers to switch from forced labor to employment that complies with labor laws and standards. If the more realistic policy is to block entry of imports from countries that are known violators of labor laws, then trade diversion should be considered. Imports from the violating country will be reduced, and consumers will substitute those products with countries that do not produce illicit products. If the researcher has information about supply elasticities for imports that come from countries without labor

⁹⁷ Synthetic fibers accounted for 63 percent of production (about 70 million mt), and other natural fibers (e.g., silk, wool) accounted for the remainder of fibers. Textile Exchange, *Preferred Fiber & Material: Market Report 2020*, 2020, 6.

⁹⁸ U.S. apparel production accounted for only 2.8 percent of the U.S. apparel market in 2016, according to the American Apparel and Footwear Association. Danziger, "Fashion Industry's Dependence on Imports," August 31, 2017.

violations, they could use a supply elasticity instead of a replacement rate to understand the sourcing changes.

Conclusion

Policymakers and market participants are increasingly eager to ensure that commonly imported products—like coffee, t-shirts, and furniture—are derived from production practices that they consider ethical, legal, and/or sustainable. When illegal and unethical practices in foreign countries are uncovered by journalists, NGOs, or government enforcement actions, a wide range of stakeholders have an interest in understanding the extent to which those products enter import supply chains. Although there is unlikely to be clear data providing distinctions between illicit and non-illicit products within trade data, researchers can still produce reasonable estimates of illicit imports using the toolbox of strategies and techniques detailed within this paper. Such estimates are subject to uncertainty, but they can show where risk of market exposure to illicit practices is most concentrated. When estimates of illicit imports are incorporated within a modeling framework, they can also be used to analyze how competition from foreign goods produced with illicit practices can undermine U.S. industries.

Bibliography

- Agnew, David J., John Pearce, Ganapathiraju Pramod, Tom Peatman, Reg Watson, John R. Beddington, and Tony J. Pitcher. "Estimating the Worldwide Extent of Illegal Fishing." *PLoS ONE* 4, no. 2 (2009). <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0004570>.
- Ainsworth, C.H., and T.J. Pitcher. "Estimating Illegal, Unreported and Unregulated Catch in British Columbia's Marine Fisheries." *Fisheries Research* 75, no. 1–3 (September 2005). <https://doi.org/10.1016/j.fishres.2005.05.003>.
- Barrett, Eamon, and Grady McGregor. "Reports of Forced Labor Are Driving Brands to Abandon Chinese Cotton." *Fortune*, July 18, 2021. <https://fortune.com/2021/07/18/china-cotton-forced-labor-xinjiang/>.
- Chua, Jasmin Malik. "'Every Supplier,' 'Every Tier': What Uniqlo's Xinjiang Links and Lapses Mean for Your Brand." *Sourcing Journal*, May 27, 2021. <https://lgi.laufer.com/news/every-supplier-every-tier-what-uniqlos-xinjiang-links-and-lapses-mean-for-your-brand/>.
- Comolli, Virginia, ed. *Organized Crime and Illicit Trade*. London, UK: Springer International Publishing, 2018. <https://doi.org/10.1007/978-3-319-72968-8>.
- Danziger, Pamela N. "Fashion Industry's Dependence on Imports: Good or Bad for the U.S. Economy?" *Forbes*, August 31, 2017. <https://www.forbes.com/sites/pamdanziger/2017/08/31/fashion-industrys-dependent-on-imports-good-or-bad-for-economy/>.
- Donaldson, Tara. "Cambodia Faces Alarming Threat of Garment Sector Subcontracting." *Sourcing Journal*, May 30, 2017. <https://sourcingjournal.com/topics/labor/cambodia-faces-alarming-threat-garment-sector-subcontracting-67269/>.
- EarthSight. *IKEA's House of Horrors*. 2019 (updated July 2021). <https://www.earthsight.org.uk/news/investigations/ikea-house-of-horrors>.
- Environmental Investigation Agency (EIA). *Moment of Truth: Promise or Peril for the Amazon as Peru Confronts its Illegal Timber Trade*, February 2018. <https://content.eia-global.org/posts/documents/000/000/694/original/MomentofTruth.pdf?1520443534>.
- Environmental Justice Foundation (EJF). *Somebody Knows Where Your Cotton Comes From*, 2009. https://ejfoundation.org/resources/downloads/track_and_trace_web.pdf.
- Escobar, Herton. "Illegal Deforestation in Brazil Soars amid Climate of Impunity." *Science*, August 5, 2020. <https://www.science.org/content/article/illegal-deforestation-brazil-soars-amid-climate-impunity>.
- Espresso International. "Coffee Cultivation." Accessed November 8, 2021. <https://www.espresso-international.com/coffee-cultivation/>.
- Fair Labor Association. "From Field to Consumer: Cotton Production and Supply Chain in Turkey." No date, accessed August 27, 2021. https://www.fairlabor.org/sites/default/files/turkey_cotton_supply_chain_map.pdf.

- Food and Agriculture Organization of the United Nations (FAO). “What Is IUU Fishing?” Accessed December 2, 2020. <http://www.fao.org/iuu-fishing/background/what-is-iuu-fishing/en/>.
- Food and Agriculture Organization of the United Nations (FAO). FAOSTAT Database. Accessed November 5, 2021. <https://www.fao.org/faostat/en/#home>.
- Food Empowerment Project. “Child Labor and Slavery in the Chocolate Industry,” October 28, 2021. <https://foodispower.org/human-labor-slavery/slavery-chocolate/>.
- Gan, Jianbang, Paolo Omar Cerutti, Mauro Masiero, Davide Pettenella, Nicola Andrighetto, and Tim Dawson. “Quantifying Illegal Logging and Related Timber Trade” in *Illegal Logging and Related Timber Trade: Dimensions, Drivers, Impacts and Responses*. International Union of Forest Research Organizations: December 2016.
- Hall, Jani. “From Trees to Tigers, Case Shows Cost of Illegal Logging.” *National Geographic*, November 10, 2015. <https://www.nationalgeographic.com/animals/article/151110-timber-russian-far-east-illegal-logging-siberia>.
- Hoare, Alison. *Tackling Illegal Logging and the Related Trade*. Chatham House, July 2015. <https://www.chathamhouse.org/2015/07/tackling-illegal-logging-and-related-trade-what-progress-and-where-next>.
- Human Rights Watch. “Uzbekistan: Forced Labor Widespread in Cotton Harvest.” January 25, 2013. <https://www.hrw.org/news/2013/01/25/uzbekistan-forced-labor-widespread-cotton-harvest>.
- International Cotton Advisory Committee (ICAC). “About ICAC,” accessed June 3, 2021. <https://icac.org/About/AboutICAC?MenuId=2>.
- International Cotton Advisory Committee (ICAC). “Data Portal,” accessed June 3, 2021. <https://icac.org/DataPortal/DataPortal>.
- International Labour Organization (ILO). “Garment Sector in Cambodia: Declining Employment despite Rising Exports,” May 30, 2017. http://www.ilo.org/asia/media-centre/news/WCMS_555470/lang--en/index.htm.
- International Labour Organization (ILO). “Systemic Forced Labour and Child Labour Has Come to an End in Uzbek Cotton.” Press release, January 29, 2021. http://www.ilo.org/washington/news/WCMS_767753/lang--en/index.htm.
- International Labour Organization (ILO). *Child Labour in Cotton: A Briefing*. Geneva, Switzerland: ILO, 2016. <https://www.ilo.org/ipeinfo/product/download.do?type=document&id=29655>.
- International Labour Organization (ILO). Home, accessed June 11, 2021, <https://www.ilo.org/global/lang--en/index.htm>.
- International Labour Organization (ILO). Statistics and databases, accessed June 11, 2021, <https://www.ilo.org/global/statistics-and-databases/lang--en/index.htm>.
- International Labour Organization (ILO). ILOSTAT: Statistics on Collective Bargaining, accessed September 28, 2021. <https://ilostat.ilo.org/topics/collective-bargaining/>.

Shedding Light on the Dark Side of Trade: Strategies for Analyzing the Extent and Impact of Illicit Imports

- International Labour Organization (ILO). Working Conditions in Bangladesh, accessed June 11, 2021 <https://www.ilo.org/dhaka/Areasofwork/working-conditions/lang--en/index.htm>.
- International Trade Centre. *The Coffee Guide*. Geneva, Switzerland: International Trade Centre, October 2021. https://www.intracen.org/uploadedFiles/intracenorg/Content/Publications/ITC_Coffee_4th_Report_20210930_web_pages.pdf.
- INTERPOL. "Project ENACT Strategic Assessment: Illegal Gold Mining in Central Africa," May 2021. <https://enactafrica.org/research/interpol-reports/illegal-gold-mining-in-central-africa>.
- Jones, Lin, Meryem Demirkaya, and Erika Bethmann. "Global Value Chain Analysis: Concepts and Approaches," April 2019. https://www.usitc.gov/publications/332/journals/concepts_approaches_in_gvc_research_final_april_18.pdf.
- KnowtheChain. "Investor Snapshot: Forced Labor in Forestry." Business and Human Rights Resource Centre, November 2019. <https://www.business-humanrights.org/en/from-us/briefings/knowthechain-investor-snapshot-forced-labor-in-forestry-incl-paper-forest-products/>.
- Lawson, Sam, and Larry MacFaul. *Illegal Logging and Related Trade: Indicators of the Global Response*. London: Chatham House, 2010. http://awsassets.panda.org/downloads/chatham_house_illegallogging_2010.pdf.
- Lippe, Rattiya Suddeephong, Shannon Cui, and Jörg Schweinle. "Estimating Global Forest-Based Employment." *Forests* 12, September 2021. <file:///s1p-fsc-01/Home/renee.berry/Downloads/forests-12-01219-v2.pdf>.
- National Council of Textile Organizations (NCTO). The Textile Journey of a Pair of Pants, accessed August 27, 2021. <file:///C:/Users/Marin.Weaver/Zotero/storage/VP22VEYZ/NCTO-textile-final.html>.
- Pauly, Daniel, and Dirk Zeller. "Catch Reconstruction: Concepts, Methods, and Data Sources." *Sea Around Us*, 2015. <http://www.seararoundus.org/catch-reconstruction-and-allocation-methods/>.
- Pearce, Fred. "The Real Price of a Chocolate Bar: West Africa's Rainforests." *Yale E360*, February 21, 2019. <https://e360.yale.edu/features/the-real-price-of-a-chocolate-bar-west-africas-rainforests>.
- Pietsch, Bryan. "E.U. Seeks to Block Import of Commodities that Drive Deforestation." *Washington Post*, November 17, 2021. <https://www.washingtonpost.com/world/2021/11/17/eu-commodity-imports-deforestation/>.
- Pitcher, Tony J, Reg Watson, Robyn Forrest, Hreidar Por Valtýsson, and Sylvie Guenette. "Estimating Illegal and Unreported Catches from Marine Ecosystems: A Basis for Change." *Fish and Fisheries* 3, no. 4 (December 2002). <https://doi.org/10.1046/j.1467-2979.2002.00093.x>.
- Pramod, Ganapathiraju, Katrina Nakamura, Tony Pitcher, and Leslie Delagran. "Estimates of Illegal and Unreported Fish in Seafood Imports to the USA." *Marine Policy* 48, September 2014. <https://doi.org/10.1016/j.marpol.2014.03.019>.

- Pramod, Ganapathiraju, Tony J. Pitcher, and Gopikrishna Mantha. “Estimates of Illegal and Unreported Seafood Imports to Japan.” *Marine Policy* 108 (October 2019).
<https://doi.org/10.1016/j.marpol.2019.02.011>.
- Prestemon, Jeffrey P. “The Impacts of the Lacey Act Amendment of 2008 on U.S. Hardwood Lumber and Hardwood Plywood Imports.” *Forest Policy and Economics* 50, January 2015.
<https://doi.org/10.1016/j.forpol.2014.10.002>.
- Responsible Sourcing Network. *From the Field: Travels of Uzbek Cotton Through the Value Chain*. San Francisco, CA: RSN, 2012.
<http://www.cottoncampaign.org/uploads/3/9/4/7/39474145/fromthefieldpublic.pdf>.
- School of Oriental and African Studies (SOSA). *Invisible to the World? The Dynamics of Forced Child Labour in the Cotton Sector of Uzbekistan*. University of London. London, United Kingdom: SOSA, 2009. <https://www.soas.ac.uk/ccac/events/cotton-sector-in-central-asia-2005/file49842.pdf>.
- Seneca Creek Associates LLC, and Wood Resources International, LLC. “‘Illegal’ Logging and Global Wood Markets: The Competitive Impacts on the U.S. Wood Products Industry,” October 2004.
http://www.unece.lsu.edu/responsible_trade/documents/2003-2006/rt03_036.pdf.
- Smeader, Terry. “Cotton and Poly Cotton Fabric: Know Everything.” *Fibre2fashion.com*, June 2010.
<http://www.fibre2fashion.com/industry-article/5001/cotton-or-poly-cotton-fabric>.
- Tacconi, Luca, Rafael J. Rodriguez, and Ahmad Maryudi. “Law Enforcement and Deforestation: Lessons for Indonesia from Brazil.” *Forest Policy and Economics* 108 (November 2019).
<https://www.sciencedirect.com/science/article/pii/S1389934118304623>.
- Textile Exchange. *Preferred Fiber & Material: Market Report 2020*. Textile Exchange, 2020.
https://textileexchange.org/wp-content/uploads/2020/06/Textile-Exchange_PREFERRED-Fiber-Material-Market-Report_2020.pdf.
- Textile School. “Blended Fabrics,” March 17, 2018. <https://www.textileschool.com/265/blended-fabrics-textile-composites/>.
- Turton, Shaun. “Vietnam's Furniture Sector 'Nervous' over U.S. Logging Probe.” *Nikkei Asia*, June 28, 2021. <https://asia.nikkei.com/Economy/Vietnam-s-furniture-sector-nervous-over-US-logging-probe>.
- The White House. *The National Action Plan to Combat Human Trafficking*, December 2021.
<https://www.whitehouse.gov/wp-content/uploads/2021/12/National-Action-Plan-to-Combat-Human-Trafficking.pdf>.
- U.S. Customs and Border Protection (CBP). “CBP Issues Region-Wide Withhold Release Order on Products Made by Slave Labor in Xinjiang,” January 13, 2021.
<https://www.cbp.gov/newsroom/national-media-release/cbp-issues-region-wide-withhold-release-order-products-made-slave>.
- U.S. Customs and Border Protection (CBP). “Forced Labor.” U.S. Customs and Border Protection. Accessed December 14, 2021. <https://www.cbp.gov/trade/forced-labor>.

Shedding Light on the Dark Side of Trade: Strategies for Analyzing the Extent and Impact of Illicit Imports

- U.S. Customs and Border Protection (CBP). “Xinjiang Uyghur Autonomous Region WRO Frequently Asked Questions,” October 20, 2021. <https://www.cbp.gov/trade/programs-administration/forced-labor/xinjiang-uyghur-autonomous-region-wro-frequently-asked-questions>.
- U.S. Department of Agriculture (USDA). Foreign Agriculture Service (FAS). *Cotton and Products Annual*. GAIN report. Ch2021-0039. China: Cotton and Products. Beijing, China: USDA, April 1, 2021. <https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Cotton%20and%20Products%20Annual%20Beijing%20China%20-%20People%27s%20Republic%20of%2004-01-2021>.
- U.S. Department of Agriculture (USDA). Foreign Agriculture Service (FAS). Production, Supply and Distribution (PSD) Online. Accessed various dates. <https://apps.fas.usda.gov/psdonline/app/index.html#/app/home>.
- U.S. Department of Justice (USDOJ). “Lumber Liquidators, Inc. Sentenced for Illegal Importation of Hardwood and Related Environmental Crimes.” February 1, 2016. <https://www.justice.gov/opa/pr/lumber-liquidators-inc-sentenced-illegal-importation-hardwood-and-related-environmental>.
- U.S. Department of Labor (USDOL). “List of Goods Produced by Child Labor or Forced Labor,” September 30, 2020. <https://www.dol.gov/agencies/ilab/reports/child-labor/list-of-goods>.
- U.S. Department of Labor (USDOL). *2020 List of Goods Produced by Child Labor or Forced Labor*. Washington D.C.: USDOL, ILAB, September 2020. https://www.dol.gov/sites/dolgov/files/ILAB/child_labor_reports/tda2019/2020_TVPR_A_List_Online_Final.pdf.
- U.S. Department of Labor (USDOL). Bureau of International Labor Affairs (ILAB). *The Department of Labor’s List of Goods Produced by Child Labor or Forced Labor*. Washington D.C.: USDOL: ILAB, Office of Child Labor, Forced Labor, and Human Trafficking, September 10, 2009. https://www.dol.gov/sites/dolgov/files/ILAB/reports/TVPR%202009_WEB_.pdf.
- U.S. Department of State (USDOS). *2020 Country Reports on Human Rights Practices*. Washington DC: DOS, Bureau of Democracy, Human Rights, and Labor, March 31, 2021. <https://www.state.gov/reports/2020-country-reports-on-human-rights-practices/>.
- U.S. Department of State (USDOS). *2021 Trafficking in Persons Report*. Washington D.C.: USDOS, June 2021. <https://www.state.gov/reports/2021-trafficking-in-persons-report/>.
- U.S. Department of State (USDOS), U.S. Department of Treasury, U.S. Department of Commerce, U.S. Department of Homeland Security, Office of the U.S. Trade Representative, and U.S. Department of Labor. “Risks and Considerations for Businesses and Individuals with Exposure to Entities Engaged in Forced Labor and other Human Rights Abuses linked to Xinjiang, China.” Xinjiang Supply Chain Business Advisory, updated July 13, 2021. https://home.treasury.gov/system/files/126/20210713_xinjiang_advisory_0.pdf.
- U.S. Geological Survey (USGS). “International Minerals Statistics and Information.” Accessed November 5, 2021. <https://www.usgs.gov/centers/nmic/international-minerals-statistics-and-information>.

- U.S. International Trade Commission (USITC). *Seafood Obtained via Illegal, Unreported, and Unregulated Fishing: U.S. Imports and Economic Impact on U.S. Commercial Fisheries*. 5168. Washington D.C.: USITC, February 2021. <https://www.usitc.gov/publications/332/pub5168.pdf>.
- U.S. International Trade Commission (USITC). *Textiles and Apparel: Assessment of the Competitiveness of Certain Foreign Suppliers to the U.S. Market*. 3671. Investigation No. 332-448. Washington D.C.: USITC, January 2004. <https://www.usitc.gov/publications/332/pub3671.pdf>.
- Union of Concerned Scientists (UCS). "The Lacey Act's Effectiveness in Reducing Illegal Wood Imports." Union of Concerned Scientists, October 2015. https://doi.org/10.1163/9789004322714_cclc_2015-0094-006.
- United Nations Statistics Division (UNSD). "ISO 3166-1 Alpha-3." UN Trade Statistics. Accessed November 5, 2021. <https://unstats.un.org/unsd/trade/kb/knowledgebase/country-code>.
- United Nations. *Classification by Broad Economic Categories, Rev.5*. New York, NY: UN, June 11, 2018. <https://doi.org/10.18356/7cff5416-en>.
- Wallach, Omri. "From Bean to Brew: The Coffee Supply Chain." Visual Capitalist, August 7, 2020. <https://www.visualcapitalist.com/from-bean-to-brew-the-coffee-supply-chain/>.
- Weiss, Jeffrey, and Katy Shin. "Potential Implications of the FOREST Act of 2021 and Related Developments in Other Jurisdictions." Global Trade Policy Blog, November 8, 2021. <https://www.steptoeglobaltradeblog.com/2021/11/potential-implications-of-the-forest-act-of-2021-and-related-developments-in-other-jurisdictions/>.
- World Customs Organization (WCO). *Illicit Trade Report 2012*. World Customs Organization, 2013. http://www.wcoomd.org/-/media/wco/public/global/pdf/topics/enforcement-and-compliance/activities-and-programmes/illicit-trade-report/itr_2012_en.pdf?db=web.
- World Economic Forum (WEF). *2011-12 Report on Illicit Trade*. Network of Global Agenda Councils Reports: 2011-2012, 2012. <http://reports.weforum.org/global-agenda-council-2012/>.
- Xu, Vicky Xiuzhong, Danielle Cave, James Leibold, Kelsey Munro, and Nathan Ruser. *Uyghurs for Sale: 'Re-Education', Forced Labour and Surveillance Beyond Xinjiang*. Policy Brief. Report No. 26/2020. Australian Strategic Policy Institute, March 1, 2020. <https://s3-ap-southeast-2.amazonaws.com/ad-aspi/2021-04/Uyghurs%20for%20sale%2019%20April%202021.pdf?VersionId=CifExOIYXRwRJRTR.kMqSgL9cx7nKia8>.
- York Saw and Knife. "Sawmills in the USA." Accessed January 3, 2022. <https://www.yorksaw.com/guide-to-sawmills/sawmills-in-the-usa/>.
- Zengerle, Patricia. "U.S. House Passes Measure Clamping Down on Products from China's Xinjiang Region." *Reuters*, December 9, 2021. <https://www.reuters.com/world/us/us-house-passes-measure-clamping-down-products-chinas-xinjiang-region-2021-12-08/>.