The Effects of the 2008 Lacey Act Amendment on International Trade in Forest Products

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Abstract

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Despite international efforts, illegal logging and its associated social, ecological, and economic effects continue on a scale that is of global concern, with significant amounts of illegally-harvested wood and the resulting wood products entering into international trade flows. Recently, major importers of forest products have begun to implement legislation, such as the U.S. Lacey Act amendment of 2008, prohibiting the possession and/or importation of wood and wood products that are of illegal origin. To date, no studies have systematically investigated the effects of the 2008 Lacey Act amendment on the international trade of forest products. Drawing on bilateral trade data and using a quantitative, regression-based comparative case study methodology, the effects of the 2008 Lacey Act amendment on the international trade in forest products were evaluated. A data-driven method was used to create aggregate control groups for comparisons with countries affected by the policy. If the policy has been effective in reducing the amount of forest products of illegal origin being imported into the U.S., we would expect to see

some unique differences in post-policy U.S. imports of wood and wood products from areas with high levels of suspicious wood in their supplies. Results from these analyses show no significant differences in post-policy U.S. imports of wood products of suspicious origins. However, the policy may be affecting the suspicious imports of major exporters of finished products to the U.S.

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Chapter 1: Introduction and Objectives

Forest ecosystems are extremely important natural resources, and are critical for sustaining life on Earth, as we know it. Covering about 31% of the land surface of the earth, forests provide a host of economic, social, and ecological benefits for both human and non-human populations (FAO, 2010). Forests contribute directly to the livelihoods of over 1 billion extremely poor people in developing countries, with over 350 million considered to be heavily-dependent on forests as a means of support (The World Bank, 2006). As a resource for human populations, forests provide for human needs through their basic uses: food, fiber, and fuel. In addition, forests provide numerous other "ecosystem services" that contribute to human well-being, such as water storage and filtration, flood control, soil retention, carbon sequestration, maintenance of biodiversity, provisioning of medicines and pharmaceuticals, as well as cultural and aesthetic values (Daily, 1997).

According to the Food and Agriculture Organization of the United Nations (2012) "[d]eforestation - the clearing of forests to use the land for other purposes, or to leave it as unused wasteland – is one of the most widespread and important changes that people have made to the surface of the earth." Over the past five thousand years, 1.8 billion hectares of forest land have been lost, a significant amount considering that there are currently 4 billion hectares of forested land on the earth (FAO, 2010; Williams, 2006). Deforestation of temperate forests has declined steadily since the 1800s, to the point that there is now no net loss of forested land in temperate forests on a global scale (FAO, 2010; Williams, 2006). However, deforestation of tropical forests increased rapidly from the late 1800s through the early 1980s. Since then, deforestation in tropical forests has declined. From 2000-2010, roughly 13 million hectares of forested land were cleared on

an annual basis. Due to afforestation and natural expansion of forests, however, the annual net loss of forested land during that decade was about 5.2 million hectares per year, which was down from 8.3 million hectares of annual net loss during the previous decade (FAO, 2010). Since most of the gains in forested land have occurred outside of tropical forests, however, deforestation rates in tropical forests remain alarmingly high, particularly in areas of Central and South America and Southeast Asia.

Conversion of forests to agricultural land concurrent with population growth and dispersion is widely considered to be the primary driver of forest loss (FAO, 2012). With the rise of the industrial age and globalizing markets, the use of wood both as a raw industrial material and as fuel contributes to these forest losses from land conversion. Most analyses point to land conversion for agriculture as the continuing primary driver of deforestation (Geist and Lambin, 2001), with other economic development activities, such as road building and mining, also contributing to losses of forested land. Many of these activities that lead to deforestation are legal and supported by government policies that encourage economic development. However, illegal logging, or the harvesting of timber that contravenes the laws of the country of harvest or production, can occur specifically for the sale or use of the harvested wood or in tandem with any of these development activities (Bosello, Parado, and Rosa, 2013).

While it is likely not the primary driver, illegal logging is an important contributor to deforestation. While estimates vary, logging for wood products is believed to be responsible for about 1/3 of global deforestation (Brack, 2005). Due to informational limitations discussed later in this analysis, estimates of illegal logging are difficult to substantiate with clear evidence. As a result, much is left to be learned about the details

of how illegal logging interacts with broader deforestation processes.[1] In developed countries, there is evidence that illegal logging is uncommon (Li et al., 2008; Seneca Creek Associates, 2008; Seneca Creek Associates, 2004). However, evidence supports the contention that much, perhaps the majority, of the deforestation that takes place in tropical countries is induced by illegal logging (Brack, 2005; Contreras-Hermosilla, Doornbosch, and Lodge, 2007).

This analysis will focus on the harvest and trade of industrial round wood, which is wood in its natural state or slightly processed. This type of wood is a raw material that is used as an input in industrial processes that transform wood into a wide variety of products. The production and trade of industrial round wood is distinct from wood used as fuel, which has very different markets. Globally, industrial round wood (including sawnwood) makes up roughly 47% of total production, while 49% of wood production is used as fuel of some kind (FAO, 2011). In tropical areas, up to 80% of the wood extracted from forests is consumed as fuel wood, while in temperate and boreal forests only 20% of wood is used for this purpose (Contreras-Hermosilla, 2007). According to a 2007 report, "the market for fuel wood, although very important in terms of volume, is so markedly different from that of industrial round wood that they cannot be analyzed together" (Contreras-Hermosilla). The report explains that only a very small fraction of fuel wood ever leaves the country of origin, as little as 2% in 2003 (Contreras-Hermosilla, 2007). In addition to contributing little to international trade flows, fuel wood is often used to meet the basic energy needs of communities in developing countries through its use for cooking and heating. This makes it very difficult for international efforts to

[1] See Palmer, 2001 for further discussion of the links between illegal logging and deforestation.

directly target the illegal harvest of fuel wood without also addressing broader, long-term development goals.

As evidenced by its large share of production, logging for industrial round wood is one of several contributors to deforestation. According to Contreras-Hermosilla (2007), "much of this logging takes place in violation of laws designed to protect forests against indiscriminate cutting." In "high risk" countries, in this case identified as China, Russia, and all tropical countries, studies estimate that illegal logging accounts for 20% - 90% (median of 40%) of industrial round wood production (Contreras-Hermosilla et al., 2007; Seneca Creek Associates and Wood Resources International, 2004). Around half of this industrial round wood leaves these high risk countries and enters into international trade flows, and experts generally assume that illegally logged wood accounts for roughly similar proportions of any wood exports from these countries (Bosello et al., 2013; Contreras-Hermosilla et al., 2007).

Beginning in the 1990s, environmental concerns about the effects of tropical deforestation and increased understanding and awareness of the economic effects of illegal logging led to diverse international efforts to reduce illegal logging. These efforts range from increased enforcement and economic development initiatives in producer countries to international agreements and market-based certification programs. With the passage of the 2008 Lacey Act amendment, the U.S. became the first country in the world to ban the import or internal trade of illegally harvested or manufactured wood and wood products (Environmental Investigation Agency, 2008). In 2013 and 2014, respectively, the European Union and Australia began to implement similar policies (Brack, 2013). In the literature, these policies are generally described as demand-side measures, due to the fact that they are intended to reduce consumer country demand

for illegally harvested wood by discriminating between legally-produced and illegally-produced wood and wood products (Contreras-Hermosilla et al., 2007). However, we disagree with the use of this nomenclature for consumer country import bans on illegally logged wood. Outlawing trade or possession of illegally harvested wood or wood products in consumer countries actually functions as a supply restriction, rather than a demand reduction, since consumer demand is not actually affected by these import bans. This distinction is discussed in detail in Chapter 2 in the explanation of the theoretical basis of economic modelling studies that investigate the effects of import bans on illegal wood.

In general, these import bans are intended to force consumers and importers to distinguish between products made from legally- and illegally-harvested wood. This reduction in the flow of illegally harvested wood and wood products to rich consumer countries is expected to reduce the incentives for the illegal harvest of wood in countries of production, as importers and companies attempt to comply with the law by avoiding trade in illegal or suspicious wood products (Contreras-Hermosilla et al., 2007). Aside from the obvious complications of implementing and enforcing these policies, there is room for doubt about whether consumer country import bans address the underlying causes of illegal logging. Despite over five years having passed since the Lacey Act was amended to outlaw U.S. commerce in illegally sourced timber and wood products, we still lack a clear understanding of the policy's effects on illegal logging or forest products trade.

This research focuses on policies that address the illegal logging of industrial round wood by investigating the trade effects of a consumer country import ban on illegally-logged wood (the Lacey Act amendment of 2008). Following a brief summary of the research

objectives, Chapter 2 will address the specific problems associated with illegal logging, discuss the context for the policy in question, and explore the expected effects of these policies. Chapter 3 explains the comparative case study methodology used in the analysis of this research question. The results of the analysis are presented in Chapter 4, followed by a broader discussion of those results in Chapter 5.

Objectives

This analysis will provide evidence to help understand the following research question: How has the 2008 Lacey Act amendment affected the international trade of forest products? International trade data and other economic indicators will be analyzed in an attempt to detect the effects, if any, of the 2008 Lacey Act amendment on the international trade in forest products. If the Lacey Act amendment of 2008 had any effect on reducing the import of wood and wood products arising from illegal harvesting activities, as was its stated purpose, we would expect to see some indication of that effect in international trade. Specifically, the policy would be expected to impact the trade of forest products destined for import to the U.S. from countries with a high prevalence of illegal logging, or to reduce imports due to increased domestic production in the overwhelmingly legal wood industry in the U.S.

Chapter 2: Background/Literature Review

Defining Illegal Logging

While it can be defined in a number of ways, this analysis will use a common definition of illegal logging as the harvesting of timber that contravenes the laws of the country of harvest or production. However, even this definition includes a wide diversity of "illegal forest activities," including actions as diverse as unauthorized individuals harvesting firewood from federal land, large-scale timber harvest and theft from protected areas, and transport of forest products in undocumented vehicles (Seneca Creek Associates, 2004). In order to define a set of "illegal forest activities" that are of concern for international trade and policy, Seneca Creek Associates (2004) defined illegal logging that rises "to a level of international significance" as the following activities:

> Directly related to illegal logging:
> (1) harvesting without authority in designated national parks or forest reserves;
> (2) harvesting without authorization or in excess of concession permit limits;
> (3) failing to report harvesting activity to avoid royalty payments or taxes; and
> (4) violating international trading rules or agreements, such as export bans or CITES.

According to the report, these types of illegal logging activity have the most severe environmental impacts and undermine attempts to implement sustainable forest management practices (Seneca Creek Associates, 2004). For the purposes of this analysis, which is focused on international trade, this more limited definition of illegal logging is more appropriate.

Problems Associated with Illegal Logging

Attempts to reduce the global illegal harvest of timber continue to be placed high on the list of important issues in international forestry. Myriad problems are associated with illegal logging. Illegal logging is associated with social problems such as government

corruption and the empowerment of organized criminal groups. Local communities, often largely poor and/or indigenous, are harmed by the loss of building materials, fuel, and non-wood forest products, decreased food security, as well as the loss of ecosystem services associated with intact forest ecosystems (The World Bank, 2006). From an ecological perspective, illegal logging can contribute to unregulated deforestation, which leads to environmental degradation and reduced biodiversity through the reduction of forest habitats. These issues are particularly alarming in developing tropical countries, where much illegal logging activity occurs. Through these ecological effects, illegal logging also contributes to climate change, as forest destruction, in general, contributes up to 20% of global CO2 emissions (Lawson and MacFaul, 2010). More specifically, "poor management practices associated with deforestation and the clearing of [tropical moist] forests are responsible for an estimated 17% of all man-made carbon emissions, 50% more than the amount produced by ships, aviation, and land transport combined" (Nelleman, 2012).

More recently, a series of reports have highlighted the negative economic effects of illegal logging to both producer and consumer countries. The global forest products industry is very large; trade in forest products accounts for an estimated 1% of global GDP and 3% of international merchandise trade (Contreras-Hermosilla, 2007). According to The World Bank (2006), illegal logging costs producer countries around $15 billion annually due to the combined effects of the lost market value of the forest products and the lost royalty revenues for producer country economies. Although this figure is often cited, the report does not support this figure with any explanation of how it was derived. A substantiated analysis in a 2004 report produced for the American Forest and Paper Association found that illegal forest activity "represents between 5% and 10% of global industrial round wood production – approximately 4% for softwood, but 15% for

hardwood," which "depress[es] world prices by 7% - 16% on average" (Seneca Creek Associates and Wood Resources International). This value is captured by the producers of illegal timber, as well as by consumers of wood products through depressed prices. Furthermore, depressed prices penalize legitimate timber operations, reducing their incentives to engage in more sustainable forestry practices. This quantification of the potential economic benefits has catalyzed further action by consumer country governments, which will be discussed later in this chapter.

In addition to the problems detailed above, illegal logging is also related to organized crime. From the 1970s through the late 1990s, the large-scale deforestation occurring in the tropical regions of the world was primarily driven by government policies supporting two forces of economic development: the use of forest resources to drive economic growth and the conversion of tropical forests into more economically productive agricultural and grazing lands (Eastin, Unpublished). However, concern about the loss of tropical forest ecosystems and global warming increased in the late 1990s, leading to calls for the protection of tropical forest ecosystems. Since that point in time, large-scale illegal logging in tropical countries has become a serious problem, often relying on collusion with corrupt government officials and the military (Eastin, Unpublished). Figure 2.1 shows the relationship between corruption and illegal forest activities. A 2012 report by INTERPOL and the United Nations Environment Program (UNEP) provided extensive evidence of the complex connections between illegal logging, tax fraud, and money laundering by organized crime groups (Nelleman, 2012). These connections with organized crime have further increased incentives for governments in both producer and consumer countries to work to reduce illegal logging. At the same time, organized criminal groups have gained power, strengthened alliances with corrupt officials, and created more sophisticated operations in many producer countries, making it harder to

effectively track illegal logging activities (Nelleman, 2012). It is important to note that Figure 2.1 shows only production and trade of raw industrial round wood (i.e., logs). As a result of programs aimed at reducing the illegal extraction of timber for export (i.e., bans of raw log exports) and the increasing amount of value-added processing of raw logs that is occurring in the countries of origin, the amount of logs in the international market has been greatly reduced over the past two decades (ITTO, 2012). Furthermore, Figure 2.1 only represents the volume of wood, not the value of the wood.

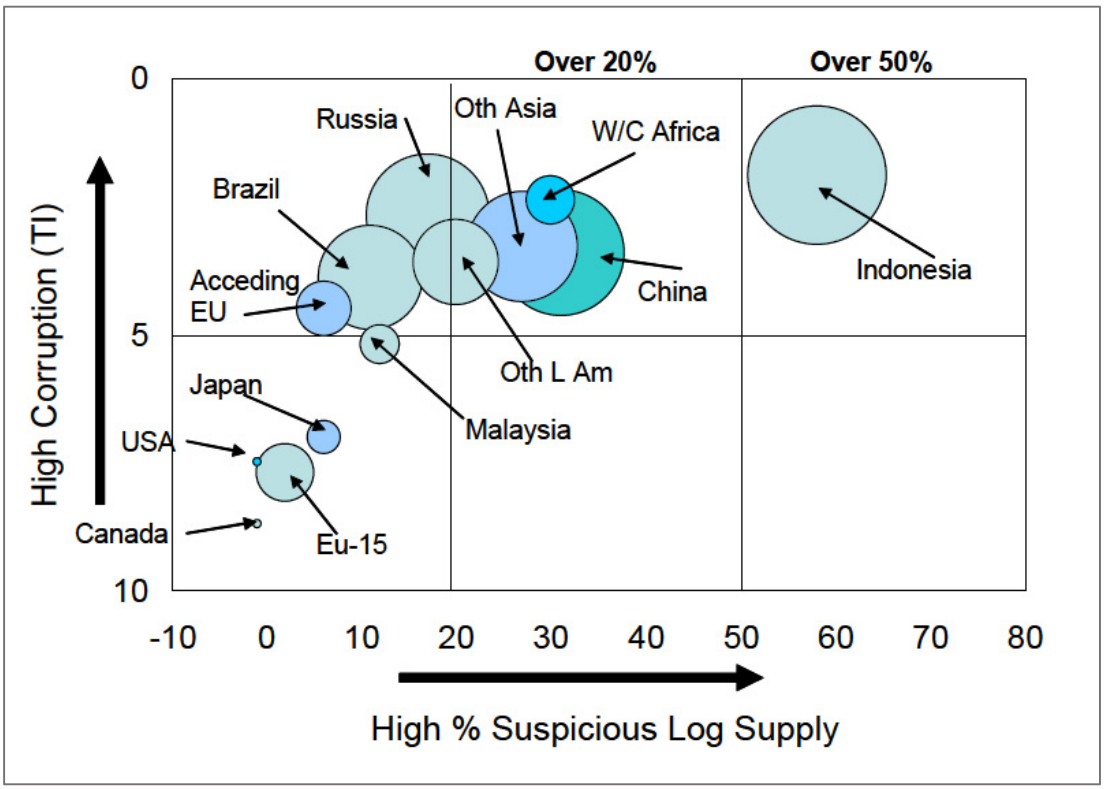

Figure 2.1: Corruption and Illegal Forest Activities; Note: Size of bubble represents volume of suspect round wood, including imports (Seneca Creek Associates and Wood Resources International, 2004, integrating information from Transparency International and WRI/SCA estimates of illegal logging).

More recently, there is evidence that large-scale illegal logging may be declining, and therefore the relative contributions of more intractable forms of illegal logging, such as unlicensed logging by smaller-scale concessionaires and logging for use in producer-country domestic markets, are likely increasing (Lawson and MacFaul, 2010). By most

measures, though, illegal logging continues on an international scale that merits attention by the international community, especially when viewed as a key driver of global deforestation. As a result of these concerns, illegal logging has been identified as a serious problem by governments and government agencies, international non-governmental organizations (NGOs), forest products trade associations, and many companies involved in the forest products industry. The response to illegal logging has taken various forms over the years.

Responses to Illegal Logging

Producer Country Responses

Various efforts to prevent illegal logging have been pursued by the countries where the initial illegal harvest of wood takes place, which are referred to as "producer countries." In this analysis, the legality of harvested wood is based on compliance with the rules and regulations of the country where the initial harvest takes place; therefore, producer countries create the legal and regulatory framework for defining illegal logging in individual countries. Overall, producer countries have much to lose from illegal logging: governments lose out on royalties, citizens and local businesses lose economic and natural resources, and forest-dependent communities lose access to local resources. Due to the complex and varied nature of illegal logging, different efforts are necessary to address its causes in these countries. Contreras-Hermosilla (2007) lays out a generally agreed-upon framework for producer country efforts to reduce illegal harvesting of wood:

1. Prevention of illegal logging
    - Improving land tenure and land ownership rights
    - Streamlining the legal framework
    - Achieving a reasonable balance between demand for and supply of industrial forest raw materials
    - Attacking the financing of illegal operations

- Improving the profitability of legal forest management and logging by promoting payments for environmental services (PES)

2. Detection of illegal logging
   - Gathering and making transparent the information necessary to track forest characteristics and their management over time
   - Monitoring the movement of forest products

3. Suppression of illegal logging
   - Increasing capacity to enforce laws and impose penalties for offenders
   - Providing interagency aid to those enforcing forest laws

Many of these efforts are components of long-term development processes that reach far beyond the forest products sector, and many are mutually dependent or dependent on the underlying strength of institutions within developing countries. While these efforts may successfully address the underlying causes of illegal logging, the timeline for implementing these measures and strengthening these institutions is considered far too long to have any effect on illegal logging activities in the near term. As a result, non-producer countries and non-state entities have also undertaken efforts aimed at reducing illegal logging in the near term.

Efforts to address illegal logging outside of producer countries have typically focused on restricting imports of illegally-sourced wood products through trade-related measures (Contreras-Hermosilla, 2007). These efforts fall into three broad categories: non-state or market-driven governance, international agreements, and individual consumer country efforts. All of these efforts attempt, to some degree, to differentiate between legally-harvested and illegally-harvested wood and the resulting wood products.

Non-State, Market-Driven Governance

Recently, voluntary, third-party product certification efforts, such as the certification system of the Forest Stewardship Council (FSC) and the Sustainable Forestry Initiative

(SFI), have gained much attention. Tikina and Innes (2008) explain that the primary objective of forest certification systems is "the improvement of forest management through marketing incentives." These systems provide companies with the ability to differentiate their products by gaining certification indicating their compliance with sustainable forest management practices. Forest certification initiatives are growing rapidly, and in Western Europe (the area of highest market penetration) certified wood products accounted for 5% of the market in the early-2000s (Brack, Gray, and Hayman, 2002). In general, certification does not necessarily imply "legality" of harvested wood. However, most certification schemes require that harvesting be carried out according to the laws of the country of origin. Rigorous certification systems, such as the FSC and SFI, also require third-party chain of custody inspection from extraction to finished product, which largely eliminates the opportunity for illegally-logged wood to become certified (Brack et al., 2002). While certification systems present opportunities for reducing illegal logging, they represent a very small (though growing) proportion of the world's forests. Furthermore, there is no evidence that companies can charge price premiums to end consumers for certified products, which may deter companies from engaging in costly certification processes (Brack et al., 2002; Chen, Innes, and Tikina, 2010; Owari et al., 2006). Without providing clear access to profit gains from compliance, these certification systems may struggle to entice companies to participate. However, these schemes do provide opportunities for companies looking to gain or maintain advantage in certain segments of the competitive forest products sector, specifically those companies selling to markets that demand "green" or sustainable wood products, such as many areas in Western Europe. While there has been discussion about creating a certification scheme that would ensure the legality of forest products, no such certification system exists at this point (Brack et al., 2002; Tacconi et al., 2003).

Aside from certification programs, in 2008 the UN began implementing a collaborative initiative on Reducing Emissions from Deforestation and forest Degradation (REDD) in developing countries. REDD is a program whereby developed countries pay developing countries (through various proposed mechanisms, including carbon offsets) for leaving forests standing, as opposed to undergoing deforestation for short-term economic gains or land conversion. This program also supports efforts in developing countries to participate in REDD+, which expands on REDD by promoting "the role of conservation, sustainable management of forests and enhancement of forest carbon stocks" in developing countries (UN-REDD, 2013). These programs also do not directly target illegal logging. However, if successful, their focus on tracking systems for sustainable forest management would likely contribute to efforts to reduce illegal logging in the developing world.

REDD and REDD+ are fairly new and are still gathering funding and identifying strategies for implementation in participating countries. There are concerns that these types of payment programs will reinforce existing power inequalities between forest users (often poor and/or indigenous communities) and the forest owners (typically governments) that will benefit directly from the payments (Griffiths, 2007). Also, these programs will rely on the strength of laws and policies enacted in developing producer countries to address sustainable forest management. The threats to these types of producer country controls need to be addressed through the broader development policies described in the previous section on producer country responses. While the REDD and REDD+ programs use market-based mechanisms, they also require a cohesive response by many members of the international community. These certification and payment programs have grown out of the relatively recent international agreements aimed at reducing both deforestation and the demand for illegally-sourced wood products.

International Agreements

Prior to 2001, illegal logging was mostly addressed through individual government enforcement efforts, as there were only scattered international efforts to address illegal logging through trade regulation. Notable among these scattered efforts was the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Established at the International Union for Conservation of Nature in 1973 and entering into force in 1975, CITES is an international agreement to ensure that the international trade in wild plants and animals does not threaten their survival (Tibbets, 2011). Specifically, CITES provides protection to many different plant and animal species that are or may become threatened with extinction as a result of international trade (CITES, 2005). Since CITES is a voluntary agreement entered into by governments and backed by individual legislation in the 177 countries that are Parties to the Convention, there are some differences from country to country in how the treaty is implemented. Overall, CITES provides varying degrees of control on the international trade of the species identified by the Convention (CITES, 2012).

While CITES has provided opportunities for the international community to reduce the international trade of certain species, it has been difficult to enforce systematically and has not succeeded in eliminating illegal logging activities, even for species listed by the Convention. In their 2003 study of U.S. regulatory compliance for imports of tropical bigleaf mahogany (listed in CITES Appendix III), Blundell and Rodan showed evidence of large reporting discrepancies between customs data (managed by the U.S. Treasury), import data from the CITES management authority in the U.S. (the U.S. Fish and Wildlife Service), and export information from the United Nations Environment Program (UNEP) and the International Tropical Timber Organization (ITTO). Some of these discrepancies

were due to difficulties in identifying sawn wood species, while others were unexplained. The authors also noted that US officials relied heavily on official export nation documents identifying the CITES compliance of wood products, creating opportunities for the inadvertent "legalization" of illegally-harvested wood identified as CITES compliant by unverified documents that are false or incorrect (Blundell and Rodan, 2003).

In 2001, at the first regional Ministerial Conference on Forest Law Enforcement and Governance (FLEG) conference in Bali, 10 countries in the East Asian Region, as well as the United States and Great Britain, adopted the Bali Declaration, which committed these countries to increase national and international efforts to address forest crime, such as illegal logging (The World Bank, 2013). Similar conferences resulted in similar declarations for other regions across the world, including Africa, Latin America, Europe, and Northern Asia. Similar to CITES, these declarations led to diverse efforts by individual governments and regional alliances to respond to illegal logging, which will now be reviewed.

Consumer Country Responses

As discussed earlier, consumer country policies generally target the international trade in forest products, since consumer countries often cannot directly address illegal logging operations in producer countries. In general, consumer country policies aimed at reducing illegal logging have attempted to reduce demand for illegally harvested wood.

As noted by Bosello et al. (2013), policies targeting international trade in order to reduce illegal logging have been criticized as misplaced. The main criticism relates to data showing that "up to 80 per cent of total felled [wood] in tropical areas is consumed as

fuelwood, while only 2 per cent of total fuelwood production is traded on international markets" (Bosello et al., 2013). This indicates that most illegal logging activities in tropical countries are directly related to poor populations seeking resources, rather than timber barons running sophisticated illegal operations geared toward export markets. The World Bank report (2006) explains that these types of illegal logging activities will be better addressed by policies and programs aimed at reducing poverty in forest-dependent communities, rather than bans on imports of illegally harvested wood by consumer countries.

No one refutes this criticism, although The World Bank report (2006) goes on to explain that international markets are an important component of illegal logging activities and that they can be used to reduce illegal logging. Brack et al. (2002) provide evidence supporting the targeting of international markets by showing that commercial enterprises often stand to benefit from illegal logging activities, and therefore targeting these markets can reduce incentives to engage in illegal logging. Furthermore, there is evidence of commercial enterprises exploiting poor populations by organizing them to engage in illegal logging activities in return for relatively small payments (Contreras-Hermosilla et al., 2007), further obscuring the separation between illegal logging for export and illegal logging by poor populations for subsistence purposes.

Consumer country policies targeting international trade also raise concerns about the disruption of free trade. Trade liberalization and economic integration have forced consumer countries to consider the impacts of national environmental policies on international trade and foreign countries in order to avoid violations of World Trade Organization (WTO) agreements, centered on the rules of the General Agreement on Tariff and Trade (GATT) (Vig and Kraft, 2003). In order to avoid trade disputes, regulating

countries must ensure that import restrictions neither discriminate between domestic and foreign goods nor target goods from individual countries. Trade agreement violations have been a main concern preventing countries from attempting to boycott tropical timber (since much of the illegal logging activity occurs in tropical countries). More dangerously, boycotts on tropical timber would restrict supply without reducing demand, consequently increasing the value of tropical timber and the incentives for illegal logging in tropical forests. Furthermore, boycotts by individual countries would likely be ineffective at reducing the initial illegal harvest of wood, since the wood could be redirected to other countries without boycotts in place. This phenomenon of shifting towards markets that do not discriminate between wood of legal and illegal origins is called "leakage," and is discussed in more detail later in this chapter.

There has never been a WTO dispute over measures taken by consumer countries to control illegal logging through trade measures, so predictions about the outcome of such a challenge must be extrapolated from other types of similar disputes (Brack, 2013). While any dispute would be subject to compliance with interpretations of WTO agreement rules, analyses of similar disputes lead experts to see little chance of a successful WTO challenge to existing and planned legality requirements in consumer countries (Brack, 2013). The types of legislation examined in this analysis (due diligence requirements requiring that wood be harvested and manufactured in compliance with local laws) only discriminate between legally- and illegally-harvested wood and wood products, not between domestic and foreign goods or goods from individual countries, raising few WTO compliance concerns.

To summarize, consumer country policies that attempt to reduce illegal logging by targeting the international trade of forest products are considered to be one of the viable tools available to consumer countries to address illegal logging. However, it is obvious from a survey of the complexities of illegal logging that consumer country policies are limited in their ability to address all types of illegal logging. Specifically, these policies do not directly address illegal logging for domestic use, nor do they address illegal logging that is "legalized" through collusion with corrupt officials. Nonetheless, key reports (Brack and Buckrell, 2011; INECE, 2008; The World Bank, 2006) indicate that reducing consumer country demand for illegally harvested wood is an effective means of reducing illegal logging.

Non-U.S. Consumer Country Responses

As a result of the 2003 adoption of the Forest Law Enforcement, Governance, and Trade (FLEGT) Action Plan (discussed earlier), the EU has begun to establish Voluntary Partnership Agreements (VPA) with countries that export timber. VPA are bilateral agreements that establish forest and trade governance structures that prevent any illegally harvested wood (as defined by the country of origin) from being exported to the EU from the producer country (Dam and Savenije, 2011). Most importantly, VPA establish Legality Assurance Systems (LAS) that identify and license legally-produced timber for export to the EU, based on the laws and regulatory structure of the individual partner country (European Forest Institute, 2009). In addition, partner countries agree to allow both EU and third-party audits to ensure compliance with the terms of the VPA.

After entering into a VPA, all wood coming to the EU from the producer country is considered by EU members to be of legal origin. These VPA allow producer countries to gain access to important markets; as of 2004 the EU was the largest importer of

industrial round wood, responsible for over 44% of all world imports (FAOSTAT, 2010). VPA provide EU importers with access to a supply of verifiably legal wood, in addition to providing incentives for improved forest governance in producer countries (European Forest Institute, 2009). Upon the 2013 implementation of the EU Timber Regulation, discussed below, VPA also provide EU importers with supply that automatically complies with the policy requirements, rather than forcing them to investigate the specific origins of their supply in order to comply with law. As of November, 2013, six countries had signed VPA with the EU: Cameroon, Central African Republic, Ghana, Indonesia, Liberia, and Republic of Congo. These countries are currently working with the EU to develop "the systems needed to control, verify, and license legal timber" (FLEGT Voluntary Partnership Agreements, 2013). Once these systems are deemed operational and the EU ratifies the agreements, then the licensed timber imports from these countries will be considered legal automatically. Nine other countries are currently negotiating VPA with the EU: Ivory Coast, Democratic Republic of the Congo, Gabon, Guyana, Honduras, Malaysia, and Vietnam (FLEGT Voluntary Partnership Agreements, 2013).

By focusing on improving governance and tracking systems in producer countries, VPA provide an interesting opportunity for assuring the legality of wood imports to the EU. Due to the complexity of the processes, though, no country has fully implemented these systems and begun to issue licenses. Furthermore, VPA only guarantee the legality of timber licensed to be exported to the EU, and do not require that countries create systems to eliminate all illegal logging, which leaves open the possibility of shifting legal products to the EU markets without reducing overall rates of illegal logging.

Some individual governments, such as Japan and Great Britain, have attempted to stimulate markets for sustainably harvested wood by creating procurement policies that

require government agencies to purchase wood products that are verified as having been legally harvested. These policies are based on the theory that large consumers, such as governments, can create enough demand for verifiably legal products to lead to price increases of those products, leading to corresponding increases in the supply of certified wood products (Contreras-Hermosilla, 2007).

In the case of Japan's *Goho-Wood* ("Legal" wood) policy, the government must procure wood products with legality verified by proof of chain of custody (Forest Agency of Japan, 2006). A variety of methods exist for documenting proof that a chain of custody exists, including third party certification, trade associations, or individual company systems. There has been no systematic study of the effects of these procurement policies on trade or illegal logging.

In March of 2013, the European Union implemented the EU Timber Regulation, which prohibits the placing on the EU market of illegally harvested timber and almost all timber products produced from illegally harvested timber (Brack and Buckrell, 2011). In order to comply with this new regulation, whatever individual or group first places the timber or timber product on the EU market must implement due diligence to minimize the risk that the timber is illegally sourced or manufactured (Brack and Buckrell, 2011). The "first placer" on the EU market must then be identified in any future trade of those products within the EU market, as well as intermediary traders, thus creating a chain of custody from first placement on the EU market to final sale. Should the legality of a product be questioned, it can then be traced back to the "first placer." The due diligence requirement is similar to that of the 2008 Lacey Act amendment, and will be explained later in relation to that policy. In November of 2014, the Australian Illegal Logging Prohibition Act will come into force for wood and wood products in Australia. This policy

is, for all intents and purposes, identical to the EU Timber Regulation in terms of requirements and methods of control. Violators of these policies can be subject to hefty fines, product seizures, suspension of trade authorization, and even imprisonment, in the case of the Australian policy. Due to the recent (EU) or impending (Australia) implementation of these policies, it is not yet clear how these policies have impacted trade and illegal logging. This analysis of the 2008 Lacey Act amendment should shed some light on the expected effects of these similar policies.

U.S. Responses

The U.S. produces and consumes large amounts of forest products, worth large sums of money. In 2007, the Environmental Investigation Agency (EIA) estimated that "high-risk timber and wood products" may have accounted for up to 10% of annual U.S. wood products imports in 2006, worth $3.8 billion, excluding paper and pulp (EIA, 2007). Similarly, wood product exports from producer and manufacturer countries to the U.S. are believed to contain significant amounts of illegally harvested wood (INECE, 2008), although these data suffer from informational limitations discussed later in this chapter. Tibbets (2011) combined data from the INECE (2008), Seneca Creek Associates (2004), and the Statistics Division of the UN Food and Agriculture Organization (2006) to create estimates of the value of U.S. imports of illegal wood products for the year 2006 (See Table 2.1).

The U.S. policy response to illegal logging began in the 1970s, catalyzed in large part by the environmental movement. The response has evolved as international attention to illegal logging has increased and more recent economic analyses have provided evidence for the negative effects of illegal logging on global and domestic wood markets.

Table 2.1: Wood Export Revenues and Illegal Exports to the United States

Export Country	2006 Total Wood Exports to the U.S. (in MM USD, excluding pulp and paper)	Estimates of global illegal exports (%)
Russia	168[2]	20-50[3]
Brazil	1,500[2]	20-90[3]
China	10,459[1]	32-40[1]
Malaysia	1,174[1]	20-35[1]
Indonesia	967[1]	70-80[1]
Peru	84[1]	30-40[1]

Source: Tibbets, 2011; [1] INECE, 2008; [2] FAOSTAT, 2006; [3] Seneca Creek Associates and Wood Resources International, 2004

In addition to being a voluntary partner to the CITES treaty described earlier, the U.S. Endangered Species Act of 1973 (ESA; 16 U.S.C. § 1531-1543) was one of the first policies with the potential to target illegal logging. The ESA created a federal program for the protection and conservation of global plant and animal species identified as "endangered" (in danger of extinction) or "threatened" (likely to become endangered) (EPA, 2010). Once listed, the ESA promotes the recovery of the species and prevents any action that causes the "taking" of the species, including "import, export, interstate, and foreign commerce" (EPA, 2010). While CITES is focused on the effects of trade on listed species, the ESA focuses on the danger of extinction without regard to the presumed cause of the species' population declines. For species listed under the ESA in the U.S., case law has held that the federal government can enforce the protection of habitat considered critical to listed species (*Babbitt v. Sweet Home Chapter of Cmtys. for a Great Or.*, 1995). For listed species found in foreign countries, the ESA prohibits the import into the U.S. of members and/or parts of members of that species. The ESA has mainly affected U.S. logging by preventing domestic habitat destruction for listed wildlife

species such as the spotted owl and the marbled murrelet, rather than preventing the logging of tree species known to be illegally harvested in a foreign country. The regulation does allow for import restrictions, but only if the species are sufficiently threatened or endangered with extinction. In terms of illegal logging, the ESA plays a larger role in the conservation of rare species that are highly valued and therefore at high risk of being traded illegally. For these species, the ESA generally overlaps with CITES, since it is the trade of the rare species that likely threatens its survival as a species.

In 2003, the U.S. developed an initiative focused on improving forest management practices in five regions of the world (the Congo Basin, the Amazon Basin, Central America, South Asia, and Southeast Asia) in order to reduce both illegal logging and deforestation (Sheikh, 2007). This initiative authorized funding, technological support, and other incentives to address the barriers to effective enforcement of forest laws in these regions. However, until 2008 the U.S. had no domestic policy directly targeting illegal logging or preventing the import of wood or wood products from all but the most endangered tree species protected by international agreements or the ESA. That year, the U.S. became the first country in the world to outlaw domestic and international trade in or possession of wood produced illegally in foreign countries.

The Lacey Act amendment of 2008

Until the passage of the 2008 Lacey Act amendment, the U.S. had no comprehensive policy addressing illegal logging. Prior to 2008, it was still legal for U.S. individuals and companies to import wood that had been harvested illegally in foreign countries. Even if it was known that wood being imported to the U.S. had been illegally harvested in another country, importers broke no domestic law when bringing that wood into the U.S., unless the species was protected under CITES or the ESA.

The original 1900 Lacey Act prohibited three actions:

1. Trade in fish or wildlife taken, possessed, transported, or sold in violation of any law (16 USC § 3372 a1), which included the import, export, transport, selling, receiving, acquiring, or purchasing of these items in interstate or foreign commerce
2. The import, export, or transport of any container or package containing any fish or wildlife unless the container had been previously labeled in accordance with the regulations (16 USC § 3372 b)
3. The falsification of records or labels for any fish, wildlife, or plant that is intended to be imported, exported, sold or transported interstate or internationally (16 USC § 3372 d)

Over time, the Lacey Act was amended to include stronger penalties for non-compliance and to create a due diligence clause. According to Black's Law Dictionary, due diligence means "Such a measure of prudence, activity, or assiduity, as is properly to be expected from, and ordinarily exercised by, a reasonable and prudent man under the particular circumstances; not measured by any absolute standard, but depending on the relative facts of the special case" (Garner and Black, 1999). Prior to this amendment, a violation of the Lacey Act could not be prosecuted without clear evidence that the violator knew of the illegal nature of the wildlife. The due diligence amendment allows violators to be prosecuted based on whether they know, or should know in the exercise of due care, of the illegal nature of the plant or wildlife. Importantly, what constitutes due diligence is not clearly defined in the Lacey Act, nor in any of its amendments. Further amendments also expanded the act to cover other wildlife, as well as plants (including trees) aside from agricultural products ("common cultivars" and "common food crops").

In 2008, the Lacey Act was amended for the sixth time, expanding the act to cover logs, lumber, and wood products (e.g., paper, plywood, furniture, etc.) made with illegally

harvested wood or plant materials (INECE, 2008). The INECE (2008) report summarizes the effects of the 2008 amendment:

> Anyone who exports or imports illegally harvested timber (or wood products derived from such timber) into the United States that knows or should have known that the wood was illegal, is guilty of a crime. The penalties are quite substantial, ranging up to five years of imprisonment and a $500,000 fine per violation, as well as forfeiture of the merchandise.

The Lacey Act amendment of 2008 also prohibits interstate trade of these items. Furthermore, for imports of any plants (wood and wood products), a customs declaration is required, which identifies the species of wood (scientific name) of the imported products, the country of harvest of the product, the quantity and measure of the wood, and the value of the shipment (16 USC § 3372 f). In practice, the 2008 amendment to the Lacey Act requires importers to exercise due diligence (collecting information and documentation about their supply chains, asking questions, following up on missing details) to avoid importing illegal wood, with lesser penalties for those that have exercised "due care" (16 USC § 3373 a). The policy relies on the laws of each country to determine the legality of harvested wood, meaning that U.S. importers must exercise due diligence to ensure that wood products imported into the U.S. were harvested according to the laws of the country of production. The policy defined illegal timber as wood harvested or traded in violation of foreign and domestic laws pertaining to "theft, logging in protected areas or without authorization, payments of taxes and fees, and transport regulations" (Brack and Buckrell, 2011). While slightly broader, this definition of legality includes all of the components of the Seneca Creek Associates' (2004) definition of "illegal logging that rises to a level of international significance," which is the definition of illegal logging used for this analysis (explained at the beginning of Chapter 2). Courts and judges have broad discretion over the determination of violation of foreign law, and a wide variety of evidence may be presented in order to verify claims of illegal actions in foreign countries (Brack and Buckrell, 2011). In the case of wood

products, which can pass through many countries prior to arriving at their final point of consumption, the law applies to any illegality covered by the policy that occurs throughout the life of the wood.

There is no one document or certification that implies due diligence or due care, and importers must establish their own methods of proving the extent of their exercise of these concepts. Since the enactment of the 2008 Lacey Act amendment, the act has been used as the basis of two high-profile actions targeting U.S. wood products importers. In 2012, Gibson Guitar Corp. settled a case brought against them by the U.S. for violations of the Lacey Act in 2009 and 2011, in which the company imported illegally harvested ebony from Madagascar and ebony and rosewood from India (USDOJ, 2012). As part of the settlement agreement, Gibson Guitar Corp. paid penalties totaling over $350,000 and forfeited wood shipments worth over $260,000, in addition to other requirements intended to strengthen Gibson's future compliance with the Lacey Act (USDOJ, 2012). In a separate and ongoing case, Lumber Liquidators is being investigated for potential violations of the Lacey Act in their hardwood flooring imports (Rubin and Banjo, 2013). There was also at least one earlier enforcement of the case that resulted in forfeiture of tropical hardwoods from Peru (Brack and Buckrell, 2011). While serious enforcement actions have occurred, many questions remain unanswered about the implementation of the law and the due diligence requirements for importers, due to the fact that the 2008 amendment remains to be adjudicated by U.S. courts.

Previous Research on Consumer Country Policies to Reduce Illegal Logging

Informational Limitations

The widely-cited 2004 report by Seneca Creek Associates and the Wood Resources Institute summarizes the informational limitations inherent in the study of global illegal logging:

> No matter how broad or narrow illegal forest activity might be interpreted, its extent is impossible to know with any degree of certainty. Reported estimates are generally supported only through anecdotal information and supposition. Quantifying illegal logging by type of activity is even less precise. For example, one might think that measuring "logging in protected areas" would be possible through satellite technology, and this may be feasible in relatively small areas, but the definition of what "protected" means also seems to vary from country to country.

Despite the international attention to illegal logging, reliable data for studying the problem are scarce. A 2010 report produced for Chatham House cited the continued poor tracking of critical indicators of illegal logging within producer countries as a main source of the confusion and lack of information about the extent of illegal logging activities (Lawson and MacFaul). The authors relate this poor tracking to a lack of adequate information management, financial management, and transparency in producer countries. The lack of development of these tracking systems undermines the accuracy of wood-balance analyses often used to estimate illegal logging activities through trade statistics.

While there are hopes that the use of improved technologies (e.g., satellite imagery and devices that can identify the tree species of sawn wood) will allow for improved tracking of illegal logging activities, these tracking systems still did not exist as recently as 2010 (Lawson and MacFaul, 2010). The absence of reliable official documents providing information about legal timber harvests, such as concession maps, forest management plans, and annual harvesting plans reduces the effectiveness of satellite imagery in

detecting illegal logging activities (Lawson and MacFaul, 2010). In the end, most tracking systems rely on the information management and transparency of producer countries. Even if those systems are improved, planned tracking systems would still likely fail to identify some types of illegalities, such as those downstream in production or those in which the government is complicit.

Where does illegal logging occur?

The most accepted source for information about the prevalence of illegal logging is the 2004 report by the Seneca Creek Associates and the Wood Resources Institute. In that report, the authors provide estimates of the amounts of round wood, lumber, and plywood of suspicious origin that enter into international trade, separated into softwood and hardwood. According to that report, the countries profiled accounted for roughly 40% of global industrial softwood round wood production and 50% of global industrial round wood hardwood production, but represented over 75% of global illegal logging activity "of the type that rises to a level of international significance" (Seneca Creek Associates, 2004). As described at the beginning of Chapter 2, this type of illegal logging results from the systemic inability of producer countries to sustainably manage their forests and has the potential to alter markets for legally-harvested forest products (Seneca Creek Associates, 2004).

In the report, the countries/regions profiled are Russia, Indonesia, Brazil, Malaysia, Western/Central Africa, Japan, China, and the European Union 15 (the core countries in Western Europe). These levels of illegal logging in high risk countries (later integrated and updated by Li et al., 2008) are used as underlying assumptions for most analyses of illegal logging and international trade. The results of the report are summarized in Table 2.2.

Table 2.2: Estimated Value of Suspicious Wood Products (Source: Seneca Creek Associates and Wood Resources International, 2004)

	Suspicious Volume (000 m^3)			Est. Value of Suspicious Volume ($ Million)		
	Profiled Countries/Regions	Rest of World	World Total	Profiled Countries/Regions	Rest of World	World Total
Production						
Roundwood	97,546	33,448	130,994	8,844	3,210	12,053
Lumber	19,731	5,505	25,236	5,354	1,563	6,917
Plywood	9,423	534	9,957	3,345	189	3,535
Sub-Total				17,542	4,963	**22,505**
Imports						
Roundwood	19,580	393	19,973	1,594	30	1,624
Lumber	5,460	321	5,780	1,388	89	1,477
Plywood	2,965	2,160	5,125	1,053	767	1,820
Sub-Total				4,035	886	**4,921**
Exports						
Roundwood	16,542	1,427	17,969	1,124	107	1,231
Lumber	5,426	1,502	6,928	1,462	385	1,846
Plywood	5,093	144	5,237	1,671	47	1,718
Sub-Total				4,256	538	**4,795**

Leakage

One phenomenon complicating the effects of import bans on illegally harvested wood, such as the Lacey Act amendment of 2008, is leakage. Leakage is the redistribution of illegally-sourced wood products to markets that do not discriminate between legal and illegal sources or products.

The trade of timber is often routed through third-party countries, such as China, which re-exports over 70% of the wood it imports (The World Bank, 2006). According to a 2010 report, "the majority of consumer-country imports of illegally sourced wood products now arrive via processing countries, presenting a major challenge to the implementation of new import controls" (Lawson and MacFaul, 2010). Furthermore, demand for wood in developing countries, most notably China, has been increasing rapidly. Between 1995 and 2007, a group of producer countries in Africa and Southeast Asia increased their wood exports to Asian countries by 5 times, as compared to a 100% increase in exports

to the EU during that same period of time (Moiseyev et al., 2010). Large manufacturing centers, such as China, can route wood products from suspicious sources to markets that do not distinguish between legal and illegal wood, and the demand is adequate to accept those products. As discussed earlier, only roughly 15% of harvested timber ever enters international markets, meaning that 85% of timber is consumed domestically in the country of origin (Centre for International Economics, 2010). Producer countries can intentionally keep wood and wood products from suspicious sources within domestic markets, likely with only small effects on exports. As a result of leakage, it is possible that import bans in developed countries could have little effect on actual illegal logging activities.

Modelling the effects of consumer country policies

Due to the difficulty of measuring levels of illegal logging, the effects of consumer country policies on levels of illegal logging are generally inferred from the economic effects of these policies, which are predicted using empirical economic models based on economic theory. If effective, import bans on illegal wood by consumer countries will lead to reduced imports of wood and wood products from illegal and/or suspicious sources as companies avoid the risk of violating the law (Bosello et al., 2013). Theoretically, this decrease in imports of illegal wood products restricts the supply of wood available for import, shifting the supply curve to the left and therefore increasing the price for all wood products, regardless of the sources. This is due to the fact that consumer demand for wood products remains stable, but the portion of supply that was made up of illegal imports is no longer available to the markets that distinguish between legal and illegal wood. Assuming that companies comply with the law, the difference in imports will be made up for to some degree by increased production of legal wood, with the expected reductions in total wood supply leading to price increases. The theoretical

principles used to estimate the effects of eliminating global illegal logging are presented in Figure 2.2, provided by Turner, Katz, and Buongiorno (2007), which shows market equilibrium states with and without illegal logging.

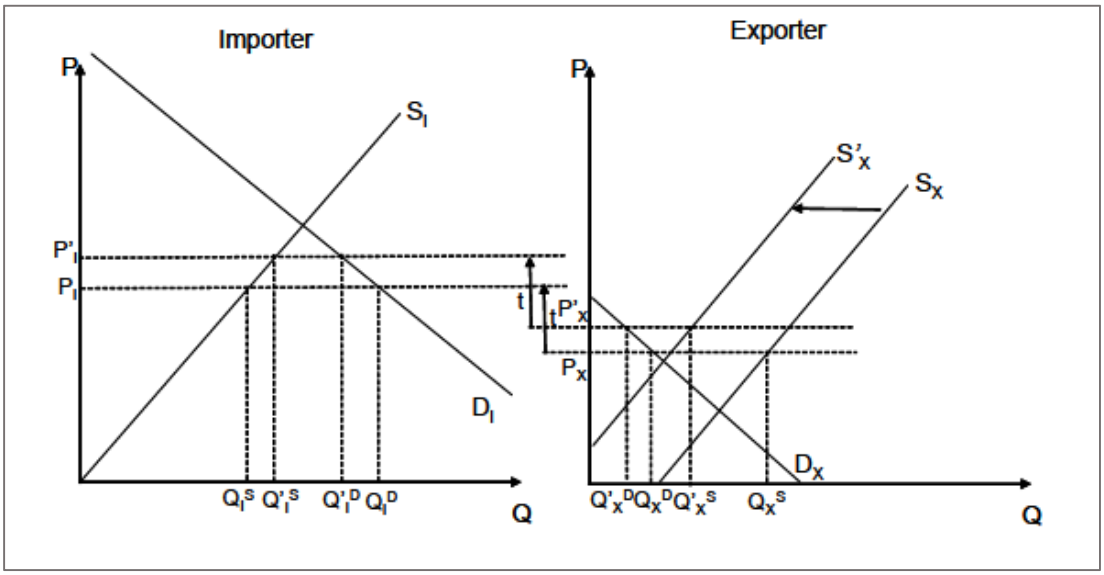

Figure 2.2: World competitive equilibrium in international markets with and without illegal logging (Turner et al., 2007).

Turner et al. (2007) explain Figure 2.2:

> With illegal logging, the price of industrial roundwood in the importer country is P_I. At that price, the quantity supplied by the importer country, Q_I^S, is less than the quantity demanded, Q_I^D. In the exporter country the price is P_X, and the quantity supplied Q_X^S is more than the quantity demanded Q_X^D. At equilibrium, the importer price is equal to the exporter price plus the unit transport cost: $P_I = P_X + t$, and the net trade of the exporter is the opposite of the net trade of the importer: $Q_I^S - Q_I^D = -(Q_X^S - Q_X^D)$.
>
> As shown in Figure [2.2], the effect of removing illegal logging in the exporter country would be to reduce harvests (a leftward shift of the supply curve from S_X to S'_X), increasing the price in the exporting country to P'_X, thus decreasing total consumption. In the importing country, the price would increase to P'_I, resulting in higher production and lower consumption. Net-trade would, therefore, decrease to $Q'^S_I - Q'^D_I = -(Q'^S_X - Q'^D_X)$.
>
> In the exporting country producer revenues decline from $P_X Q_X^S$, with illegal logging, to $P'_X Q'^S_X$, without illegal logging. Consumer expenditures may increase or decrease. The producer gross revenue in the importer country increases from $P_I Q_I^S$ to $P'_I Q'^S_I$, while consumer expenditures, i.e.,

how much consumers must pay for the industrial roundwood they use, changes from $P_I Q_I^D$ to $P'_I Q'^D_I$.

Due to a lack of data, empirical economic models used to study the effects of import bans are not able to differentiate between legal and illegal wood production, so these models do not allow for rebalancing of legal and illegal production in response to policy treatments (Bosello et al., 2013). Instead, levels of illegal wood production are assumed to remain constant at the levels experienced at the time of the policy treatments, and the consumer countries affected by the policy are assumed to reduce their imports from suspicious countries in direct proportion to the estimates of illegal logging as a percentage of total production in those countries. The proportion of illegal wood production in any country is assumed to be balanced across domestic production and production for export, as well as across different types of forest products, despite the fact that no evidence for this assumption exists (Dieter, 2009).

It is important to note that these economic simulation models generally investigate the market effects of eliminating illegal wood production in producer countries. In real world situations, reductions in imports of illegal wood in countries affected by import bans do not necessarily lead to the reductions in illegal wood production in exporter countries assumed by these economic models, due to the leakage of illegal wood to other markets without import restrictions. Overall, the results from economic modeling studies, while limited by their assumptions, can help to illuminate the potential market effects of consumer country bans on illegal timber, if, in fact, those bans lead to reduced illegal wood production in exporter countries.

The 2004 report by Seneca Creek Associates and Wood Resources International used the University of Wisconsin's Global Forest Products Model (GFPM) partial equilibrium

economic simulation model of global forest products production and trade to investigate the economic implications of eliminating illegal wood from global production. This study found that eliminating illegal wood in international markets would lead to increases in world wood prices ranging from 7% to 16%, and increases in U.S. wood prices ranging from 2% to 4%. These price increases arise from the elimination of suspicious wood production, which is modelled as reductions in the wood production and exports from each country in direct proportion to the levels of illegal production identified in those countries in the same report (Seneca Creek Associates, 2004). According to this study, the benefits of illegal logging are captured by producers of illegal wood, as well as all consumers of wood products (through price reductions from increased supply). The potential price increases benefitting legal wood producers that resulted from the simulated elimination of illegal wood in the global supply detailed in this report greatly increased the attention being paid to illegal logging by both industry groups and government agencies in consumer countries. However, it is important to note that eliminating illegal wood is expected to lead to increased costs of wood products for consumers, due to the resulting restriction in wood supply.

Using similar economic simulation models, Turner et al. (2007) found that gradually eliminating global illegal logging over 5 years would lead to increased wood prices and increased domestic production in most countries without suspicious domestic timber production. The wood price increases arise because increases in the global production of legal wood are not large enough to offset the short-term global supply reduction resulting from the elimination of illegal wood production. Li et al. (2008) also used similar economic simulations to model the effects of eliminating illegal wood on the international trade of various wood products. Similarly, these authors found evidence for wood product price increases and slight decreases in global round wood production,

as well as a varied distribution of production effects among countries. Li et al. (2008) also provided evidence that producer countries would bear the brunt of reductions in illegal wood production through decreased producer revenues and increased consumer costs. A 2008 report prepared for the European Commission by Finnish independent consulting group Indufor Oy and the European Forest Institute summarizes the one discernible theme of these analyses: production declines in producer countries with illegal logging resulting from import bans result in increased world prices for wood and wood products (INDUFOR, 2008).

The previous studies use partial equilibrium models that focus on the economic effects of these policies on the wood products sector, ignoring the policies' effects on other sectors of the economy. These models can be somewhat limited, due to the fact they ignore the interdependence of wood products markets and markets for non-wood products, which are substitutes for each other in many cases. However, one study using a general equilibrium model that included other sectors of the economy found that a unilateral restriction on illegal wood imports in Australia did very little to reduce illegal logging, mostly as a result of leakage, described earlier (Centre for International Economics, 2010).

While the details of the economic effects may not be as important to some stakeholders, the result that unilateral policies restricting imports could have negligible effects on levels of illegal logging is important information for policy makers pursuing consumer country measures as a means of combatting illegal logging activities. Importantly, the CIE (2010) report found evidence that joint implementation of illegal logging import restrictions by various consumer countries (i.e., the U.S., Australia, and the EU) reduced the amount of leakage of illegal wood. However, this result was tempered by the finding

that the economic costs (costs to consumers) of these restrictions continued to outweigh the benefits (increased revenues for domestic producers) for any of the countries. A study using a similar model for EU import restrictions found similar results, with slight global reductions of levels of illegal logging in producer countries, despite relatively larger reductions in the amount of illegally harvested wood flowing into international markets (Bosello et al., 2013). Contrary to the CIE study, though, the authors found that the combined increases in domestic production revenues provided net benefits to areas with overwhelmingly legal logging industries.

Research on the 2008 Lacey Act amendment

While studies modeling the effects of import restrictions are fairly common, research focusing on the effects of the Lacey Act amendment of 2008 on illegal logging is scarce. What research there is has focused on qualitative issues surrounding understanding of the policy and expert perceptions of its effects. Using questionnaires and interviews with industry association leaders, government representatives, and wood products importers and exporters, Tibbets (2011) found evidence that the policy and related due diligence requirements were not communicated effectively to those associated with the wood products industry. In addition to being poorly communicated, those interviewed generally did not believe that the policy would have an effect on global illegal logging, most believed that the policy could be easily bypassed through loopholes and false reporting, and few industry representatives indicated that the policy had led to changes in business practices (Tibbets, 2011). For importers of wood products to take seriously the import restrictions in the Lacey Act amendment of 2008, the policy must have consequences that are understood and that outweigh the benefits of having an insecure supply chain. The two high-profile cases discussed earlier (Gibson Guitars and Lumber Liquidators) provide evidence that the government is, indeed, enforcing the

new law, and that businesses are being held accountable for illegalities in the supply chains of their products. Furthermore, those importers must believe that the policy will be enforced. While Tibbets' (2011) research calls into question the implementation of the policy, it includes no description of the quantitative effects of the policy on trade in wood and wood products.

Chapter 3: Methods

Estimating Post-Policy Differences

The 2008 Lacey Act amendment aims to distinguish between wood products of legal and illegal origins. Specifically, the policy created a definition of illegally-sourced wood and wood products, and then placed the burden of ensuring the legality of wood and wood products on individuals and businesses in the U.S, including those products imported from other countries. While the 2008 Lacey Act amendment also applies to domestic wood and wood products, a 2008 report produced by Seneca Creek Associates for the American Hardwood Export Council shows that unlawful timber harvest of hardwoods within the U.S. is *de minimus*. Global illegal or suspicious harvest of hardwood trees (angiosperms, such as deciduous trees at higher latitudes) is more pervasive than that of softwood trees (gymnosperms, such as conifers). With this strong evidence that the U.S. domestic timber supply is almost completely of legal origin, the 2008 Lacey Act amendment can be seen as a *de facto* import ban on illegally-harvested wood or products incorporating materials from illegally-harvested wood.

As shown in Chapters 1 and 2, the issues associated with illegal logging are global, diverse, and embedded in the social and economic conditions of the mainly developing producer countries where the actual harvesting occurs. As a result, we would not expect immediate and drastic reductions in illegal wood harvesting in producer countries to result from a *de facto* import ban in one large market (the U.S.). Furthermore, while some information about the global harvest of illegal wood is available, it takes the form of estimates of the share of illegally-harvested timber produced by a country (see Li et al., 2008). Dieter (2009) explains the general approach used in research on illegal logging with such limited data: “Due to the lack of accurate data there is a common agreement

in assuming that the share of illegally harvested timber in total harvests equals the share of trade in illegally harvested timber in total wood trade." This assumption has no evidence in the literature, but it has been made throughout the literature studying illegal logging. These realities about the studies of illegal logging and its associated trade make the direct study of levels of illegally-harvested wood impractical. Unfortunately, devising a better model for distinguishing between legal and illegal wood products imports is beyond the scope of this study. As such, this study does not attempt to investigate any changes in levels of illegal logging that may have resulted from the implementation of the 2008 Lacey Act amendment. For our purposes, we will continue to make the assumption that exports from countries with significant levels of illegal logging reported in the literature contain the same proportion of illegally-harvested wood as domestic supply streams. Due to the difficulties of identifying the legality of any specific shipment or product, we will label wood with significant likelihood of having originated from illegal origins as "suspicious."

While we cannot easily distinguish between legal and illegal products, we do expect the policy to reduce U.S. demand for illegally-harvested wood. Prior to the instatement of the policy, even wood and wood products of known illegal origins could not be stopped or turned back at the border. As a result of the 2008 Lacey Act amendment, authorities have the ability to prosecute those importing wood products of known illegal origins. Indeed, in both of the high-profile cases based on violations of the 2008 Lacey Act amendment (see Chapter 2), non-profit organizations produced strong evidence of the illegal origin of wood being imported by the businesses prior to enforcement action by the authorities. Since no cases based on the 2008 Lacey Act amendment have gone to trial yet, the judiciary has not clarified the enforcement of the law. However, enforcement actions by the federal government lead us to assume that importers and

companies that use imported wood in their products take seriously the possibility of seizure and confiscation of illegally-harvested products, in addition to civil and/or criminal prosecution and the potentially detrimental public relations effects of being identified as contributing to illegal and irresponsible actions.

Due to the long supply chains of wood products made from standardized wood inputs, few importers of wood products (possibly none) could feasibly ensure the legality of each product all the way back to the origin of the initial timber harvest(s) that produced the wood. As a result, U.S. importers would be expected to reduce their risk of violating the new law by shifting their purchases to products with less likelihood of having been produced from illegally-harvested wood. As a result, any effects of the 2008 Lacey Act amendment can be expected to be concentrated on U.S. imports of wood and wood products and the supply chains of those imported products. Successful implementation of the policy would be expected to produce some effects on U.S. imports of wood products from suspicious sources. In other words, the 2008 Lacey Act amendment would be expected to drive U.S. importers of wood and wood products to reduce their risk of violating the law by ensuring that their supply chains consisted of wood unlikely to have been harvested illegally. In order to investigate this phenomenon, this study undertakes an economic analysis of the international trade in wood products in the years prior to and immediately following the implementation of the 2008 Lacey Act amendment.

Using international trade data (organized by Harmonized System (HS) codes), trade flows pre- and post-Lacey Act are analyzed using a quasi-experimental "differences-in-differences" (DD) method used in the social sciences to study the effects of real-world policy interventions. Imbens and Woolridge (2008) summarize the DD method:

> Outcomes are observed for units observed in one of two groups, in one of two time periods. Only units in one of the two groups, in the second time period, are exposed to a treatment. There are no units exposed to the treatment in the first period, and units from the control group are never observed to be exposed to the treatment.

A well-known example of the use of the DD methodology to investigate a policy treatment can be found in the analysis of the effects of a minimum wage increase on employment in New Jersey (Card and Krueger, 1994). For our analysis, the DD method allows us to compare international trade in wood products pre- and post-Lacey Act implementation (May of 2008), "in an effort to provide a counterfactual to what would have occurred in the treatment group [i.e., the United States] had the policy change not been implemented" (Hurwitz et al., 2013) . In our application of the DD method, we will estimate the changes in international trade levels that can be attributed to the policy treatment while recognizing that any changes resulting from the policy treatment take place within the larger framework of international trade, which is driven by a variety of factors unrelated to the policy treatment. The DD method, then, is a comparative case study methodology, in which we compare two groups post-policy treatment: Group 1 is expected to have been affected by the policy, while Group 2 has no expectation of having been affected by the policy. In our case, effectively an import ban of illegally-harvested wood and wood products in only the U.S. market, we can use other countries as our comparison groups, since the import ban only affects the U.S. and we have no expectation of spillover effects. In other words, the decision by the U.S. to distinguish between products incorporating legally- and illegally-harvested wood does not cause Canada (or any other country) to distinguish between products incorporating legally- and illegally-harvested wood.

The differences-in-differences methodology is an example of a fixed effects regression model. In empirical studies in the social sciences, fixed effects models are used in place

of ordinary least squares (OLS) regression models when there is reason to believe that there are unobserved confounding characteristics that differentially affect various units of observation in the analysis (e.g., individuals, states, or countries). In our case, unobserved factors such as the availability and price of different wood products substitutes within the U.S. and the dependence of the U.S. on wood imports versus domestic wood production are examples of these unobserved characteristics that may confound the analysis of U.S. wood products imports.

Fixed Effects vs. Ordinary Least Squares Regression Models

Fixed effects models are used to estimate the change in some outcome variable as a result of the implementation of some treatment (in this case, a policy). Figures 3.1 and 3.2 show the basic model of the differences-in-differences method. Y_2 is the variable of interest in the post-treatment period, and Figure 3.1 shows how we arrive at the estimation of the average treatment effect (ATE).

	Pre	Post
Treatment	Y_1	Y_2
Control	Y_3	Y_4

ATE
$(Y_2 - Y_1) - (Y_4 - Y_3)$

Figure 3.1: Standard measurement of the average treatment effect (Berry, 2011)

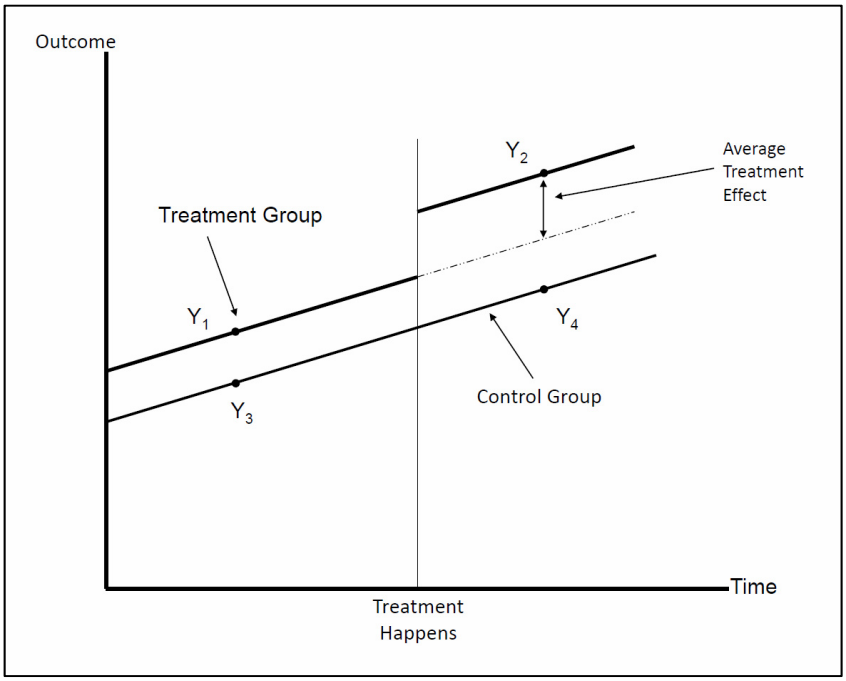

Figure 3.2: Representation of the average treatment effect being measured in differences-in-differences estimates (Berry, 2011)

Under experimental conditions, we can use an Ordinary Least Squares (OLS) regression to compare the means in the pre- and post-policy periods for both the treatment and control groups and arrive at an estimate of the treatment effect. However, in real-world conditions we cannot randomly assign the treatment to groups. Without random assignment, we cannot assume that the estimated effect of the treatment is uncorrelated with the error term (i.e., the treatment effect may be endogenous). In other words, we cannot rule out the possibility that there is some other, unobserved characteristic of the treatment group that is actually causing (or contributing to) the post-treatment effect on the outcome variable and therefore biasing our estimate of the effect of the treatment on the outcome variable. Without random assignment, then, OLS regression estimates may be affected by this omitted variable bias and therefore may provide effect estimates that are unrepresentative of the causal effect of the treatment on the outcome variable. In real-world phenomena, there are always assumed to be unobserved confounding characteristics that differ among the units of observation, so

the non-random implementation of a treatment (i.e., a policy) inherently raises concerns about OLS regression estimates of the treatment effects on the outcome variable.

Using time-series or panel data (i.e., multiple observations on the same units), however, fixed effects models allow for the presence of different unobserved confounding characteristics within units of observation (in our case, countries), but assume that the unobserved characteristics are constant over time within each unit of observation. The fixed effects model derives its name from the fact that by taking time differences within units in cross-sectional time-series data, the model is equivalent to estimating a "fixed effect" of unobserved confounding variables for each unit of observation. However, this effect is not, in fact, nonrandom; rather it is arbitrarily correlated with treatment effects and any confounders that vary over time within the same unit (See Appendix A for equations). As a result, all time-invariant factors are ruled out as sources of omitted variable bias, leaving only time-varying characteristics (within a unit of observation) as potential sources of bias in the fixed effects estimation of the treatment effect on the outcome variable.

Fixed effects models are generally favorable over random effects models (those that eliminate the unobserved covariates that vary over time within units) when the true nature of the variation in unobserved confounders is unknown. This is because random effects models allow for more efficient estimation of treatment effects when their assumptions are met, however, they will be biased when the unobserved covariates are correlated with the included observed covariates. On the other hand, fixed effects

models will be unbiased, but inefficient, when unobserved covariates are not correlated with the included observed covariates.[2]

Establishing a Control Group

Two of the main concerns with the comparative case study methodology are:

1. "[A]mbiguity about how comparison units are chosen"
2. "[U]ncertainty about the ability of the control group to reproduce the counterfactual outcome trajectory that the affected units would have experienced in the absence of the intervention or event of interest" (Abadie, Diamond, and Hainmueller, 2010).

In order to address the first problem of choosing an appropriate comparison group, Abadie et al. (2010) developed a data-driven "synthetic control" method that allows for the selection and weighting of comparative data from the pool of other countries for which trade data exist based on their similarity to the variable(s) of interest (including predictor variables) in the country of interest over the time period prior to the policy treatment. Once the data from the comparison groups are analyzed, selected, and weighted, the weighted data are aggregated to form a single comparison group: the synthetic control. The synthetic control method creates this aggregated comparison country by minimizing the mean squared prediction error (MSPE) for the outcome variable (and any number of predictor variables included in the model) between the aggregated control "country" and the treatment country. In other words, it creates an aggregated "country" made up of data from the available countries in the way that most closely matches the treatment country over the entire pre-treatment period, thus improving the validity of any comparisons between the two groups in the post-treatment period. The method for creating the synthetic control group is detailed further in Abadie

[2] Thank you to Christopher Berry for a clear presentation that contributed greatly to this explanation of fixed effects regression models (Berry, 2011).

et al., 2010, and is used in this analysis of the effects of the 2008 Lacey Act amendment on international trade in wood products.

In a detailed discussion, Abadie et al. (2010) show that the random-effects factor model used to establish and compare the treated group with the synthetic control group generally approximates the fixed-effects model described above, even though the factor model allows for the effects of unobserved confounding characteristics to vary over time (unlike a fixed-effects model). The details of this approximate equivalence between the random-effects model used in the creation of the synthetic control (which allows unobserved confounders to vary over time within a single unit of observation) that includes a long period of pre-policy data on the outcome and predictor variables, and a fixed-effects model (which assumes that unobserved confounders do not vary over time within the same unit of observation) are technical and complex. To summarize, a long period of pre-treatment data on the predictor and outcome variables allows us to assume that we are mostly capturing the effects of any unobserved confounders on the variable of interest, thus making the random-effects model and a fixed-effects model approximately equivalent for our analysis. For the technical details of the conditions used to establish this approximate equivalence, see Appendix B in Abadie et al. (2010).

The second problem (uncertainty about the ability of the control group to accurately represent the counterfactual) cannot be dealt with definitively, as it is a restatement of the counterfactual that we are attempting to estimate with our quasi-experimental comparison. However, we can probe the robustness of the conclusions from the comparison between the treatment country and its synthetic control using falsification tests. Falsification tests have been used to probe the results obtained from DD methods in many studies (see Card and Krueger, 1994; Bertrand, Duflo, and Mullainathan, 2004;

Abadie et al., 2010), as well as in other research contexts. For our method, we can use the mean squared prediction error (MSPE) as a way of judging both the efficacy of our model (how well the treatment group and the synthetic control are matched in the pre-treatment period), as well as the potential values of the outcome variable in the treatment unit had the policy intervention never occurred. We do this by applying the same synthetic control method to all the other countries in the donor pool and creating within each a fictional "policy intervention" at the same time as our real policy intervention. Abadie et al. (2010) refer to this process as a "permutation test," which reveals the level of expected effects if the policy were applied to a unit chosen at random. Subsequently, each country is matched with its own optimized synthetic control group which minimizes pre-"treatment" differences between the two groups for the outcome and predictor variables. The synthetic control is then used to predict the behavior of the outcome variable in the post-treatment period, again in the same manner, and the post-treatment synthetic control prediction can be compared with the actual post-treatment data for the outcome variable. Each iteration of this test is referred to as a "placebo test," in reference the fictional policy treatment. Assuming a good pre-treatment fit between a placebo country and its synthetic control, the differences in the post-treatment period can be seen as the expected prediction error for a fictional policy treatment applied at random within the donor pool. Since we apply these placebo tests to all countries in the donor pool, rather than just a single comparison unit, this falsification test is more systematic, creating a stringent requirement for judging whether the post-treatment effects seen in the treatment unit are "large relative to the distribution of the effects estimated for the regions not exposed to intervention" (Abadie et al., 2010).

When all countries in the donor pool are matched with their individual synthetic controls over the pre-treatment period, then the resulting array of post-treatment differences generated serves as a kind of "confidence interval" of expected effects from a fictional policy applied to a random country. We do this iteratively for all countries in the donor pool, and then compare the post-treatment prediction errors for the treatment and placebo countries. If the post-treatment differences in the variable of interest for the treatment country (as compared to its synthetic control) fall outside the array of post-treatment differences obtained in the placebo tests, despite similar levels of pre-treatment fit (i.e., similar pre-treatment MSPE), then we can reasonably infer that the policy treatment had some effect on the variable of interest in the treatment country above and beyond the effects expected due to random chance. Again, these comparisons are all made using pre- and post-treatment MSPE as measures of similarity between actual levels and the levels predicted by the synthetic control group. In order to establish significance, the post-policy differences in the treatment group must be larger than those predicted by at least 19 countries from the donor pool with similar pre-treatment fit with their synthetic control groups. If that level of difference is achieved, the chances of encountering the levels of post-policy differences observed for the treatment country as a result of random chance are 1/20, or 5%. As Abadie et al. (2010) note, this is "a test level typically used in conventional tests of statistical significance."

It is important to note that internationally traded wood products have long supply chains. The caveat to the assumption of no effects on other countries is that U.S. policy may affect other countries' trade in products expected to eventually enter the U.S. market, and therefore the policy treatment may, in theory, affect the trade levels of other countries in some ways (this assumption was discussed earlier in the explanation of the comparative case study method for estimating policy effects). However, if other

countries in the available control group (called the “donor pool”) make changes to trade as a result of the policy, we can assume that any changes resulting from the policy would lead to reductions in their trade in suspicious wood products (in efforts to decrease the risk of illegal wood entering into the supply chains of products exported to the U.S.). Assuming that this would be the only expected direct effect of the policy, any estimates of policy effects on U.S. or third-party country imports can be considered lower bound estimates, since it is possible that other countries represented in the synthetic comparison group may be decreasing their imports of suspicious wood products in the post-policy period.

Data Sources

Bilateral trade data were gathered using the Global Trade Atlas (GTA), which consists of data collected by Global Trade Information Services, Inc. (GTIS), a private organization that collects country-by-country data on imports, exports, and trade balances for various products going back as far as 1990 (Data can be accessed by subscription at the following address: http://www.gtis.com/gta/). GTA data are gathered from the reporting of the various official national agencies responsible for tracking and managing trade in each country. The system includes detailed trade information for 84 countries, representing virtually all world trade (Global Trade Information Services, Inc., 2013). The trade data are broken down into product codes using the Harmonized Commodity Description and Coding System (HS), down to the ten-digit code level, and include figures for both value (available in various currencies using monthly averages of exchange rates for conversions) and quantity of trade (volume or number of units imported/exported). While the data are all aggregated from official sources, the GTA has some features that make it ideal for comparisons of user-defined country and product groups.

The Harmonized Commodity Description and Coding System (HS) is a system of four-, six-, and ten-digit codes used to classify internationally traded goods. The system is used to classify over 98% of products traded on international markets, and is therefore recognized as a "universal economic language and code for goods" (World Customs Organization, 2013b). Descriptions of relevant HS codes for wood products can be found in Appendix B.

Trade information for Vietnam is not included in the GTA trade database in detail, so export data from all GTA countries to Vietnam were used to estimate Vietnam's imports. In addition, data on country-by country exports to Vietnam from suspicious countries not included in detail in the GTA trade database were provided on request by the United Nations Economic Commission for Europe (UNECE). For tropical countries not included in the GTA database, all wood exports to Vietnam not identified as coniferous were treated as tropical hardwood.

In order to analyze the differential effects of the 2008 economic crisis on various countries, the annual real GDP data from the World Bank country-by-country economic indicators were used (The World Bank Country-by-Country Economic Indicators: Annual Real GDP; available at http://data.worldbank.org/indicator/NY.GDP.MKTP.CD). The World Bank does not separate economic indicators from Taiwan and China, so Taiwan economic indicators were retrieved from the Republic of China (Taiwan) National Statistics website (Republic of China (Taiwan) National Statistics, 2013).

Details of the Analysis

The 2008 Lacey Act amendment came into force on May 22, 2008 (USDA APHIS, 2013). As a result, 2008 is designated as the year of the policy treatment. GTA data on wood products trade are generally sparse prior to the year 2000, so the years 2000 through 2007 were designated as the pre-intervention or pre-policy period. We assume that the policy had no effect on trade prior to the year 2008. As noted earlier, the synthetic control method draws on all the countries in the donor pool in order to create a synthetic comparison group that minimizes the mean squared prediction error (MSPE) for the values of the variable of interest, as well as any predictor variables, for the country of interest over the pre-intervention period. Since the policy change occurred in the year 2008, the years 2009 through 2012 were chosen as the results period. In the results period, we compare the outcome variable from the country of interest with that of the synthetic control (optimized to best match the country of interest over the pre-treatment period), although for this period no measures are taken to minimize the MSPE between the two groups. For the results (post-policy) period, the model applies the country weights established from the pre-treatment optimization and then aggregates data on the outcome variable from all countries in the donor pool. Since our method takes into account unobserved characteristics that affect the countries analyzed, the difference between the treatment and control groups in the post-policy period are assumed to be attributable to the policy intervention (plus random prediction error). We use falsification tests (in this case, placebo tests for a fictional policy treatment in all countries in the donor pool) to determine whether or not post-treatment differences in the treatment country are greater than the differences we would expect from random chance.

All trade data were aggregated annually, creating a cross-sectional time series for each of the 84 countries tracked by the Global Trade Atlas. All countries with any missing trade data after the year 2001 were eliminated from the donor pool of control countries. The remaining 68 countries in the sample have complete trade data reported over the pre- and post-treatment periods, aside from a few countries missing 2000/2001 data (8 countries reported no trade data in 2000, and 6 of those countries reported no trade data in 2001). All missing data were treated as $0 (i.e., no trade). Overall, this assumption is reasonable because the GTA trade database contains no missing data after the year 2002 for any of the countries included in the analysis. However, due to the rather high levels of imports in their preliminary years of reported trade, it is likely that the 8 countries with missing data in the first years of the analysis had non-zero trade levels unreported for those years with missing data. However, these 8 countries are relatively small economies, making it less egregious to treat their first year or two of imports as $0, due to the fact that overall trade levels in these countries are comparatively small. Furthermore, due to the synthetic control method used to create the control comparison group, any distortion of trade caused by the assumption of no trade in the years of missing data would be expected to make these countries less likely to be matched with the analyzed countries, all of which contain data for all the years in the pre-treatment period. In summary, the inclusion in the donor pool of these few countries with some missing data in the early pre-treatment period is not expected to distort the outcome of the analysis.

Due to fundamental differences in trade quantity measurements throughout the world (some products are tracked in different countries either by the raw number of articles traded or by volume), this analysis will use the 2012 value in U.S. dollars of traded goods as the primary trade indicator. It may be the case that the value of traded goods does

not reflect the volume of goods traded, due to fluctuations in the prices of wood and wood products. However, for our purposes we will assume that the value of traded goods adequately reflects the amount of trade in some product or product group. Due to the incompatibility of various volume measurements, value is the only measurement of trade that is widely available and comparable both within and between all products. An effort was made to test the appropriateness of using trade value as a proxy for trade quantity (discussed in Chapter 5), and this assumption appears to be reasonable.

Primary wood products are wood products made directly from timber. In general, primary products include logs, lumber, plywood, fiberboard, cants, ties, posts, and pilings (Hoff et al., 1997; Vlosky, 2011). Secondary wood products are those products made using primary wood products, including millwork, furniture, and flooring (Hoff et al., 1997; Vlosky, 2011). This separation is not always clear, as some products (e.g., plywood) are generally categorized as primary products, despite the fact that extensive manufacturing processes are required in order to produce these products from raw timber. In other words, some primary products are more or less manufactured than others. Many primary wood products pass through countries for further refinement through manufacturing processes prior to reaching the final consumer, however primary products can also be used in their primary form, depending on the use. In some of our analyses, efforts are made to differentiate between primary and secondary wood products, based on the HS codes.

This analysis will not address trade in pulpwood, pulp, paper, and other associated pulp products, due to the difficulty of tracking the origins of these products. However, past studies (Lawson and Macfaul, 2010; Seneca Creek Associates, 2004) have provided

evidence for illegal activities in the harvest of pulpwood, which differs from timber used for solid wood products.

Because this analysis focuses on official trade data, we make no attempt to account for undocumented smuggling of suspicious wood between countries. Some smuggled wood is of high-value or protected species (The New Indian Express, 2014). However, there are also reports of large-scale smuggling of lower-value wood, as in the case of Russian Far East exports bypassing official checkpoints en route to China, thereby eliminating official oversight and avoiding Russian export tariffs (EIA, 2013). As such, estimates of suspicious wood used in this document can be considered to be conservative.

Countries Identified as Being at Risk for Exporting Illegally-Harvested Wood

To study the effects of the 2008 Lacey Act amendment, it is prudent to focus on products from countries with high levels of suspicious wood exports. As discussed earlier, we cannot access information on the legality of any particular wood imports, so we assume that the percentage of illegal wood coming from these countries is equivalent to the levels of illegal wood production these countries shown in the literature. Based on this literature, two groups of countries were created. Tables 3.1 and 3.2 list the countries suspected of exporting significant amounts of products made from illegally-harvested wood. "Suspicious Producer Countries" are countries that are generally suspected of exporting significant amounts of illegally harvested logs and primary wood products (>15% of production and exports). "Suspicious Processing Countries" are countries noted in the literature as being major importers of illegally-harvested wood, in addition to being manufacturing centers that export large quantities of both primary and secondary wood products. These processing countries may or may not have significant levels of domestic illegal/suspicious timber harvesting. This list was compiled using information

from Seneca Creek Associates, 2004; Duery and Vlosky, 2006; Li et al., 2008; Lawson and MacFaul, 2010.

In all of the analyses in this thesis, imports from suspicious producer countries and suspicious processing countries are analyzed separately in order to account for the trade specialization of different country groups (discussed later this chapter).

Table 3.1: Suspicious Producer Countries, by region

South America *(tropical hardwood)*	**Asia/Oceania** *(tropical hardwood)*
Bolivia Brazil Colombia Ecuador Peru	Cambodia Indonesia Laos Malaysia Myanmar Papua New Guinea Thailand Vietnam
West/Central Africa *(tropical hardwood)*	**Europe** *(softwood and temperate hardwood)*
Benin Cameroon Central African Republic Congo Democratic Republic of Congo Cote d'Ivoire Equatorial Guinea Gabon Ghana Liberia Nigeria Togo	Estonia Latvia Russia

Table 3.2: Suspicious Processing Countries

China
India
Japan
Taiwan
Vietnam

Analysis 1: U.S. Wood Products Imports from Suspicious Countries

As noted earlier, the response by U.S. importers to the Lacey Act amendment of 2008 could take various forms. In general, U.S. importers would be expected to reduce imports of goods with a high likelihood of incorporating wood of suspicious origin. Due to the difficulties inherent in establishing the legality of initial harvest in the complex trade systems of wood products, it could be that U.S. importers are complying with the 2008 Lacey Act amendment by shifting purchases away from suspicious countries and toward domestic production or trade with countries with fewer concerns about illegally-harvested wood. If this were the case, then bilateral trade with suspicious producer and processing countries would be affected by the 2008 policy.

In order to test this, the total value of U.S. imports from suspicious producer and processing countries is compared with a control group of other countries established using the synthetic control method. Unfortunately, the U.S. is one of the largest importers of wood and wood products in the world, as well as the strongest economy in the world, over the entire pre-treatment period (2000 to 2007). Due to the U.S. position as a consistent outlier on trade levels, there is no combination of other countries that the model can use to create an appropriate comparison group for the U.S. over the pre-treatment time period. As a result, the comparative case study methodology is not

useful for investigating post-policy changes in the raw levels of trade (based on import values) in the U.S.

To address this problem, trade levels in the U.S. are normalized by dividing each year's imports of the product group by the average annual U.S. imports for the same product group over the pre-treatment period:

$$\frac{\text{Annual U.S. imports (in 2012 USD) for year } Y \text{ for product group } X \text{ from country group } Z}{\text{Average pre-treatment (2000-2007) annual U.S. imports (in 2012 USD) for product group } X \text{ from country group } Z}$$

Imports for all countries and product groups were normalized in the same manner, by comparing each country's annual imports to that country's annual average imports during the pre-treatment period. The resulting values are country-specific time trends, showing how import levels compare to average pre-treatment import levels within each country in a normalized manner that is readily comparable across countries.

Normalized time trends of U.S. imports were analyzed for four product groups:

1. All wood and articles of wood (HS 4400), excluding fuel (HS 4401 and 4402) and bamboo products (HS 440921, 441210)
2. All wooden furniture, excluding seats (HS 940330, 940340, 940350, 940360)
3. All wood and articles of wood (HS 4400) identified as hardwood (See Appendix C for a list of all HS hardwood product codes)
4. Tropical wood products (See discussion below for a list of all tropical wood HS product codes)

Table 3.3 summarizes these sub-analyses, followed by a discussion of the basis for choosing the product groups:

Table 3.3: Explanation of variables investigated in the sub-analyses that make up Analysis 1

	Imports from Suspicious Producer Countries	Imports from Suspicious Processing Countries
All Wood Products (HS 44)	Analysis 1A	Analysis 1E
Wood Furniture (HS 9403)	Analysis 1B	Analysis 1F
Hardwood Products	Analysis 1C	Analysis 1G
Tropical Wood Products	Analysis 1D	Analysis 1H

For Analysis 1, we would expect economic size/strength to be predictive of wood products imports. To account for this, total annual real GDP is included as a predictor variable in the same normalized time trend format used to create the import time trend:

$$\frac{\text{Annual real GDP (in 2012 USD) for year } Y}{\text{Average annual real GDP (in 2012 USD) over the years 2000-2007}}$$

Similarly, the normalized time trend of annual product group imports for the years 2000, 2004, and 2007 are included as predictors of trade levels in order to control for time lag effects.

In order to understand overall import trends, all U.S. imports of wood and wood products identified under HS code 44, excluding fuel (HS 4401 and 4402) and bamboo products (HS 440921, 441210), were included. Wooden furniture, excluding seats (HS 940330, 940340, 940350, 940360), was analyzed separately due to the fact that it is a more heavily-manufactured, high value product that tends to be produced by countries specializing in wood products manufacturing (many of which are included in the list of suspicious processing countries).

As noted in the literature, an analysis conducted on such a broad level as that described above cannot capture the subtleties of the international trade in wood products. As an

example, the above analysis assumes that all the wood and wood products imported from Brazil have the same likelihood of arising from suspicious origins, and that importers would similarly reduce imports of all products from Brazil due to concerns about the legality of the wood harvest associated with those wood products. In fact, as noted in the 2004 Seneca Creek Associates report:

> Two-thirds of the total timber harvest in Brazil comes from plantation forests, where illegal logging is not considered to be a problem. The problem of illegal logging is only an issue with tropical timber production, which occurs primarily in the Amazon region (p. 36).

When all exports arising from Brazil are grouped together, we may overestimate the amount of exports with a high-likelihood of having originated from suspicious timber harvests. It could be the case that importers in the U.S. and other countries are importing increasing amounts of wood products arising from wood harvested from Brazil's plantation forests; products unlikely to have been illegally harvested. This manner of supply rebalancing away from suspicious products within specific countries of export would not be captured by the initial analysis detailed above. This problem extends to other various wood products and countries aggregated together for the initial broad-stroke analysis.

In an effort to address this issue, more limited groups of wood products were created to focus the analysis on products with higher risks of arising from suspicious origins. Unfortunately, the HS coding system used to identify and categorize internationally-traded wood products is not created in such a way as to allow for the optimal study of wood products with potentially suspicious origins. Here are a few examples of the shortcomings in the HS system for the purposes of this analysis:

1. Many HS codes for wood products do not distinguish between hardwoods and softwoods, in general. For most of our countries of analysis, only hardwood species are of the greatest concern for illegal logging.

2. Many HS codes for wood products do not distinguish between tropical and temperate hardwood species. For many of our countries of analysis, only tropical hardwood species are of the greatest concern for illegal logging.
3. Many HS codes for wood products have large, ambiguous NESOI ("Not Either Specified or Included") product groups, making it impossible to establish the origin species for many wood products.
4. HS codes for wood furniture do not distinguish between origin species of products.

Despite these issues, a group of internationally-traded wood products that are considered to have a high likelihood of arising from suspicious origins can be generated. First, eliminating softwood products from the analysis allows us to focus on products known to originate from hardwoods, which are at higher risk of having originated from suspicious harvesting. The only countries in the world identified as having significant levels of suspected illegal harvesting of softwoods are Russia, Estonia, and Latvia (Seneca Creek Associates, 2004; Li et al., 2008). Furthermore, a recent investigation of Russian illegal logging activities showed evidence of significant legality concerns about Russian hardwood exports (EIA, 2013). See Appendix C for a list of all HS codes included in the Hardwood Products group.

Narrowing our analysis further to just wood products specifically identified as tropical hardwood allows us to focus on a group of products at a high risk of having been illegally harvested.

The Tropical Hardwood Product group is made up of the following HS codes:

1. Tropical wood (logs) - 4403.31, 4403.32, 4403.33, 4403.34, 4403.35, 4403.41, 4403.49
2. Tropical wood (lumber) - 4407.21, 4407.22, 4407.23, 4407.24, 4407.25, 4407.26, 4407.27, 4407.28, 4407.29
3. Tropical wood (veneer) - 4408.20, 4408.31, 4408.39
4. Tropical plywood (at least one ply of tropical wood) - 4412.11, 4412.13, 4412.22, 4412.31, 4412.92

While this list does not account for all products with a high risk of arising from suspicious origins, it is certainly a list of products with a high likelihood of being produced from wood with suspicious origins. As a result, we would have a greater expectation of seeing effects on U.S. imports of these products as a result of the 2008 policy.

Analysis 2: Accounting for Trade with Third-Party Countries

As a result of globalizing economies and manufacturing specialization, the system of international trade in wood products is complex. Many countries have trade relationships with others at various stages in manufacturing, leading to the increasing movement of wood products to third-party countries and a globally-decreasing reliance on bilateral trade for wood and wood products (Dieter and Englert, 2006). Adding to this decrease in bilateral trade relationships is the inter-industry and intra-industry specialization shown by countries involved in the wood products trade (Dieter and Englert, 2006).

It may be that U.S. importers are requiring their foreign suppliers to be accountable for the legality of the origin of the wood used in their exports, regardless of whether the wood was produced domestically in the country of export or imported from some other country of production. As a result, major exporters to the U.S. of finished wood products may be changing purchasing decisions to secure their own supply chains and maintain their competitiveness in U.S. import markets. If this is the case, the effects of the 2008 Lacey Act amendment might not be evident in the levels of U.S. imports from suspicious countries, but rather in the imports of the major re-exporters to the U.S. Third-party trade was investigated by analyzing the imports of primary wood products by the major

re-exporters to the U.S., using the synthetic control method employed in the analysis of U.S. imports (Analysis 1).

The top three countries that the U.S. imported wood furniture from in 2012 (China, Vietnam, and Canada) accounted for almost 70% of all U.S. wood furniture imports that year, by value (2012 total U.S. wood furniture imports were valued at over $8.4 billion). U.S. wood furniture imports from China accounted for over 40% of U.S. wood furniture imports in 2012, worth more than $3.3 billion. Vietnam and Canada accounted for roughly 18% and 10% of U.S. wood furniture imports, respectively. Conversely, exports from these countries to the United States accounted for a significant portion of their wood furniture exports. In 2012, wood furniture exports to the U.S. accounted for roughly 30% (China), 55% (Vietnam), and 94% (Canada) of the total value of all wood furniture exports from each of these countries. Imports of hardwood and tropical wood products from suspicious producer countries were analyzed for each of the top three exporters of wood furniture to the U.S. While we cannot account for what percentage of furniture bound for the U.S. arose from domestic production or imported wood in those countries, we can assume that changes in supply in response to the U.S. policy should have effects on the imports of primary wood products from suspicious producer countries. A rise in domestic production would also cause a fall in imports, so a shift in supply away from countries with large quantities of suspicious wood would be directly observable. Table 3.4 summarizes the sub-analyses that make up Analysis 2:

Table 3.4: Explanation of variables investigated in the sub-analyses that make up Analysis 2

Hardwood Products	Tropical Wood Products
Analysis 2A	Analysis 2B

The Stata coding used for the analysis is included in Appendix D. A statistical software package and information for applying the synthetic control comparative case study method are available at Jens Hainmueller's website (Hainmueller et al., 2014).

Chapter 4: Results

Overview of U.S. Wood Products Imports

Figures 4.1 through 4.8 summarize the U.S. imports of wood and wood products from suspicious countries and show how U.S. imports from suspicious countries compare with imports from other countries.

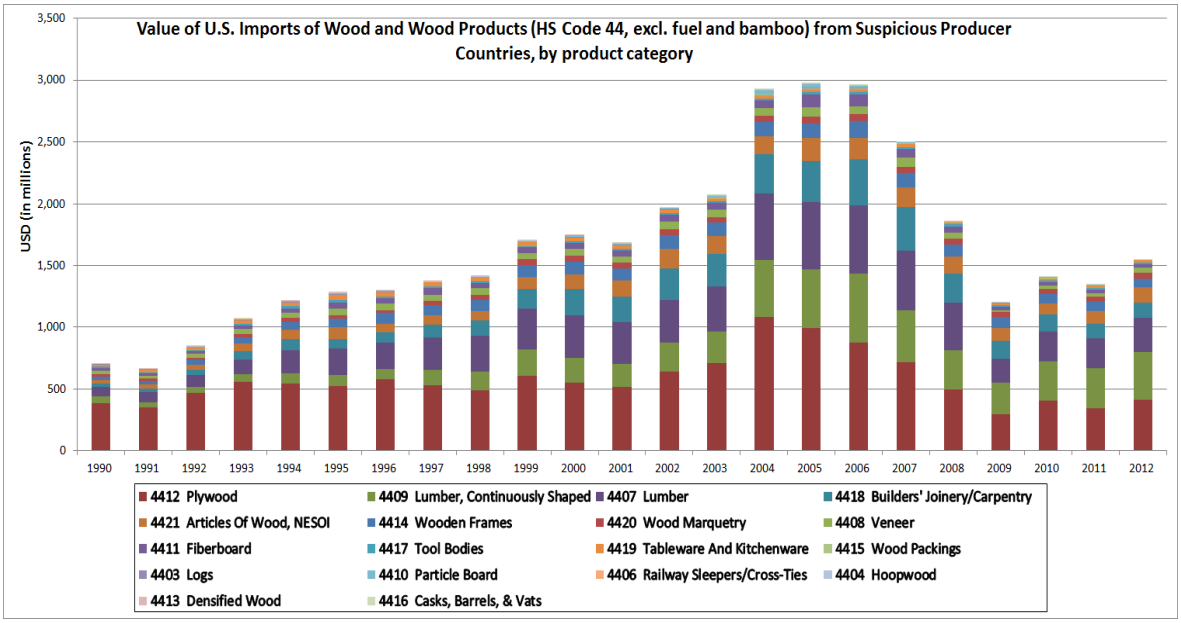

Figure 4.1: Value of annual U.S. imports of wood and articles of wood (HS code 44, excluding fuel wood and bamboo) by product group from suspicious producer countries

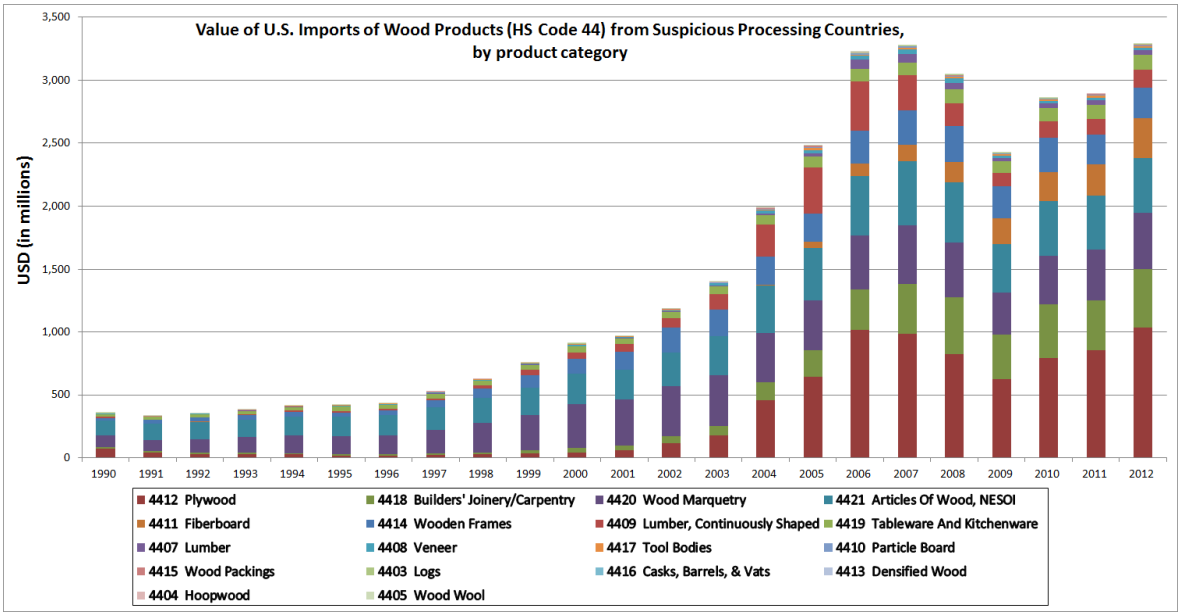

Figure 4.2: Value of annual U.S. imports of wood and articles of wood (HS code 44, excluding fuel wood and bamboo) by product group from suspicious processing countries

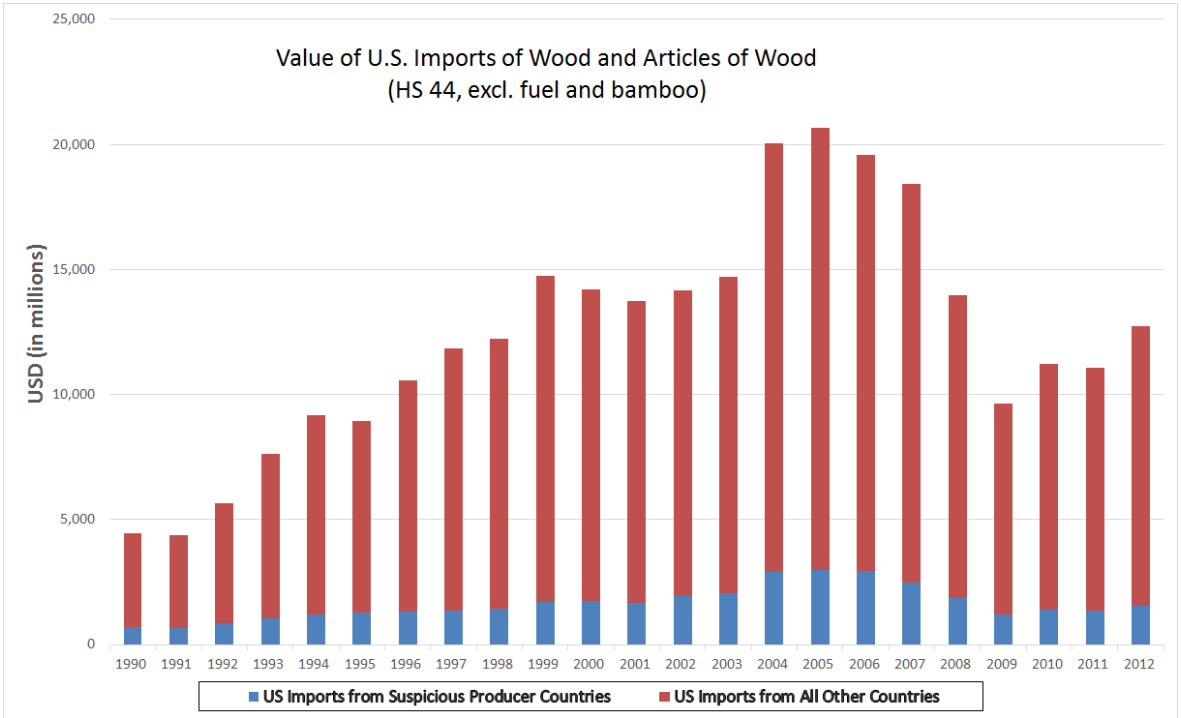

Figure 4.3: Contribution from suspicious producer countries to total annual value of U.S. imports of wood and articles of wood (HS code 44, excluding fuel wood and bamboo)

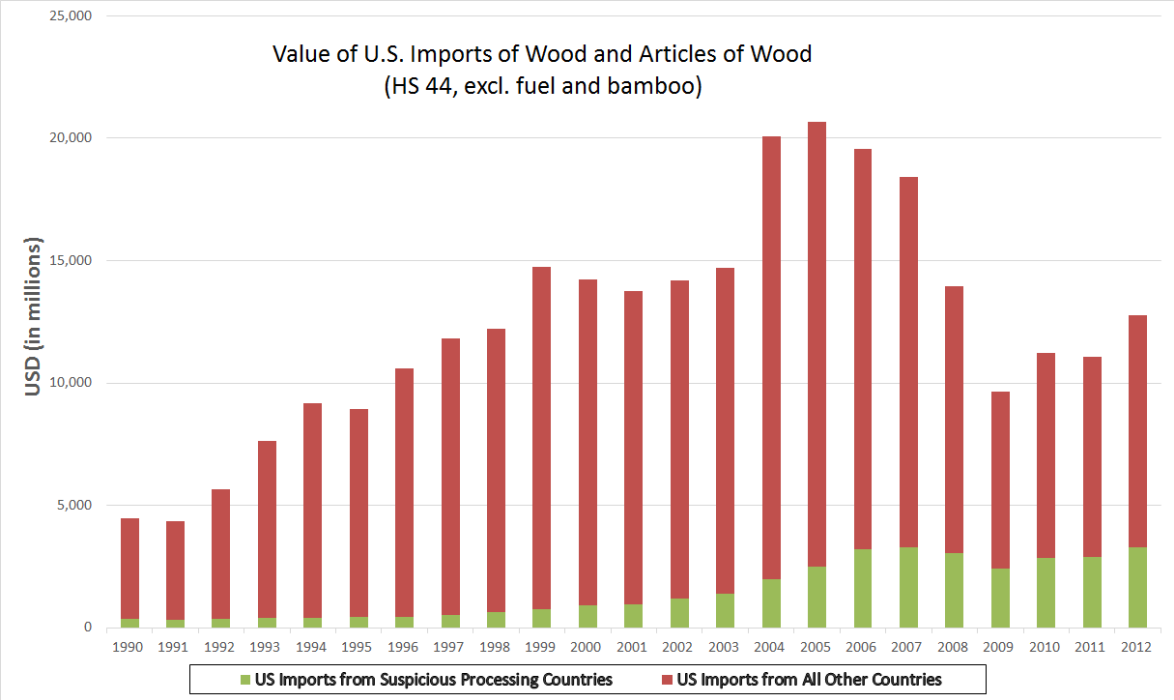

Figure 4.4: Contribution from suspicious processing countries to total annual value of U.S. imports of wood and articles of wood (HS code 44, excluding fuel wood and bamboo)

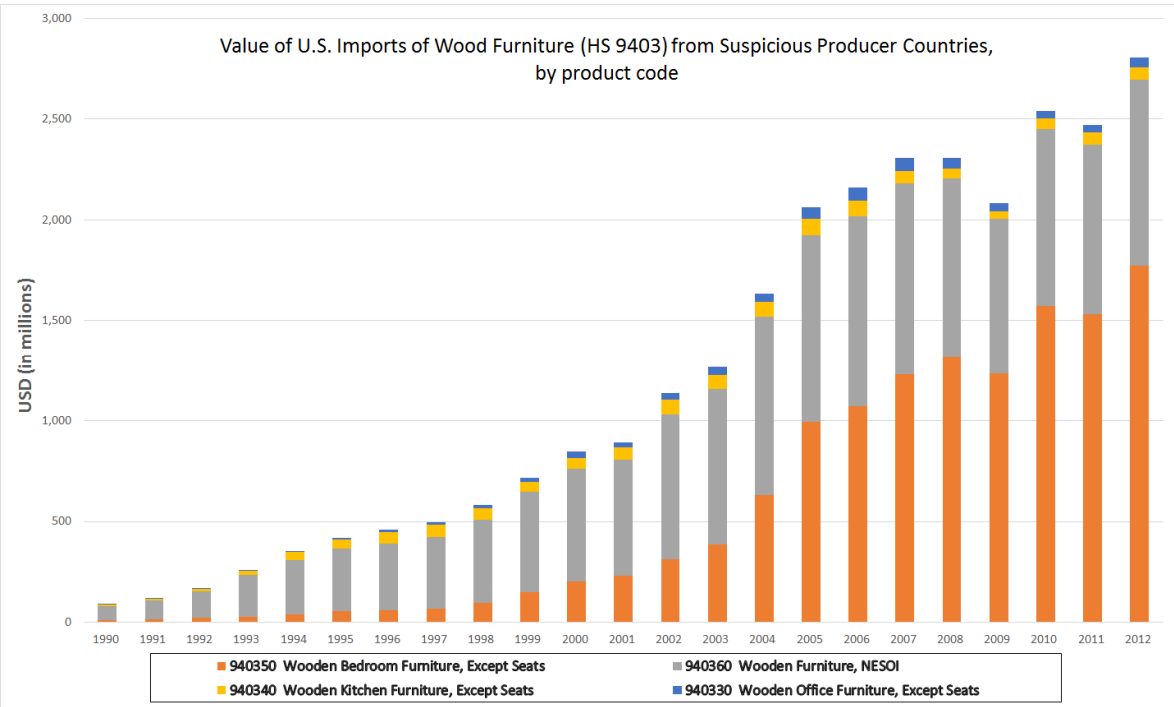

Figure 4.5: Value of annual U.S. Imports of wood furniture (HS code 9403) by product group from suspicious producer countries

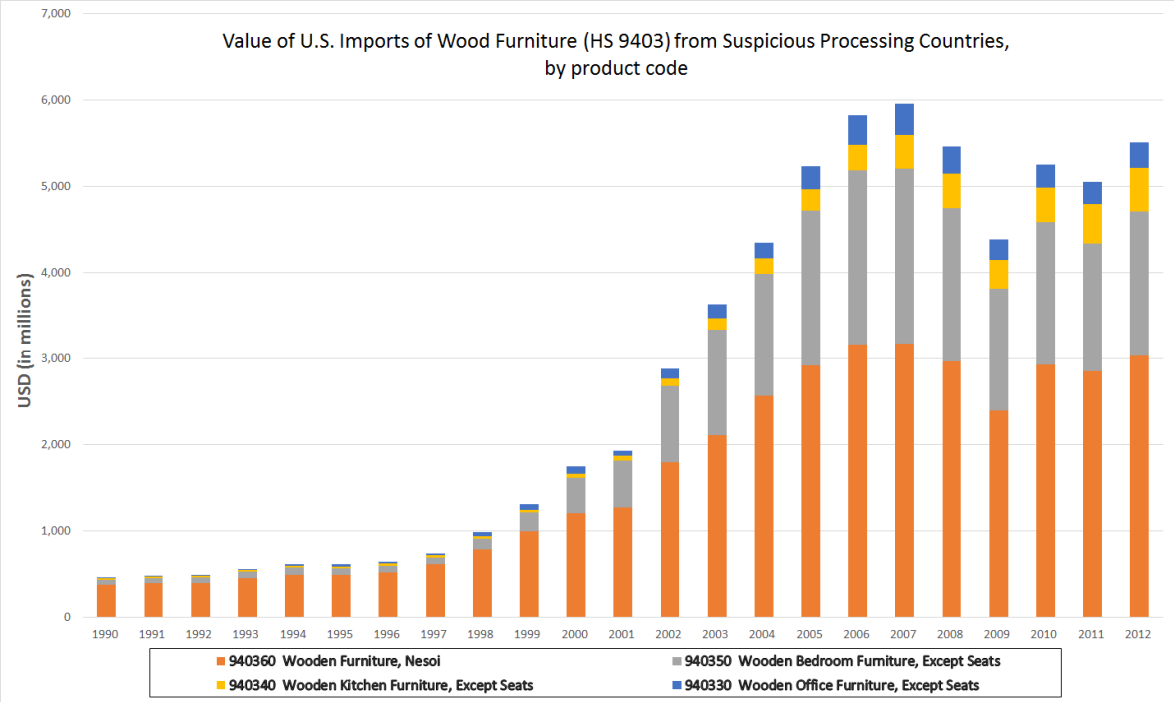

Figure 4.6: Value of annual U.S. Imports of wood furniture (HS code 9403) by product group from suspicious processing countries

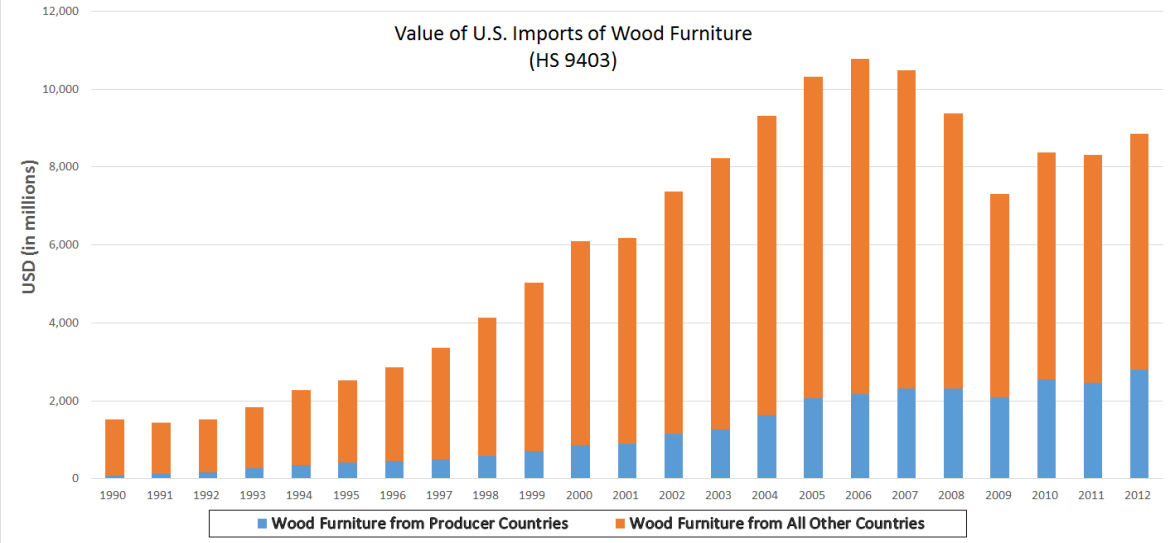

Figure 4.7: Contribution from suspicious producer countries to total annual value of U.S. imports of wood furniture (HS code 9403)

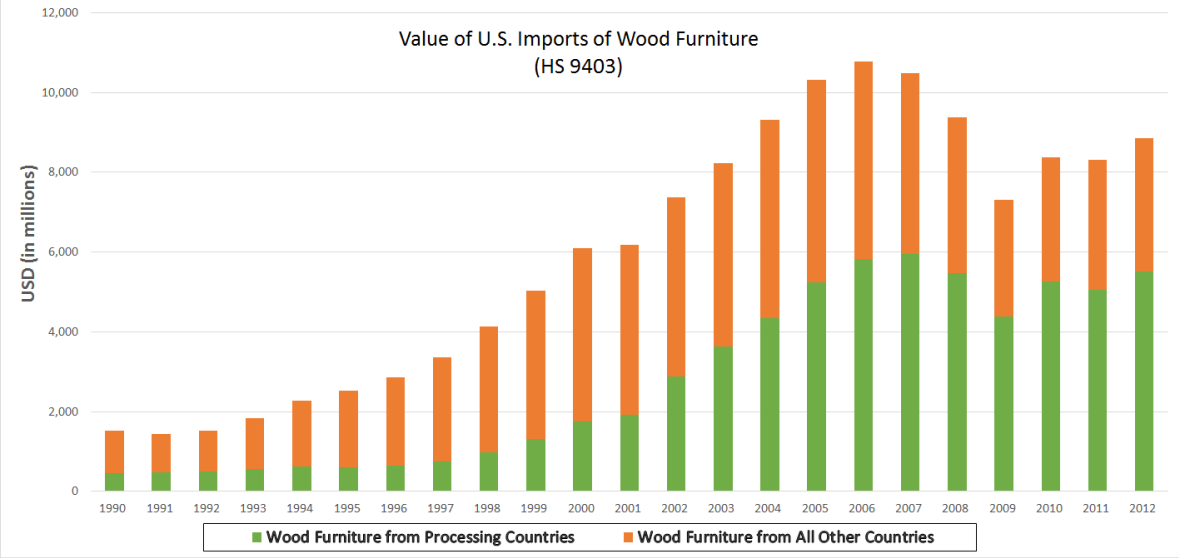

Figure 4.8: Contribution from suspicious processing countries to total annual value of U.S. imports of wood furniture (HS code 9403)

Overview of Results

Table 4.1 summarizes the results of Analysis 1 and 2. Detailed results are reported in the following sections.

Table 4.1: Summary of results from Analyses 1 and 2

	Post-treatment difference	Is post-treatment difference significant?	Actual 2012 imports (normalized)	Predicted 2012 imports (normalized)
	Increase, Decrease, or No Difference	**Significant or Insignificant**		
	Are suspicious import levels after the policy higher or lower than predicted by the synthetic control?	Is the post-policy difference larger than that seen in the placebo tests for other countries?	Level of imports (as a percentage of average pre-2007 imports) in the country of interest in the year 2012.	Level of imports (as a percentage of average pre-2007 imports) in the synthetic control group in the year 2012
U.S. Imports from Suspicious Producer Countries				
Analysis 1A				
U.S. Imports of Wood Products (HS 44) from Suspicious Producer Countries	**Decrease**	**Insignificant**	**0.66**	**0.90**
Analysis 1B				
U.S. Imports of Wood Furniture (HS 9403) from Suspicious Producer Countries	**Increase**	**Insignificant**	**1.82**	**1.64**
Analysis 1C				
U.S. Imports of Hardwood Products from Suspicious Producer Countries	**No Difference/Slight Decrease**	**Insignificant**	**0.32**	**0.31**
Analysis 1D				
U.S. Imports of Tropical Wood Products from Suspicious Producer Countries	**Decrease**	**Insignificant**	**0.74**	**2.26**
U.S. Imports from Suspicious Processing Countries				
Analysis 1E				
U.S. Imports of Wood Products (HS 44) from Suspicious Processing Countries	**Decrease**	**Insignificant**	**1.70**	**2.04**
Analysis 1F				
U.S. Imports of Wood Furniture (HS 9403) from Suspicious Processing Countries	**Increase**	**Insignificant**	**1.40**	**1.27**
Analysis 1G				
U.S. Imports of Hardwood Products from Suspicious Processing Countries	**Decrease**	**Insignificant**	**0.39**	**0.83**
Analysis 1H				
U.S. Imports of Tropical Wood Products from Suspicious Processing Countries	**Decrease**	**Insignificant**	**0.63**	**3.47**
Third-party Country Imports from Suspicious Producer Countries				
Analysis 2A				
China Imports of Hardwood Products from Suspicious Producer Countries	**Increase**	**Insignificant**	**1.72**	**1.49**
Vietnam Imports of Hardwood Products from Suspicious Producer Countries	**Decrease**	**Significant**	**1.55**	**4.64**
Analysis 2B				
China Imports of Tropical Wood Products from Suspicious Producer Countries	**Increase**	**Insignificant**	**1.00**	**1.04**
Vietnam Imports of Tropical Wood Products from Suspicious Producer Countries	**Increase**	**Insignificant**	**3.06**	**2.48**

Analysis 1: U.S. Wood Products Imports from Suspicious Countries

U.S. Imports from Suspicious Producer Countries

Analysis 1 investigates the trend in U.S. imports from suspicious countries. We will first focus on the results of the analyses of U.S. imports from suspicious producer countries. Tables 4.2 through 4.16 and Figures 4.9 through 4.39 show the results of Analysis 1.

Analysis 1A: Total Wood Product Imports (HS 44) from Suspicious Producer Countries

Using the method outlined in Chapter 3, a synthetic control group (in this case, identified as the "Synthetic U.S.") of weighted and aggregated data from countries in the donor pool was created as a control for comparison with U.S. imports. Table 4.2 shows the optimized weights assigned to various countries for the creation of the Synthetic U.S. for Analysis 1A. These weights are indicators of how similar each country was to the U.S. in the pre-treatment period based on the outcome variable (in this case, the annual value of normalized U.S. imports of wood products from suspicious producer countries) and the predictor variables (annual normalized GDP and 3 years of lagged U.S. imports). These weights are then applied to each country's data for the outcome variable in both the pre-treatment and the post-treatment years to create the Synthetic U.S. comparison group for the real U.S.

Figure 4.9 compares the time trend of the value of U.S. imports from suspicious producer countries with the time trend of the value of imports from suspicious producer countries of the Synthetic U.S. over the pre- and post-treatment periods. The year of the policy treatment (2008) is indicated with a vertical red line.

Interpreting the time trends in Fig. 4.9 requires some explanation. Since annual imports are calculated in relation to each country's average pre-treatment import levels, any

value lower than 1 indicates that annual imports for that year were lower than the pre-treatment average import levels for that country. Values higher than 1 indicate that annual import levels are above that country's average pre-treatment levels, with greater numbers indicating larger increases in imports (as compared to average pre-treatment import levels). Figure 4.9 shows that U.S. total wood products imports from suspicious producer countries dropped below average pre-treatment levels during the post-treatment period, with the largest drop occurring from 2007 to 2009 and imports slowly recovering from 2010 to 2012. These import trends reflect the housing crisis and consequent global recession began in earnest in 2007/2008. However, Fig. 4.9 shows that U.S. import levels in the post-treatment period dropped to a higher degree and recovered more slowly than predicted by the Synthetic U.S.

Table 4.2: Country weights in the Synthetic U.S. for Analysis 1A

Country	Weight	Country	Weight	Country	Weight
Algeria	0.255	Hong Kong	0.001	Philippines	0.079
Argentina	0.001	Hungary	0.002	Poland	0.001
Australia	0.002	Iceland	0.001	Portugal	0.002
Austria	0.003	India	0.002	Romania	0.001
Belgium	0.002	Indonesia	0.001	Russia	0.002
Brazil	0.001	Ireland	0.476	Serbia	0
Bulgaria	0.001	Italy	0.004	Singapore	0.002
Canada	0.003	Japan	0.008	Slovakia	0.001
Chile	0.003	Jordan	0.003	Slovenia	0.001
China	0.002	Latvia	0.001	South Africa	0.002
Colombia	0.001	Lithuania	0.001	South Korea	0.002
Costa Rica	0.002	Luxembourg	0.001	Spain	0.002
Croatia	0.002	Malaysia	0.003	Sri Lanka	0.002
Cyprus	0.002	Malta	0.003	Sweden	0.002
Czech Republic	0.002	Mexico	0.006	Switzerland	0.001
Denmark	0.002	Morocco	0.001	Taiwan	0.003
Ecuador	0.06	Netherlands	0.002	Thailand	0.004
Estonia	0.001	New Zealand	0.002	Turkey	0.001
Finland	0.002	Norway	0.002	Ukraine	0.002
France	0.002	Panama	0.004	United Kingdom	0.003
Germany	0.002	Paraguay	0.003	Uruguay	0.002
Greece	0.003	Peru	0.002	Venezuela	0.001
Guatemala	0.002				

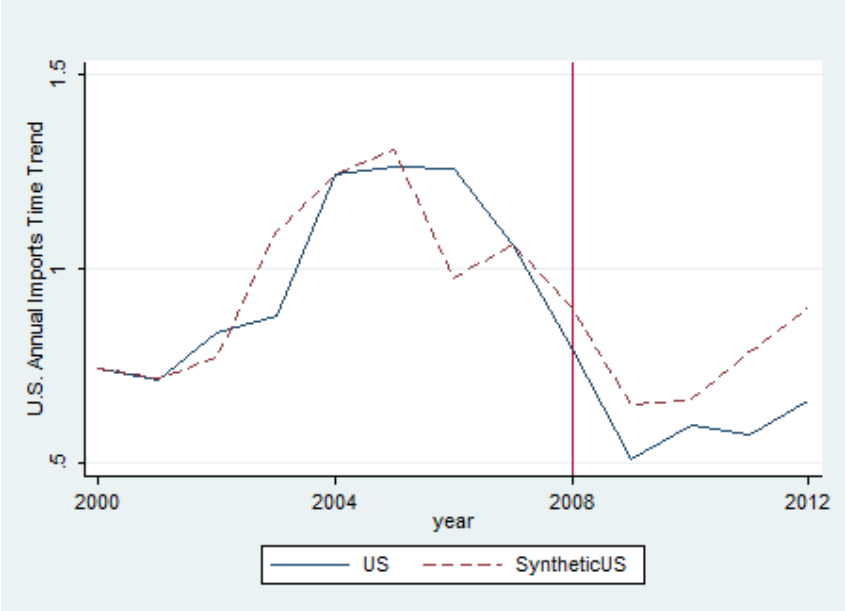

Figure 4.9: Trends in U.S. imports of wood and wood products (HS 44) from suspicious producer countries: Synthetic U.S. and U.S.

Figure 4.10 takes the same information from Fig. 4.9, but plots the differences between the values for the Synthetic U.S. and the U.S., with the "0" line representing the Synthetic U.S. Fig. 4.10 allows us to see how actual U.S. wood imports differed from the Synthetic U.S. in the pre- and post-treatment periods. By 2012, we see that U.S. import levels were about 20% below the normalized import levels predicted by the Synthetic U.S.

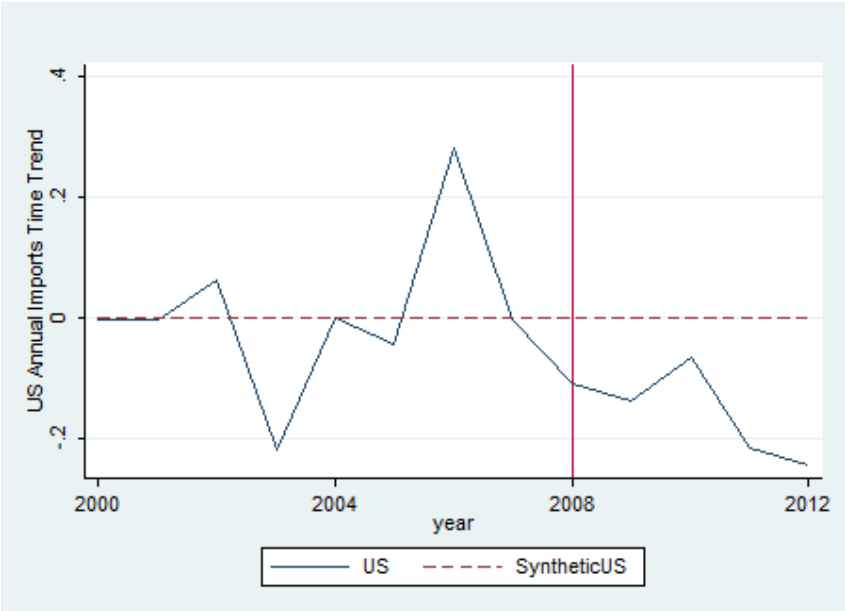

Figure 4.10: Differences in total wood imports from suspicious producer countries between the Synthetic U.S. and the U.S.

As discussed earlier, we want to evaluate the robustness of these results in order to determine whether they are significant or not. After all, the post-policy differences in import levels between the U.S. and Synthetic U.S. could be reflecting prediction error generated by our comparison model, rather than representing truly unexpected import trends in the U.S. As discussed in Chapter 3, placebo tests for all the countries in the donor pool are used to establish the significance of these post-treatment differences between U.S. and Synthetic U.S. The question asked by each placebo test is this: "What magnitude of changes would we see post-policy (fictional) for a control country where we have no expectation of effects from the policy treatment?" Figure 4.11 shows the differences between the actual and the synthetic control imports from suspicious producer countries for each of the 68 countries analyzed, plotted in the same manner as that used to create Figure 4.10. As Figure 4.11 shows, the post-policy differences in U.S. imports from suspicious producer countries (as compared with the Synthetic U.S) appear to be within the range of post-policy differences in other countries (as compared to their own individual synthetic control groups). However, we note that some of the pre-treatment differences between placebo countries and their synthetic controls appear to be larger than the differences seen between the U.S. and the Synthetic U.S. A poor pre-treatment fit indicates that the model was unable to establish an appropriate control group for the country.

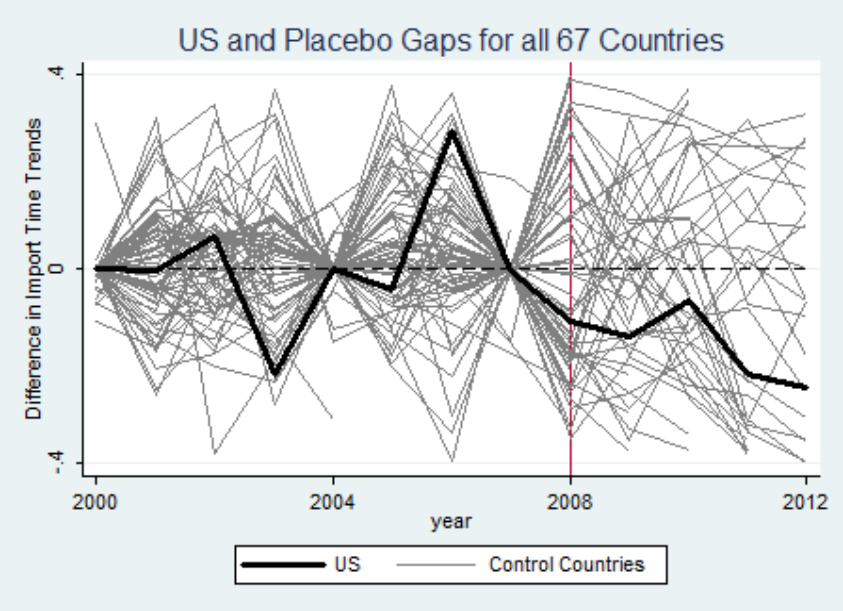

Figure 4.11: Gap in U.S. total wood imports from suspicious producer countries and placebo gaps for all 67 control countries.

To ensure that we are comparing post-treatment differences among countries with good pre-treatment fit, we eliminate any countries with a pre-treatment mean squared prediction error (MSPE) more than 2 times greater than the pre-treatment MSPE for the U.S. comparison. The resulting analysis is focused on countries that have similar levels of pre-treatment fit with their synthetic control groups as those observed for the treatment country and its synthetic control. These results are shown in Figure 4.12.

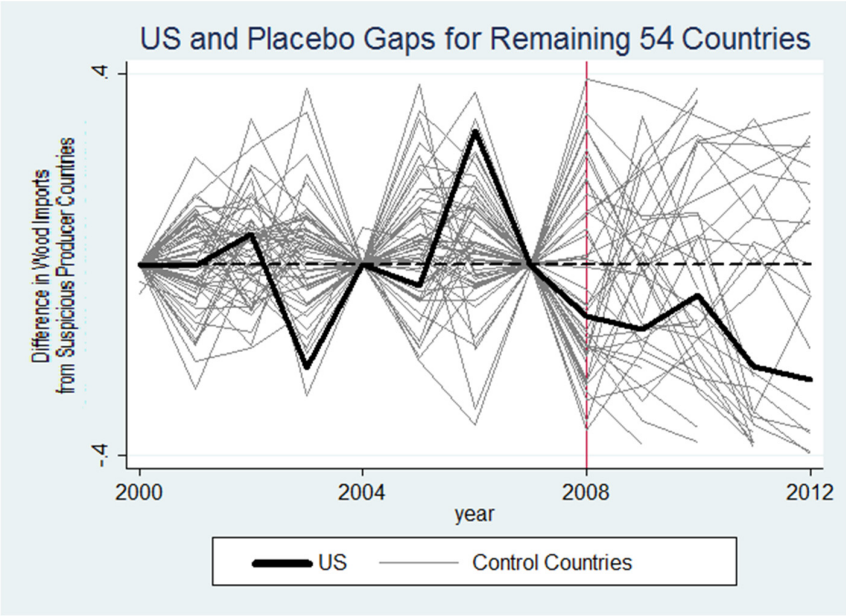

Figure 4.12: Gap in U.S. total wood imports (HS 44) from suspicious producer countries and placebo gaps for 54 control countries (discards countries with pre-2008 MSPE two times higher than the U.S.').

As we see in Figure 4.12, the post-treatment differences between the U.S. and the Synthetic U.S. are within the range of differences observed if we were to apply the policy at random to a country in our donor pool. In this case, the post-policy differences between the U.S. and Synthetic U.S. failed the robustness test, indicating that the post-policy differences are not significant. In other words, the post-policy reductions in U.S. wood imports, as compared with the Synthetic U.S., are similar to the post-treatment differences observed for placebo countries where we have no expectation of policy treatment effects.

Table 4.3 quantifies the post-policy differences in imports of wood products from suspicious producer countries for all of the countries included in the placebo tests shown in Figure 4.12 (ordered from largest to smallest). Post-policy differences are reported as the summed mean squared prediction error (MSPE) over the entire post-policy period (the years 2009 through 2012), ordered from greatest to least. MSPE does not distinguish between the directions of the post-policy changes, so the summed error may

result from either increases or decreases from the levels predicted by the synthetic control group. To clarify the post-policy differences observed, the general direction of the post-policy differences observed for each country are indicated by color in the table. Orange indicates a decrease from predicted levels, blue indicates an increase from predicted levels, and no color indicates mixed increases and decreases in the post-policy period. As noted above, the levels of post-policy differences between the U.S. and Synthetic U.S. are well within the observed post-policy differences for the placebo countries. This indicates that the post-policy differences in U.S. wood imports from suspicious producer countries are not only insignificant by our standards, but also unsubstantial when compared to the amount of variability seen in these imports in the placebo tests.

Table 4.3: Post-policy difference (summed MSPE) between each country and its synthetic control for all countries included in Figure 4.12.
Orange = decrease; Blue = increase; White = mixed increases and decreases

Country	Summed Post-policy MSPE	Country	Summed Post-policy MSPE
Colombia	18.89	Netherlands	0.69
Indonesia	15.91	Malaysia	0.62
Brazil	15.83	Romania	0.59
Peru	15.16	Canada	0.56
Russia	13.94	Austria	0.52
Panama	11.53	Thailand	0.46
Sri Lanka	8.24	Poland	0.44
India	5.00	Denmark	0.43
Croatia	4.84	Turkey	0.39
Malta	4.07	Cyprus	0.38
Costa Rica	3.81	United Kingdom	0.33
Guatemala	3.65	China	0.30
Slovakia	3.17	Italy	0.29
Uruguay	2.77	Hungary	0.29
Lithuania	2.21	South Korea	0.27
Greece	2.06	France	0.27
Switzerland	1.97	New Zealand	0.18
Spain	1.97	South Africa	0.14
Iceland	1.95	**United States**	**0.13**
Slovenia	1.80	Estonia	0.12
Ireland	1.44	Jordan	0.12
Singapore	1.34	Taiwan	0.09
Morocco	1.12	Sweden	0.07
Portugal	0.92	Belgium	0.04
Norway	0.78	Germany	0.04
Australia	0.74	Mexico	0.03
Finland	0.70	Japan	0.02
Czech Republic	0.69		

Analysis 1B: Wood Furniture Imports (HS 9403) from Suspicious Producer Countries

We next apply this analysis to U.S. wood furniture imports. The results of this analysis are shown in Tables 4.4 and 4.5, as well as Figures 4.13 through 4.16.

We see that U.S. imports of wood furniture from suspicious producer countries increased steadily over the entire period analyzed (Fig. 4.13). Although for a short time U.S. imports were below those predicted by the Synthetic U.S., the post-policy wood

furniture imports from suspicious producer countries are generally higher than those predicted by the Synthetic U.S (Fig. 4.14).

Not surprisingly, our placebo tests show that the post-policy differences between the U.S. and the Synthetic U.S. are not significantly different from those seen with a random assignment of the policy to any country in the donor pool (Figs 4.15 and 4.16).

Table 4.4: Country weights for Synthetic U.S. for Analysis 1B

Country	Weight	Country	Weight	Country	Weight
Algeria	0.005	Hong Kong	0.011	Philippines	0.011
Argentina	0.006	Hungary	0.134	Poland	0.134
Australia	0.011	Iceland	0.01	Portugal	0.01
Austria	0.009	India	0.006	Romania	0.006
Belgium	0.011	Indonesia	0.009	Russia	0.009
Brazil	0.009	Ireland	0.01	Serbia	0.01
Bulgaria	0.003	Italy	0.01	Singapore	0.01
Canada	0.009	Japan	0.1	Slovakia	0.1
Chile	0.007	Jordan	0.01	Slovenia	0.01
China	0.005	Latvia	0.006	South Africa	0.006
Colombia	0.004	Lithuania	0.004	South Korea	0.004
Costa Rica	0.009	Luxembourg	0.006	Spain	0.006
Croatia	0.017	Malaysia	0.009	Sri Lanka	0.009
Cyprus	0.007	Malta	0.012	Sweden	0.012
Czech Republic	0.007	Mexico	0.008	Switzerland	0.008
Denmark	0.1	Morocco	0.047	Taiwan	0.047
Ecuador	0.017	Netherlands	0.014	Thailand	0.014
Estonia	0.006	New Zealand	0.012	Turkey	0.012
Finland	0.009	Norway	0.014	Ukraine	0.014
France	0.012	Panama	0.014	United Kingdom	0.014
Germany	0.02	Paraguay	0.008	Uruguay	0.008
Greece	0.007	Peru	0.006	Venezuela	0.006
Guatemala	0.036				

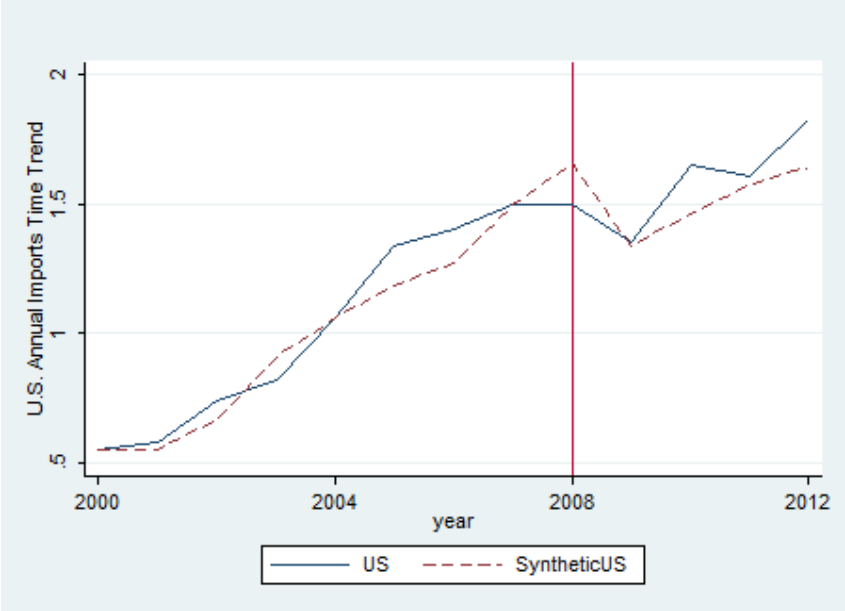

Figure 4.13: Trends in U.S. imports of wood furniture (HS 9403) from suspicious producer countries: Synthetic U.S. and U.S.

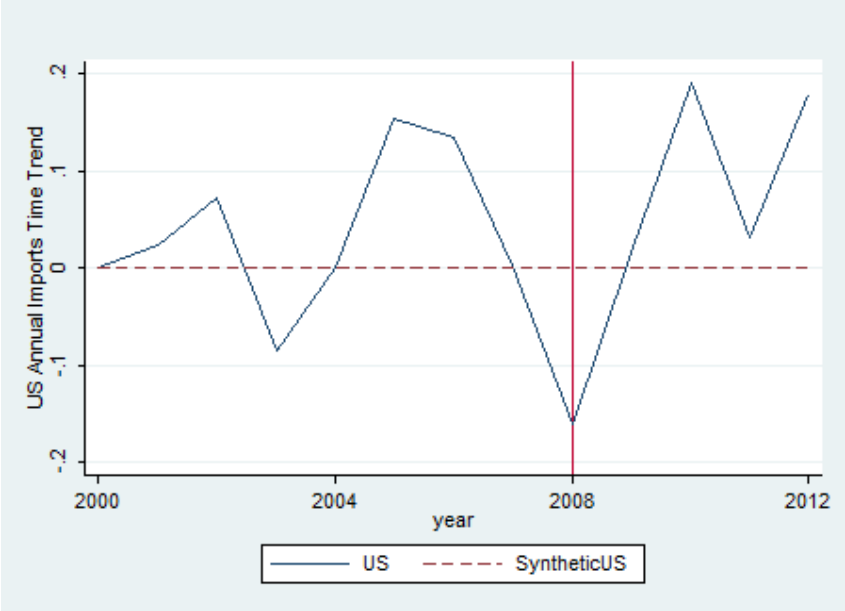

Figure 4.14: Differences in wood furniture imports from suspicious producer countries between the Synthetic U.S. and the U.S.

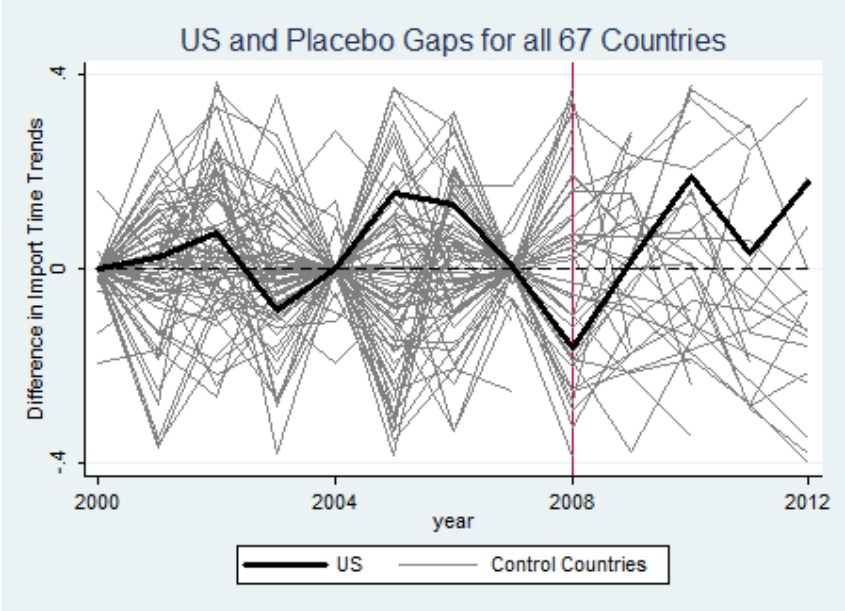

Figure 4.15: Gap in U.S. wood furniture imports from suspicious producer countries and placebo gaps for all 67 control countries.

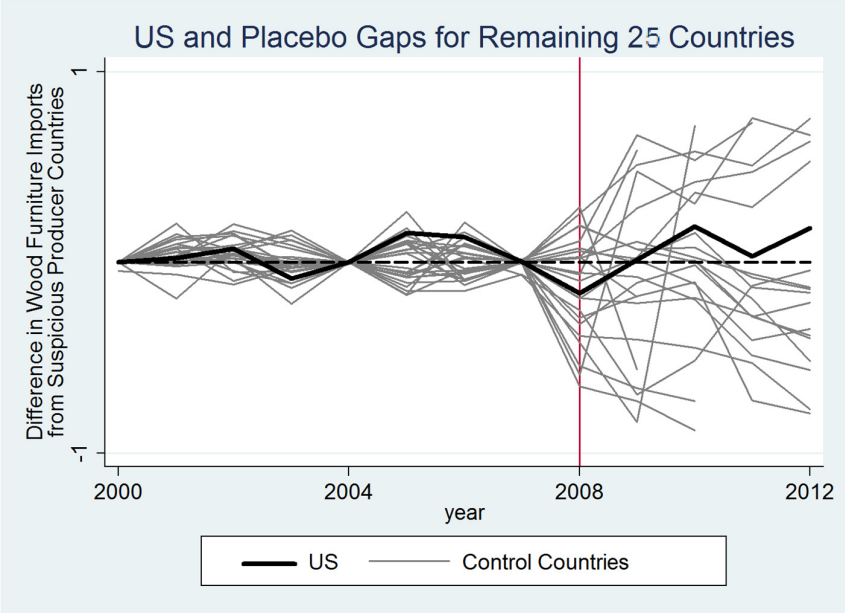

Figure 4.16: Gap in U.S. wood furniture imports from suspicious producer countries and placebo gaps for 25 control countries (discards countries with pre-2008 MSPE two times higher than the U.S.').

Table 4.5 shows the post-policy differences for the U.S. and placebo countries observed in Figure 4.16. The post-policy increase observed in U.S. imports of wood furniture from suspicious producer countries appears to be well below the more extreme post-policy

differences observed in the placebo countries. As a result, these post-policy differences appear to be unsubstantial, as well as insignificant by the more stringent standards of the analysis.

Table 4.5: Post-policy difference (summed MSPE) between each country and its synthetic control for all countries included in Figure 4.16.
Orange = decrease; Blue = increase; White = mixed increases and decreases

Country	Summed Post-policy MSPE	Country	Summed Post-policy MSPE
Peru	93.32	Australia	0.88
Lithuania	59.91	Guatemala	0.76
Colombia	45.88	France	0.60
Russia	18.90	Canada	0.50
India	14.53	Sweden	0.32
Slovakia	10.55	Italy	0.31
Portugal	6.63	United Kingdom	0.30
Spain	3.87	Netherlands	0.23
Taiwan	2.53	Norway	0.14
Japan	1.42	**United States**	**0.07**
Austria	1.34	Belgium	0.07
Denmark	1.23	Finland	0.04
Greece	1.19	Germany	0.03

Analysis 1C: Hardwood Product Imports from Suspicious Producer Countries

The results of the analysis of U.S. hardwood product imports are shown in Table 4.6 and Figures 4.17 through 4.19.

U.S. hardwood imports from suspicious producer countries dropped steeply from 2007 through 2009, and remained low throughout the post-policy period (Fig. 4.17). However, the U.S. and Synthetic U.S. are matched very well throughout the entire time period analyzed (Fig. 4.18). Further analysis of the placebo tests is unnecessary in this case, as we see almost no differences between U.S. imports and those predicted by the Synthetic U.S. in the post-policy period (Fig. 4.19). Furthermore, by the year 2012 U.S. hardwood product imports from suspicious producer countries are almost identical to the levels

predicted by the Synthetic U.S. (Table 4.1 and Fig. 4.18), indicating that the policy did not appear to affect U.S. imports of hardwood products from suspicious producer countries.

Table 4.6: Country weights in the Synthetic U.S. for Analysis 1C

Country	Weight	Country	Weight	Country	Weight
Algeria	0.118	Hong Kong	0	Philippines	0.001
Argentina	0.058	Hungary	0.007	Poland	0.002
Australia	0.003	Iceland	0.005	Portugal	0.004
Austria	0.002	India	0.002	Romania	0.008
Belgium	0.004	Indonesia	0.001	Russia	0.001
Brazil	0.001	Ireland	0.223	Serbia	0
Bulgaria	0.04	Italy	0.002	Singapore	0.002
Canada	0.004	Japan	0.016	Slovakia	0.001
Chile	0.002	Jordan	0.001	Slovenia	0.005
China	0.002	Latvia	0.001	South Africa	0.001
Colombia	0.414	Lithuania	0.002	South Korea	0.002
Costa Rica	0.001	Luxembourg	0.001	Spain	0.002
Croatia	0.001	Malaysia	0.002	Sri Lanka	0.002
Cyprus	0.003	Malta	0.001	Sweden	0.002
Czech Republic	0.002	Mexico	0.002	Switzerland	0.003
Denmark	0.002	Morocco	0.001	Taiwan	0.003
Ecuador	0	Netherlands	0.002	Thailand	0.003
Estonia	0.001	New Zealand	0.001	Turkey	0.003
Finland	0.002	Norway	0.005	Ukraine	0
France	0.002	Panama	0.001	United Kingdom	0.01
Germany	0.002	Paraguay	0.002	Uruguay	0.001
Greece	0.002	Peru	0.001	Venezuela	0.001
Guatemala	0.001				

Figure 4.17: Trends in U.S. imports of hardwood products from suspicious producer countries: Synthetic U.S. and U.S.

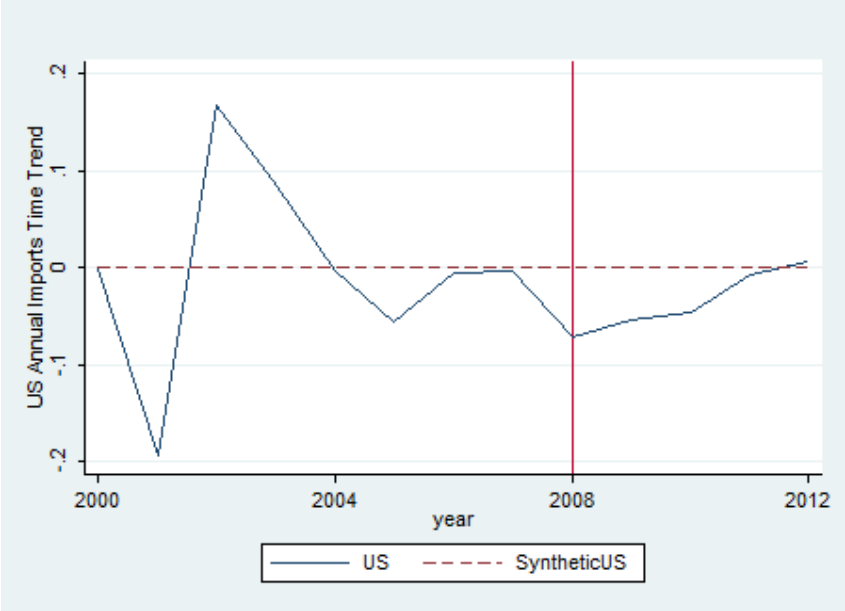

Figure 4.18: Differences in hardwood product imports from suspicious producer countries between the Synthetic U.S. and the U.S.

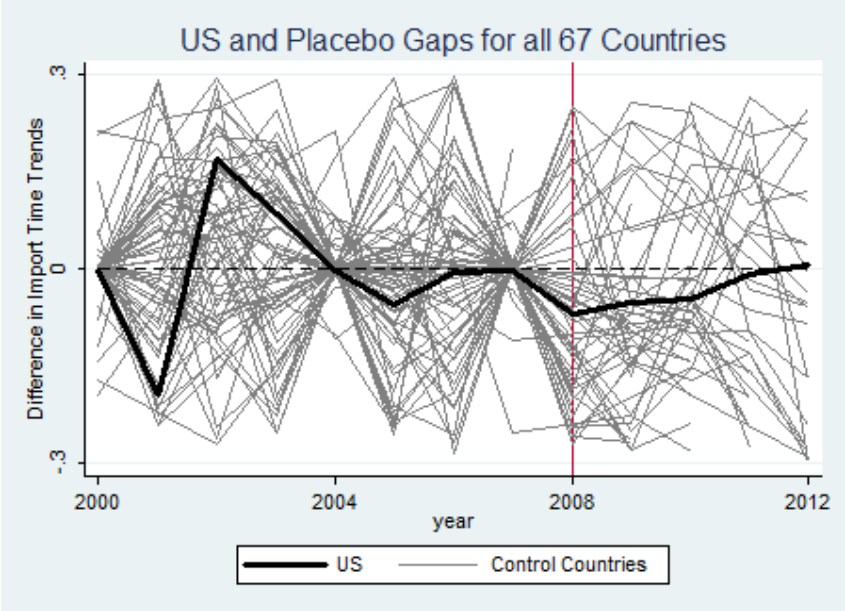

Figure 4.19: Gap in U.S. hardwood imports from suspicious producer countries and placebo gaps for all 67 control countries.

Analysis 1D: Tropical Wood Product Imports from Suspicious Producer Countries

Tables 4.7 and 4.8 and Figures 4.20 through 4.24 show the results of the analysis of U.S. imports of tropical wood products.

U.S. imports of tropical wood products from suspicious producer countries dropped around 2008 and remained well below the pre-treatment average for the entire post-policy period (Fig. 4.20). Compared with the Synthetic U.S., U.S. imports of tropical wood products from these countries were substantially lower than predicted in the post-policy period (Fig. 4.21), with 2012 normalized import levels around 150% lower than those predicted by the Synthetic U.S (see Table 4.1).

Table 4.7: Country weights in the Synthetic U.S. for Analysis 1D

Country	Weight	Country	Weight	Country	Weight
Algeria	0.013	Hong Kong	0.015	Philippines	0.011
Argentina	0.018	Hungary	0.009	Poland	0.017
Australia	0.012	Iceland	0.027	Portugal	0.015
Austria	0.011	India	0.013	Romania	0.013
Belgium	0.013	Indonesia	0.01	Russia	0.01
Brazil	0.006	Ireland	0.021	Serbia	0.007
Bulgaria	0.012	Italy	0.015	Singapore	0.01
Canada	0.014	Japan	0.021	Slovakia	0.009
Chile	0.014	Jordan	0.011	Slovenia	0.05
China	0.013	Latvia	0.008	South Africa	0.022
Colombia	0.15	Lithuania	0.006	South Korea	0.012
Costa Rica	0.013	Luxembourg	0.009	Spain	0.013
Croatia	0.009	Malaysia	0.018	Sri Lanka	0.013
Cyprus	0.01	Malta	0.011	Sweden	0.011
Czech Republic	0.013	Mexico	0.015	Switzerland	0.013
Denmark	0.012	Morocco	0.011	Taiwan	0.016
Ecuador	0.006	Netherlands	0.012	Thailand	0.012
Estonia	0.01	New Zealand	0.011	Turkey	0.013
Finland	0.011	Norway	0.011	Ukraine	0.009
France	0.013	Panama	0.011	United Kingdom	0.013
Germany	0.013	Paraguay	0.009	Uruguay	0.009
Greece	0.012	Peru	0.012	Venezuela	0.011
Guatemala	0.01				

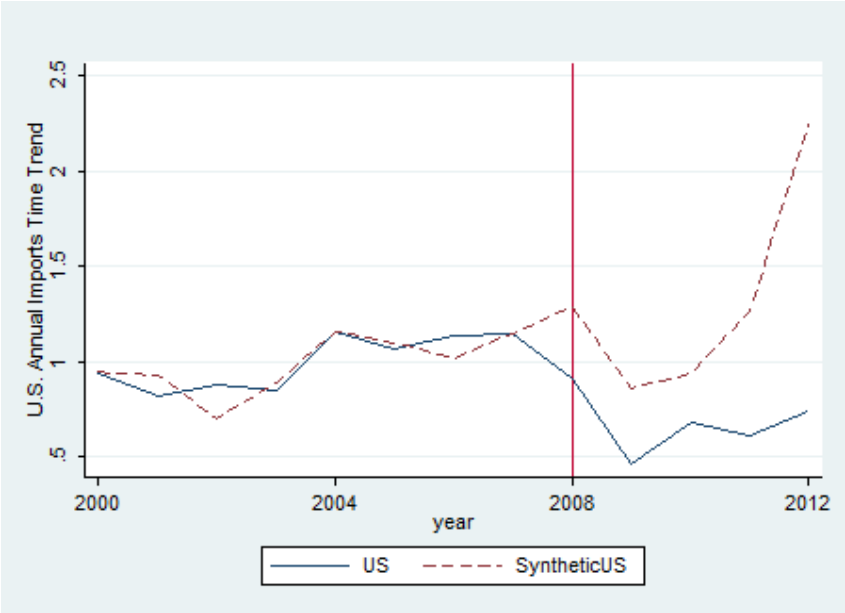

Figure 4.20: Trends in U.S. imports of tropical wood products from suspicious producer countries: Synthetic U.S. and U.S.

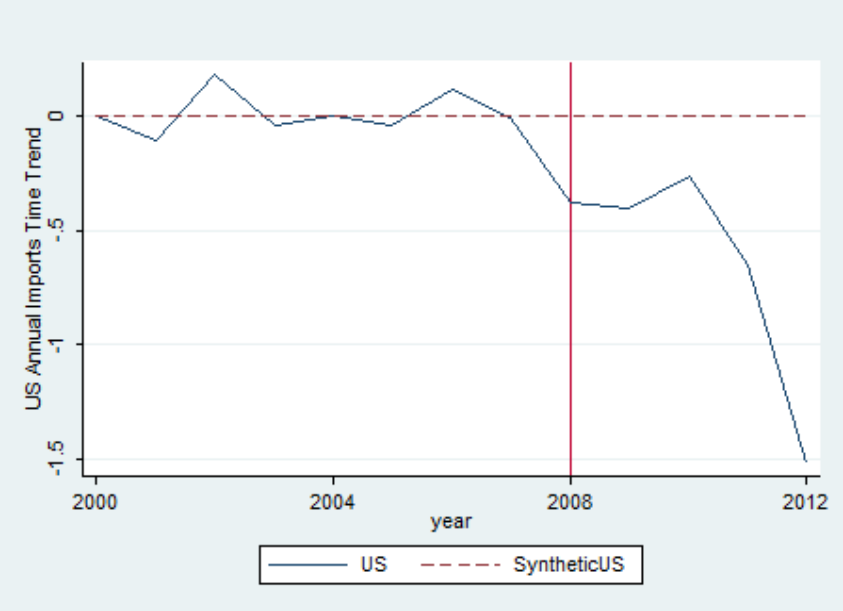

Figure 4.21: Differences in tropical wood product imports from suspicious producer countries between the Synthetic U.S. and the U.S.

The placebo tests show the difference in U.S. imports of tropical wood products from suspicious producer countries to be rather large in comparison (Fig. 4.22). However, even after removing countries with poor pre-treatment fits, the U.S. is not an outlier in the post-policy period, with several other placebo countries showing larger differences from their synthetic control groups over the course of the post-policy period. While post-treatment U.S. imports of tropical wood products from suspicious producer countries were substantially below the levels predicted by the Synthetic U.S., those differences were comparable to the post-treatment differences observed for various placebo countries for which we have no expectation of effects from the policy. Overall, the post-policy differences are not significant by the standards of this analysis.

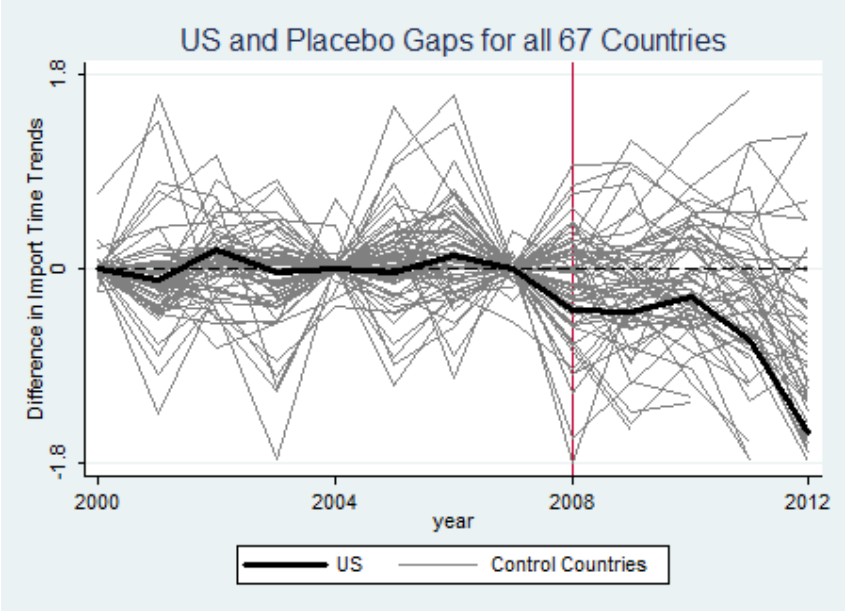

Figure 4.22: Gap in U.S. tropical wood product imports from suspicious producer countries placebo gaps for all 67 control countries.

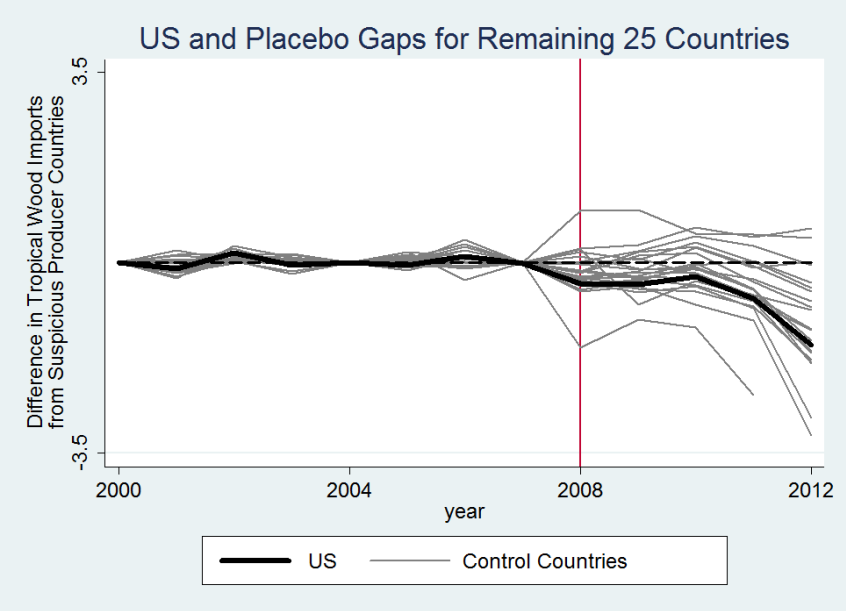

Figure 4.23: Gap in U.S. tropical wood imports from suspicious producer countries and placebo gaps for 25 control countries (discards countries with pre-2008 MSPE two times higher than the U.S.').

Table 4.8 shows the post-policy differences for the U.S. and all placebo countries included in Figure 4.23. While the post-policy reduction in tropical wood imports from suspicious producer countries between the U.S. and Synthetic U.S. is substantial and

trending in the direction we predict to result from the policy in the year 2012 (Table 4.1 and Fig. 4.20), Table 4.8 shows that there are greater post-policy differences observed in several of the placebo countries. Overall, Table 4.8 leads us to conclude that there is much variability in the imports of tropical wood products from suspicious producer countries in the countries analyzed, and that during the post-policy period various countries experienced dramatic decreases in these imports as compared to the levels predicted by their synthetic control groups.

Table 4.8: Post-policy difference (summed MSPE) between each country and its synthetic control for all countries included in Figure 4.23.
Orange = decrease; Blue = increase; White = mixed increases and decreases

Country	Summed Post-policy MSPE	Country	Summed Post-policy MSPE
Sweden	21.50	Venezuela	2.29
Turkey	12.68	Greece	2.08
Ireland	11.97	France	1.93
Portugal	9.29	Chile	1.72
Spain	4.31	Italy	1.26
Canada	4.11	South Africa	1.16
Finland	3.84	South Korea	0.83
Uruguay	3.78	Mexico	0.60
Germany	3.75	Australia	0.41
United States	**2.96**	China	0.38
United Kingdom	2.94	Taiwan	0.37
Denmark	2.87	Belgium	0.25
Netherlands	2.31	Thailand	0.11

U.S. Imports from Suspicious Processing Countries

The next portion of the analysis focuses on U.S. imports of the same four product groups from suspicious processing countries.

Analysis 1E: Total Wood Product Imports (HS 44) from Suspicious Processing Countries

Tables 4.9 and 4.10 and Figures 4.24 through 4.27 show the results of the analysis of U.S. imports of wood products (HS 44).

U.S. imports of wood products from suspicious processing countries rose rapidly in the pre-treatment period, slowing from 2007 through 2009 (the worst years of the housing crisis and economic recession), then regaining growth in the latter part of the post-treatment period (Fig. 4.24). However, growth in U.S. wood products imports from these countries did not rise as quickly as predicted by the Synthetic U.S. in the post-policy period (Fig. 4.25).

The placebo tests show that the post-treatment differences between the U.S. and the Synthetic U.S. are insignificant when compared with other placebo countries in the post-treatment period (Figs. 4.26 and 4.27). In other words, U.S. imports of all wood products (HS 44) do not appear to have been significantly affected by the 2008 policy according to this analysis.

Table 4.9: Country weights for the Synthetic U.S. for Analysis 1E

Country	Weight	Country	Weight	Country	Weight
Algeria	0.001	Hong Kong	0.212	Philippines	0.001
Argentina	0.001	Hungary	0.126	Poland	0.002
Australia	0.011	Iceland	0.004	Portugal	0.004
Austria	0.002	India	0.001	Romania	0
Belgium	0.002	Indonesia	0.003	Russia	0.001
Brazil	0.001	Ireland	0.005	Serbia	0.001
Bulgaria	0.001	Italy	0.003	Singapore	0.005
Canada	0.007	Japan	0.06	Slovakia	0.002
Chile	0.005	Jordan	0.003	Slovenia	0.001
China	0.003	Latvia	0.001	South Africa	0.003
Colombia	0.001	Lithuania	0.002	South Korea	0.004
Costa Rica	0.005	Luxembourg	0	Spain	0.004
Croatia	0.002	Malaysia	0.005	Sri Lanka	0.007
Cyprus	0.003	Malta	0.002	Sweden	0.003
Czech Republic	0.006	Mexico	0.23	Switzerland	0.003
Denmark	0.008	Morocco	0	Taiwan	0.005
Ecuador	0	Netherlands	0.004	Thailand	0.004
Estonia	0.001	New Zealand	0.009	Turkey	0.001
Finland	0.002	Norway	0.006	Ukraine	0.001
France	0.003	Panama	0.089	United Kingdom	0.006
Germany	0.003	Paraguay	0.003	Uruguay	0.001
Greece	0.004	Peru	0.002	Venezuela	0.002
Guatemala	0.095				

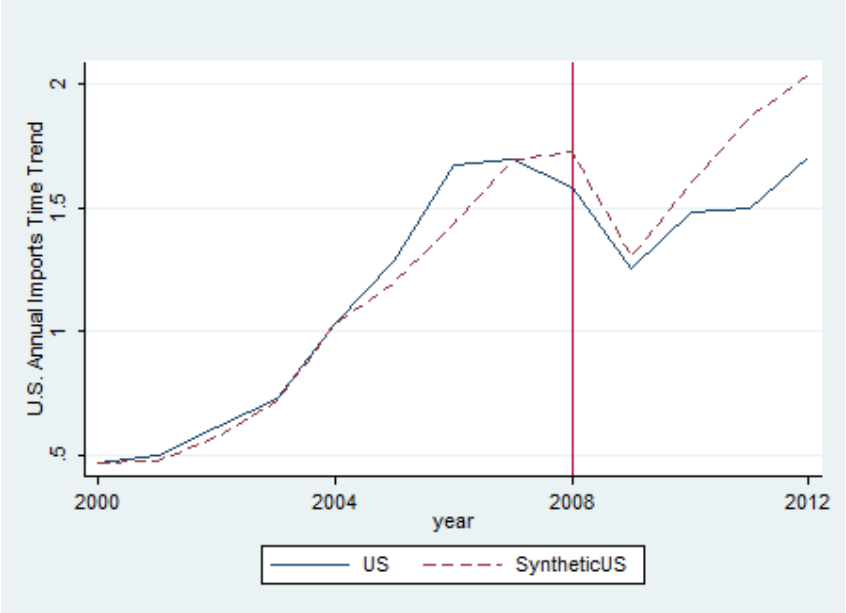

Figure 4.24: Trends in U.S. imports of wood and wood products (HS 44) from suspicious processing countries: Synthetic U.S. and U.S.

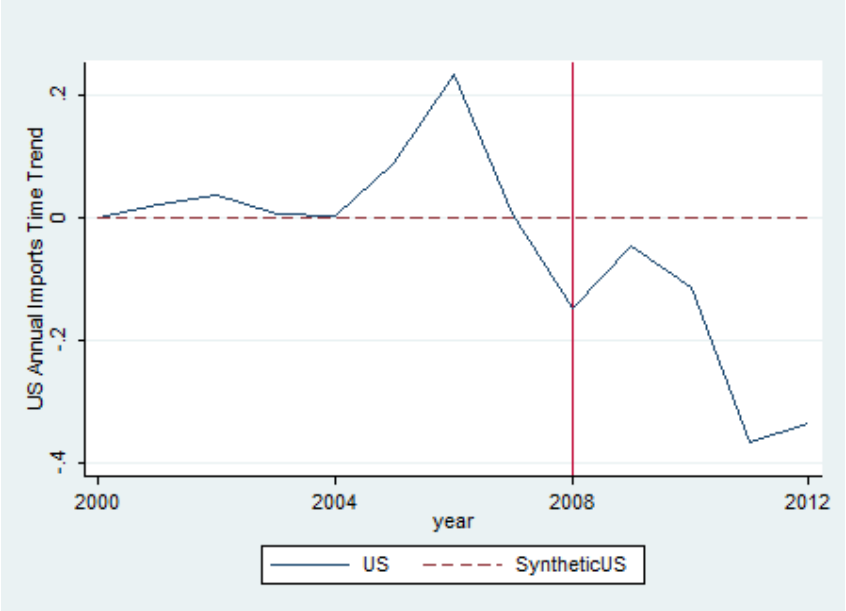

Figure 4.25: Differences in total wood imports from suspicious processing countries between the Synthetic U.S. and the U.S.

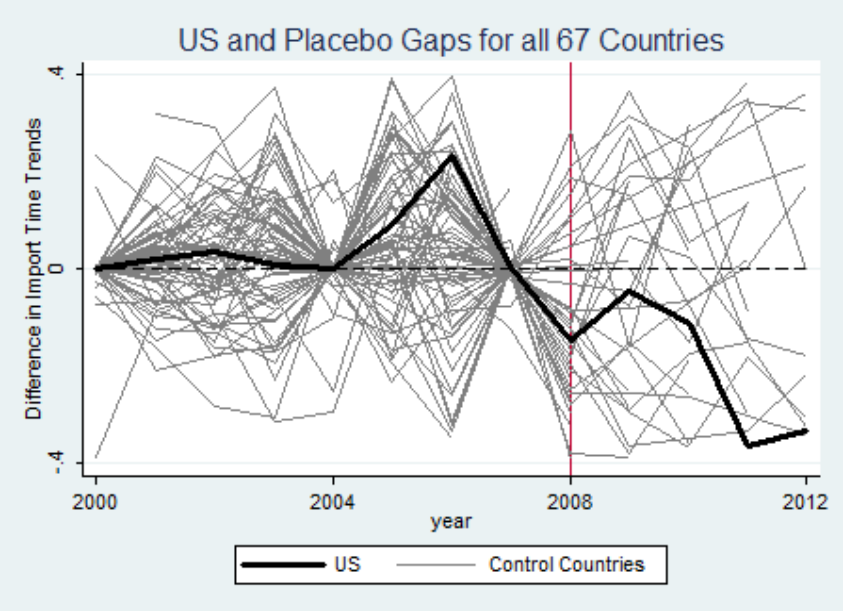

Figure 4.26: Gap in U.S. total wood imports from suspicious processing countries and placebo gaps for all 67 control countries.

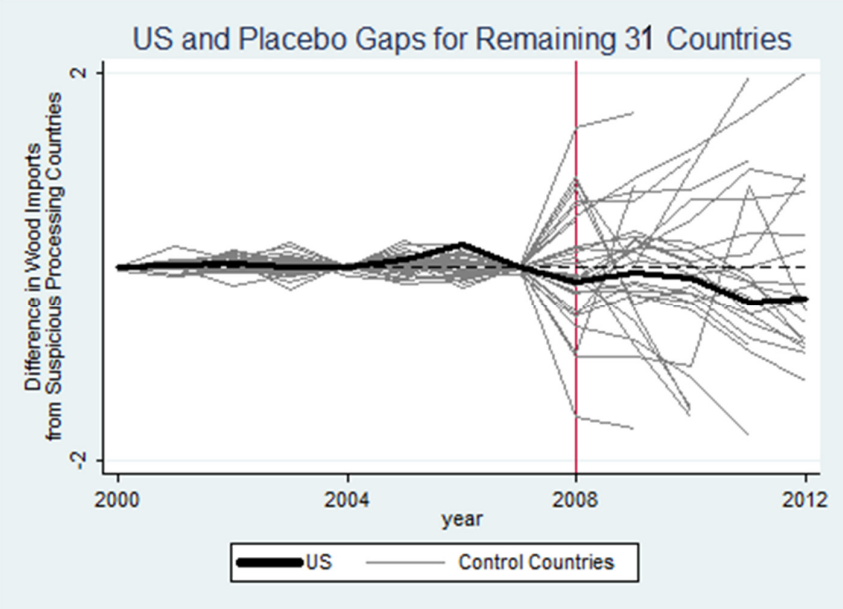

Figure 4.27: Gap in U.S. total wood product imports (HS 44) from suspicious processing countries and placebo gaps for 31 control countries (discards countries with pre-2008 MSPE two times higher than the U.S.').

Table 4.10 shows the post-policy differences for the countries included in Figure 4.27. In this case, U.S. imports wood imports from suspicious processing countries decreased only slightly from the post-policy levels predicted by the Synthetic U.S. when compared with the post-policy differences seen in many of the placebo countries. This leads to the

conclusion that the 2008 policy is having little to no effect on U.S. imports of all wood products from suspicious processing countries.

Table 4.10: Post-policy difference (summed MSPE) between each country and its synthetic control for all countries included in Figure 4.27.
Orange = decrease; Blue = increase; White = mixed increases and decreases

Country	Summed Post-policy MSPE	Country	Summed Post-policy MSPE
Brazil	95.45	Denmark	2.45
Uruguay	93.11	Thailand	2.08
Peru	86.50	Malaysia	1.60
Ukraine	78.33	Canada	1.41
Colombia	37.64	Finland	1.14
Slovakia	31.94	Panama	1.04
Ireland	31.44	France	1.02
Cyprus	22.66	Italy	0.84
Chile	16.86	Netherlands	0.70
Austria	15.67	Germany	0.51
Indonesia	15.43	Sweden	0.49
Greece	14.93	Japan	0.29
Spain	9.99	South Korea	0.29
Australia	8.84	**United States**	**0.26**
Switzerland	8.64	United Kingdom	0.06
China	2.79	New Zealand	0.04

Analysis 1F: Wood Furniture Imports (HS 9403) from Suspicious Processing Countries

The results of the analysis of U.S. wood furniture imports from suspicious processing countries are shown in Tables 4.11 and 4.12 and Figures 4.28 through 4.31.

Similar to total wood imports, U.S. wood furniture imports from suspicious processing countries rose until around 2007, at which point they slowed through 2009, then rebounded (Fig. 4.28). After 2009, observed post-policy import levels in the U.S. were higher than those predicted by the Synthetic U.S. (Fig. 4.29).

Table 4.11: Country weights for the Synthetic U.S. for Analysis 1F

Country	Weight	Country	Weight	Country	Weight
Algeria	0	Hong Kong	0.123	Philippines	0.001
Argentina	0	Hungary	0.42	Poland	0
Australia	0.001	Iceland	0.001	Portugal	0
Austria	0	India	0	Romania	0
Belgium	0.001	Indonesia	0.001	Russia	0
Brazil	0	Ireland	0	Serbia	0
Bulgaria	0	Italy	0.001	Singapore	0
Canada	0.001	Japan	0.322	Slovakia	0
Chile	0	Jordan	0.001	Slovenia	0.001
China	0.001	Latvia	0	South Africa	0
Colombia	0	Lithuania	0	South Korea	0.001
Costa Rica	0	Luxembourg	0.001	Spain	0.001
Croatia	0.001	Malaysia	0	Sri Lanka	0.001
Cyprus	0	Malta	0.001	Sweden	0.001
Czech Republic	0	Mexico	0.001	Switzerland	0.001
Denmark	0.001	Morocco	0.001	Taiwan	0.001
Ecuador	0.033	Netherlands	0.001	Thailand	0.001
Estonia	0	New Zealand	0.001	Turkey	0.001
Finland	0.001	Norway	0.001	Ukraine	0.001
France	0.001	Panama	0.001	United Kingdom	0.001
Germany	0.001	Paraguay	0.001	Uruguay	0.001
Greece	0.001	Peru	0	Venezuela	0.001
Guatemala	0.066				

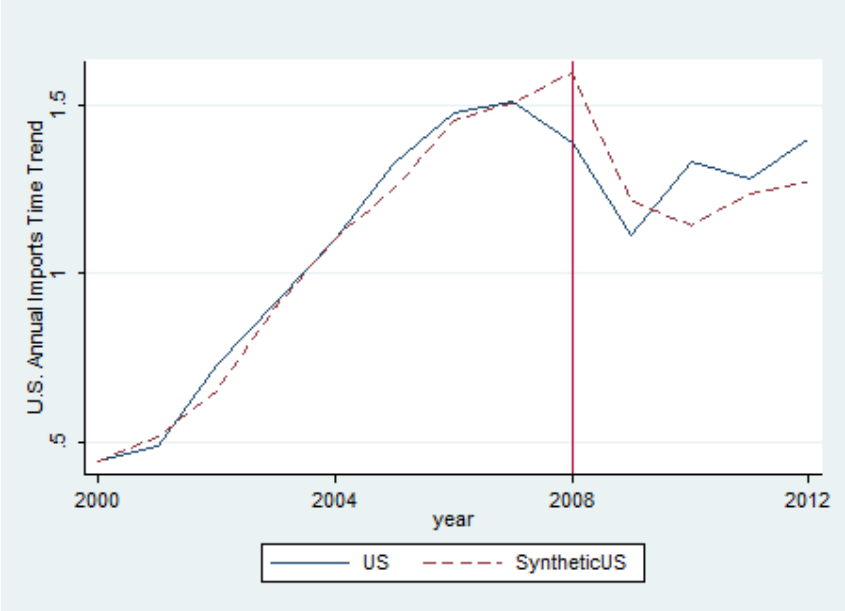

Figure 4.28: Trends in U.S. imports of wood furniture (HS 9403) from suspicious processing countries: Synthetic U.S. and U.S.

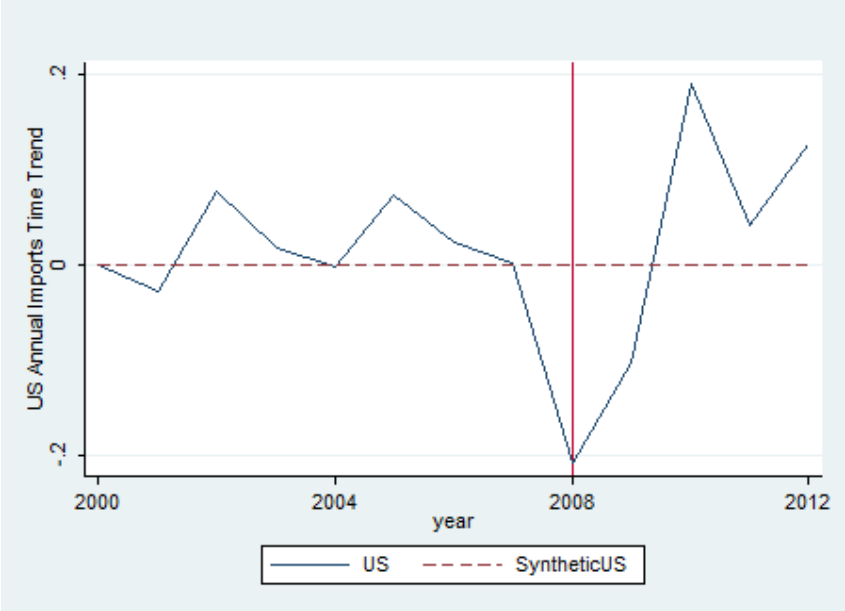

Figure 4.29: Differences in wood furniture imports from suspicious processing countries between the Synthetic U.S. and the U.S.

The placebo tests (Fig. 4.30) show that the pre-policy fit between the U.S. and the Synthetic U.S. is better than that of most of the other countries analyzed. In Fig. 4.31 we see that only 11 other countries had pre-treatment MSPE less than two times that of the U.S. Comparing U.S. post-policy differences to only 11 placebo countries does not allow for the establishment of significance at a conventional level (19 comparison countries are required to establish 95% confidence in the significance of the post-policy differences observed for the treatment country). However, we can see from Figure 4.31 that even this small set of countries includes a number of countries with larger differences from their synthetic controls in the post-treatment period. As a result, the differences between the U.S. and Synthetic U.S. are deemed insignificant, making further probing of this result unnecessary.

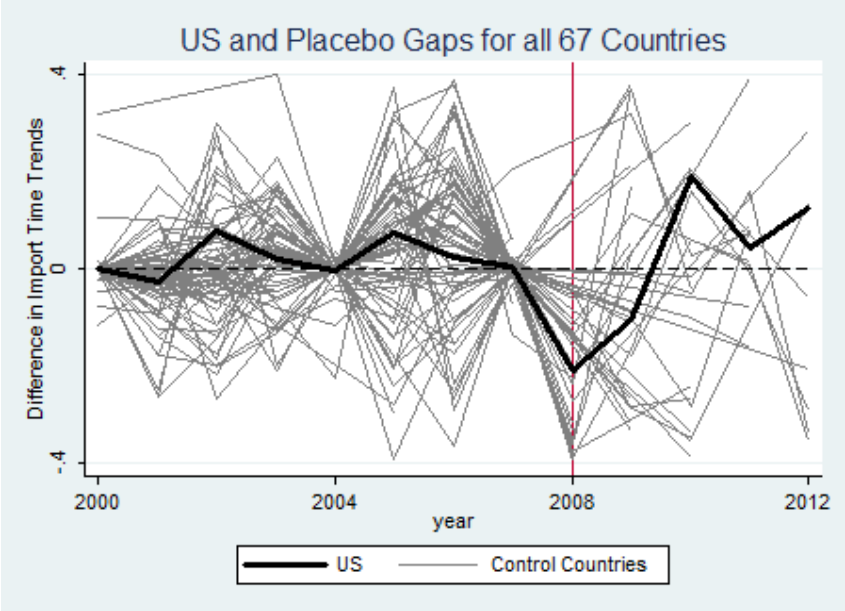

Figure 4.30: Gap in U.S. wood furniture imports from suspicious processing countries and placebo gaps for all 67 control countries.

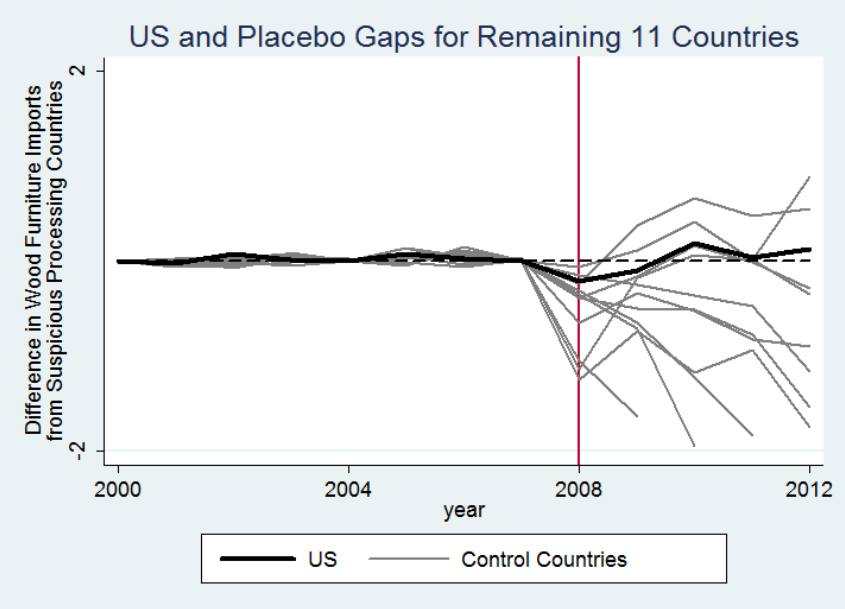

Figure 4.31: Gap in U.S. wood furniture imports (HS 9403) from suspicious processing countries and placebo gaps for 11 control countries (discards countries with pre-2008 MSPE two times higher than the U.S.').

Table 4.12 shows that the post-policy differences observed for U.S. imports of wood furniture from suspicious processing countries are quite small relative to those seen in the placebo countries. In general, post-policy U.S. imports of wood furniture are very similar to those predicted by the Synthetic U.S., indicating that the policy does not appear to be affecting these import levels.

Table 4.12: Post-policy difference (summed MSPE) between each country and its synthetic control for all countries included in Figure 4.31.
Orange = decrease; Blue = increase; White = mixed increases and decreases

Country	Summed Post-Policy MSPE
Croatia	26.39
Ireland	22.19
Finland	10.63
Czech Republic	5.81
Sweden	3.44
United Kingdom	1.85
Italy	1.75
Norway	1.10
Romania	0.82
Netherlands	0.31
France	0.14
United States	**0.06**

Analysis 1G: Hardwood Product Imports from Suspicious Processing Countries

Tables 4.13 and 4.14 and Figures 4.32 through 4.35 report the results of the analysis of U.S. hardwood product imports from suspicious processing countries.

U.S. imports of hardwood products from these countries spiked in 2006 and then plummeted in 2007 and remained below average pre-treatment levels for the entire post-treatment period (Fig. 4.32), despite the slight recovery predicted by the Synthetic U.S. in the post-treatment period (Fig 4.33). However, the placebo tests reveal that these post-policy differences in U.S. imports of hardwood products were much smaller than the differences seen in many of the placebo countries, again leading us to judge the post-policy changes in U.S. import levels to be insignificant (Figs. 4.34 and 4.35).

Table 4.13: Country weights in the Synthetic U.S. for Analysis 1G

Country	Weight	Country	Weight	Country	Weight
Algeria	0.003	Hong Kong	0.129	Philippines	0.005
Argentina	0.002	Hungary	0.004	Poland	0.002
Australia	0.003	Iceland	0.003	Portugal	0.007
Austria	0.003	India	0.002	Romania	0.003
Belgium	0.009	Indonesia	0.004	Russia	0.002
Brazil	0.007	Ireland	0.004	Serbia	0.002
Bulgaria	0.004	Italy	0.003	Singapore	0.014
Canada	0.006	Japan	0.006	Slovakia	0.002
Chile	0.009	Jordan	0.003	Slovenia	0.003
China	0.002	Latvia	0.395	South Africa	0.002
Colombia	0.002	Lithuania	0.002	South Korea	0.007
Costa Rica	0.002	Luxembourg	0.197	Spain	0.003
Croatia	0.006	Malaysia	0.003	Sri Lanka	0.007
Cyprus	0.011	Malta	0.003	Sweden	0.003
Czech Republic	0.005	Mexico	0.004	Switzerland	0.003
Denmark	0.005	Morocco	0.002	Taiwan	0.004
Ecuador	0.005	Netherlands	0.005	Thailand	0.003
Estonia	0.007	New Zealand	0.005	Turkey	0.006
Finland	0.002	Norway	0.004	Ukraine	0.002
France	0.005	Panama	0.003	United Kingdom	0.008
Germany	0.006	Paraguay	0.001	Uruguay	0.012
Greece	0.004	Peru	0.002	Venezuela	0.002
Guatemala	0.004				

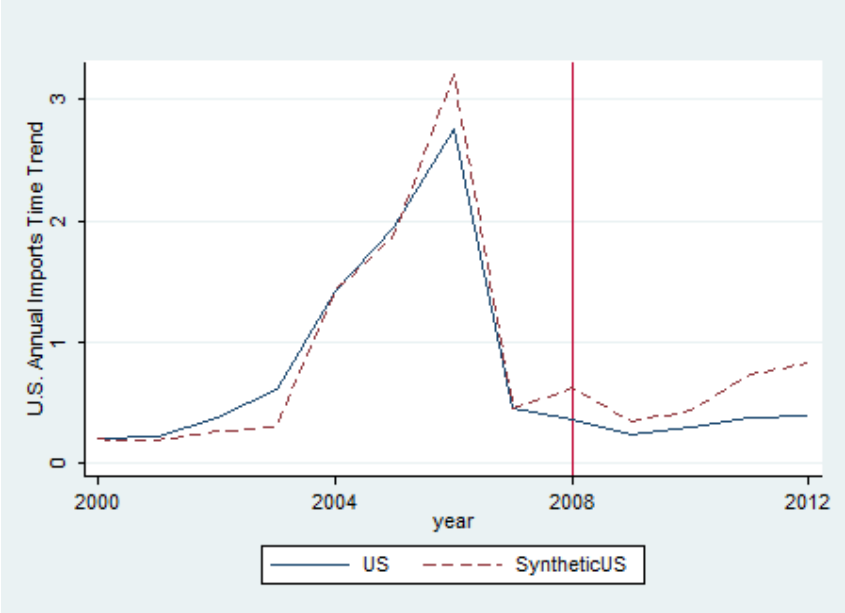

Figure 4.32: Trends in U.S. imports of hardwood products from suspicious processing countries: Synthetic U.S. and U.S.

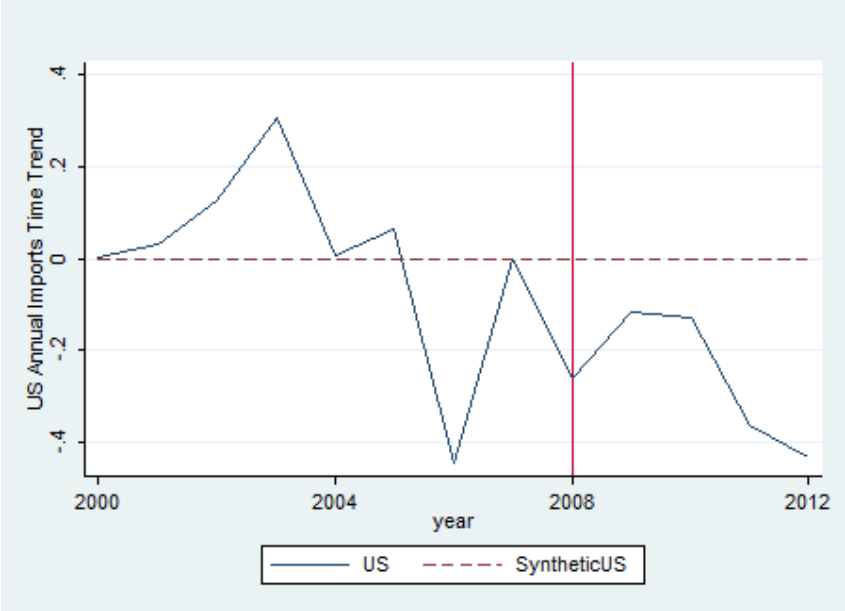

Figure 4.33: Differences in hardwood product imports from suspicious processing countries between the Synthetic U.S. and the U.S.

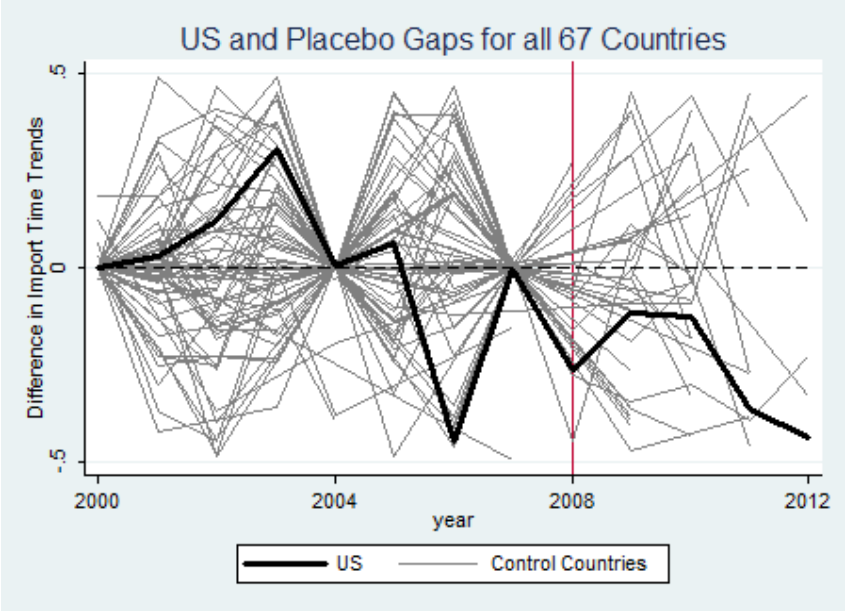

Figure 4.34: Gap in U.S. hardwood product imports from suspicious processing countries and placebo gaps for all 67 control countries.

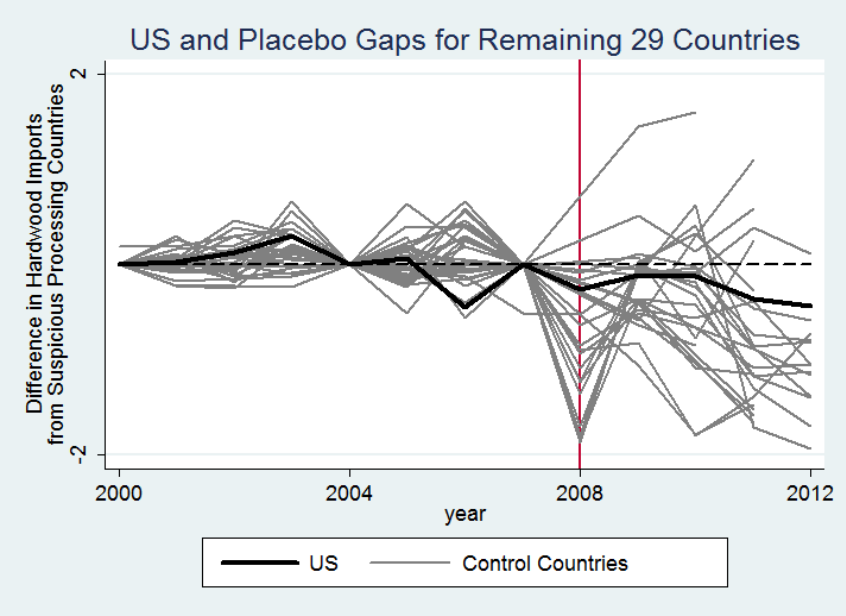

Figure 4.35: Gap in U.S. hardwood product imports from suspicious processing and placebo gaps for 29 control countries (discards countries with pre-2008 MSPE two times higher than the U.S.').

Table 4.14 shows that post-policy decreases in U.S. imports of hardwood products from suspicious processing countries are small when compared with the differences seen in many of the placebo countries. This indicates that there is much variability in these types of imports among the countries analyzed and illustrates our inability to attribute the relatively minor post-policy changes observed for the U.S. to the 2008 policy.

Table 4.14: Post-policy difference (summed MSPE) between each country and its synthetic control for all countries included in Figure 4.35.
Orange = decrease; White = mixed increases and decreases

Country	Summed Post-policy MSPE	Country	Summed Post-policy MSPE
Russia	200.23	Italy	7.96
China	189.42	Hungary	7.06
Colombia	127.30	Jordan	6.38
Finland	106.20	United Kingdom	4.67
Argentina	75.02	France	3.65
Romania	61.18	Sri Lanka	2.97
Malta	38.92	Mexico	2.70
Spain	30.87	Germany	2.68
Poland	28.72	Canada	2.68
Indonesia	19.90	New Zealand	1.78
South Africa	19.41	Singapore	1.56
Greece	13.79	Japan	1.17
Norway	12.50	South Korea	0.57
Denmark	11.44	**United States**	**0.35**
Malaysia	8.27	Hong Kong	0.18

Analysis 1H: Tropical Wood Product Imports from Suspicious Processing Countries

Results for the analysis of tropical wood product imports from suspicious processing countries are shown in Tables 4.15 and 4.16 and Figures 4.36 through 4.39.

U.S. imports of these products from suspicious processing countries rose from 2004 to 2007, then fell and remained below the pre-treatment average import level for the entire pre-treatment period (Fig. 4.36). However, in the post-treatment period the Synthetic U.S. predicted a large surge in imports in 2011, with another large, though reduced, increase predicted for 2012 (Fig. 4.37). As of 2012, U.S. imports of tropical wood products from suspicious processing countries remained over 280% lower than the levels predicted by the Synthetic U.S. (see Table 4.1).

The placebo tests (Figs. 4.38 and 4.39) show that these post-treatment import differences between the U.S. and Synthetic U.S. are quite large in comparison to the

majority of the differences seen in the placebo tests. Table 4.16 quantifies the post-policy differences for the countries included in Figure 4.39 (excluding three countries with no tropical wood imports from suspicious processing countries in either the pre-policy or post-policy periods). However, even in this small group of countries with pre-treatment fit similar to that observed for the U.S., there are four other countries with greater post-treatment differences from their synthetic controls than those observed for the U.S. This leads us to conclude that the post-policy differences between the U.S. and the Synthetic U.S. are not significant (Table 4.16), despite the substantial post-policy differences in U.S. imports observed in the post-policy period. In other words, the 2008 policy may be contributing to suppressed post-policy imports of these tropical wood products in the U.S., but U.S. import reductions are within the range of those seen in placebo countries (Ireland and Spain) during the same time period (Fig. 4.39 and Table 4.16).

Table 4.15: Country weights in the Synthetic U.S. for Analysis 1H

Country	Weight	Country	Weight	Country	Weight
Algeria	0.01	Hong Kong	0.01	Philippines	0.014
Argentina	0.01	Hungary	0.01	Poland	0.012
Australia	0.012	Iceland	0.02	Portugal	0.011
Austria	0.01	India	0.012	Romania	0.009
Belgium	0.012	Indonesia	0.011	Russia	0.011
Brazil	0.005	Ireland	0.012	Serbia	0.01
Bulgaria	0.012	Italy	0.014	Singapore	0.011
Canada	0.013	Japan	0.016	Slovakia	0.009
Chile	0.016	Jordan	0.019	Slovenia	0.008
China	0.012	Latvia	0.077	South Africa	0.012
Colombia	0.012	Lithuania	0.011	South Korea	0.012
Costa Rica	0.02	Luxembourg	0.019	Spain	0.014
Croatia	0.006	Malaysia	0.015	Sri Lanka	0.012
Cyprus	0.01	Malta	0.01	Sweden	0.011
Czech Republic	0.01	Mexico	0.015	Switzerland	0.008
Denmark	0.012	Morocco	0.044	Taiwan	0.012
Ecuador	0.006	Netherlands	0.011	Thailand	0.012
Estonia	0.129	New Zealand	0.013	Turkey	0.009
Finland	0.013	Norway	0.011	Ukraine	0.008
France	0.013	Panama	0.022	United Kingdom	0.013
Germany	0.014	Paraguay	0.008	Uruguay	0.006
Greece	0.013	Peru	0.007	Venezuela	0.011
Guatemala	0.012				

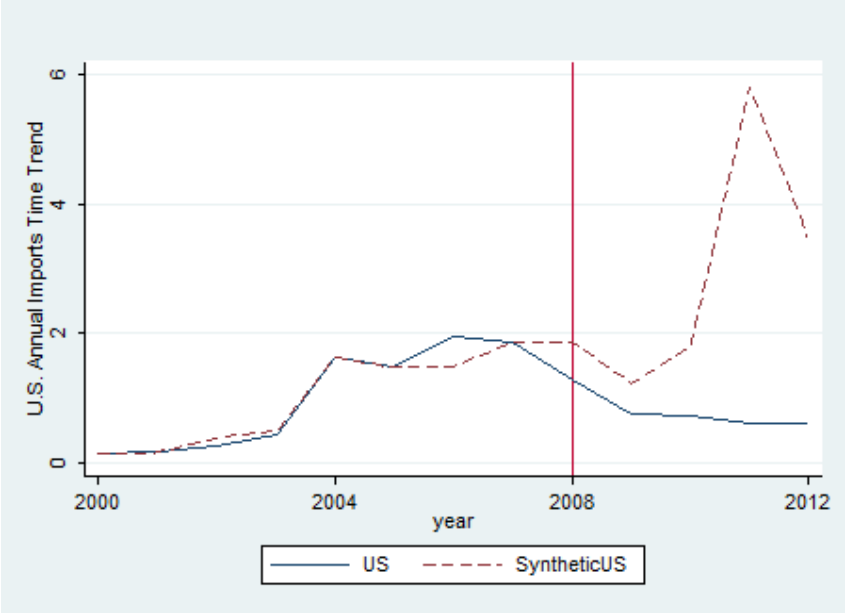

Figure 4.36: Trends in U.S. imports of tropical wood products from suspicious processing countries: Synthetic U.S. and U.S.

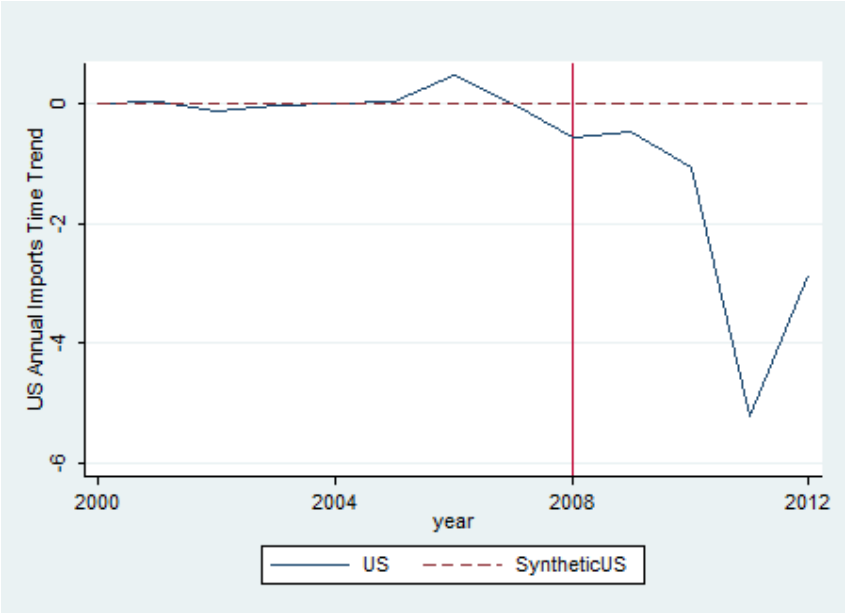

Figure 4.37: Differences in tropical wood product imports from suspicious processing countries between the Synthetic U.S. and the U.S.

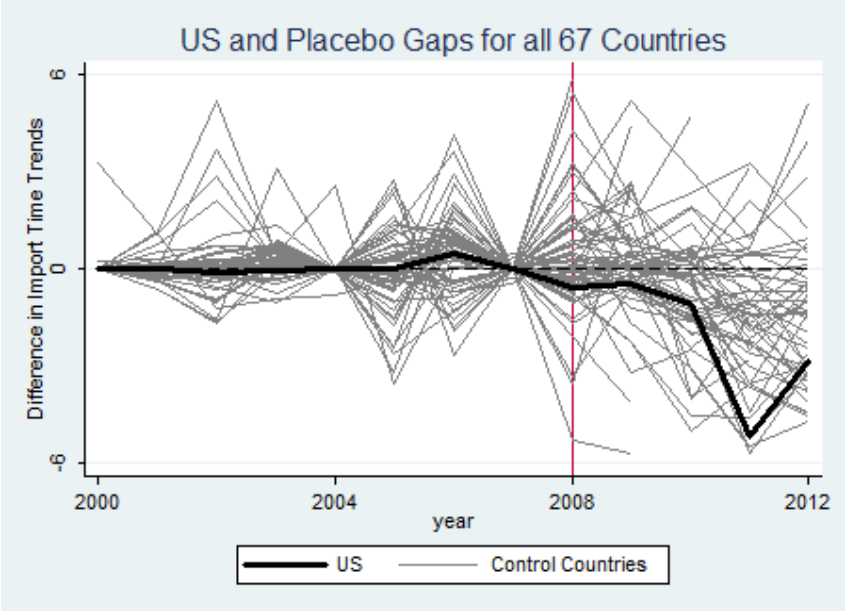

Figure 4.38: Gap in U.S. tropical wood product imports from suspicious processing countries placebo gaps for all 67 control countries.

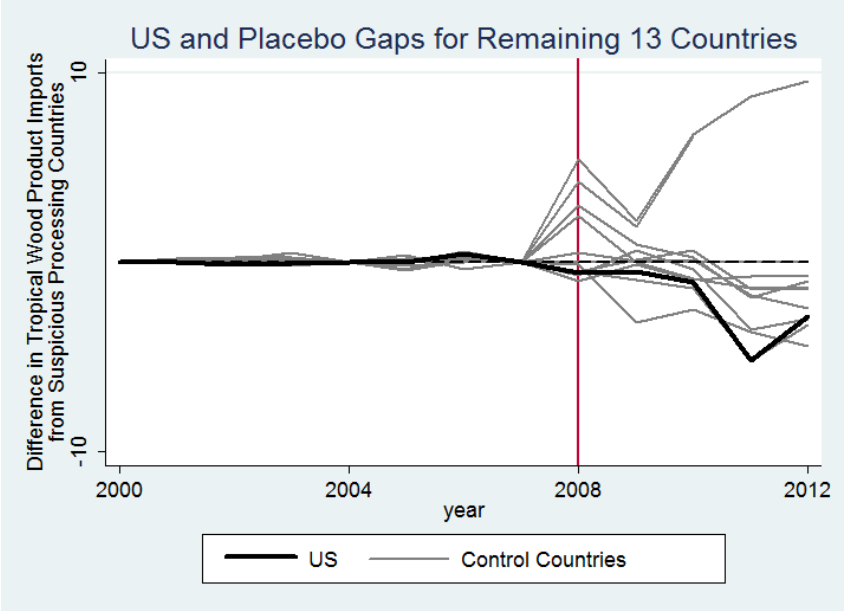

Figure 4.39: Gap in U.S. tropical wood imports from suspicious processing countries and placebo gaps for 13 control countries (discards countries with pre-2008 MSPE two times higher than the U.S.').

Table 4.16: Post-policy difference (summed MSPE) between each country and its synthetic control for all countries included in Figure 4.39.
Orange = decrease; Blue = increase; White = mixed increases and decreases

Country	Summed Post-policy MSPE
India	665.53
Colombia	217.68
Ireland	49.59
Spain	40.23
United States	**36.53**
United Kingdom	21.91
France	9.01
Germany	5.55
Italy	4.50
Canada	4.39
South Korea	1.93

Analysis 2: Third-party Country Imports from Suspicious Producer Countries

Analysis 2 investigated whether importers in suspicious processing countries might be reducing their own imports of primary wood products from suspicious producer countries as a result of efforts to secure the legality of supply chains for wood products that are then exported to the U.S. Imports of primary wood products by major exporters of wood furniture to the U.S (China, Vietnam, and Canada) were analyzed using the same synthetic control group comparative case study methodology employed in the analysis of U.S. imports. However, in each case the third-party country of interest is analyzed as the "treatment" country.

Canada's imports from suspicious producer countries were analyzed, but results for Canada's imports from suspicious producer countries are not shown in detail. Canada differs from Vietnam and China in that it is not a major importer of primary wood products due to its large domestic timber supply. Canadian imports of both hardwood and tropical wood products from suspicious producer countries showed lower post-treatment levels than those predicted by the Synthetic Canada. However, the placebo

tests showed that the differences in Canada's post-treatment hardwood or tropical wood imports were not significant. It should be noted, however, that Canada's imports of tropical wood products from suspicious producer countries were substantially lower than the levels predicted by the Synthetic Canada in the post-policy period. In 2012, these imports were 180% below the levels predicted by the Synthetic Canada, leading us to conclude that the policy may be having some effect on Canadian imports, although the differences observed are within the range of those seen in other placebo countries over the same time period.

Figures 4.40 through 4.56 and Tables 4.17 through 4.20 show the results of Analysis 2 for China and Vietnam. All country weights for the synthetic control groups in these analyses can be found in Appendix E.

Analysis 2A: Third-party Country Hardwood Imports from Suspicious Producer Countries

China's Hardwood Imports

Figures 4.40 through 4.43 and Table 4.17 show the results of the analysis of China's imports of hardwood products from suspicious producer countries. China's hardwood imports from these countries show the now-familiar trend of pre-treatment growth, slowing from 2007 to 2009, and rebounding strongly from 2010 on (Fig. 4.40). China shows both increases and decreases from the levels predicted by the Synthetic China in both the pre-treatment and post-treatment periods (Fig. 4.41). However, the placebo tests show that the differences between China and the Synthetic China in the post-treatment period are well within the expected range of post-treatment variation for the synthetic control predictions (Figs. 4.42 and 4.43).

Table 4.17 shows the post-policy differences for the countries included in Figure 4.43, confirming that the increases in China's post-policy imports are within the levels of post-policy increases seen in other countries analyzed. However, our theory would predict decreases in China's imports from suspicious producer countries in response to the 2008 U.S. policy, so it is safe to conclude that the policy is not leading to substantial decreases in China's hardwood imports from suspicious producer countries.

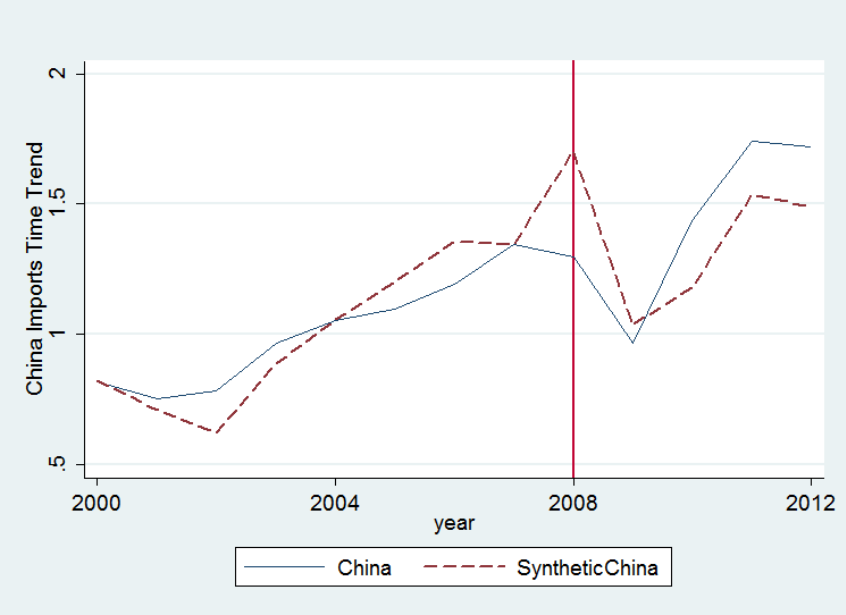

Figure 4.40: Trends in China's imports of hardwood products from suspicious producer countries: Synthetic China and China

Figure 4.41: Differences in hardwood imports from suspicious producer countries between the Synthetic China and China.

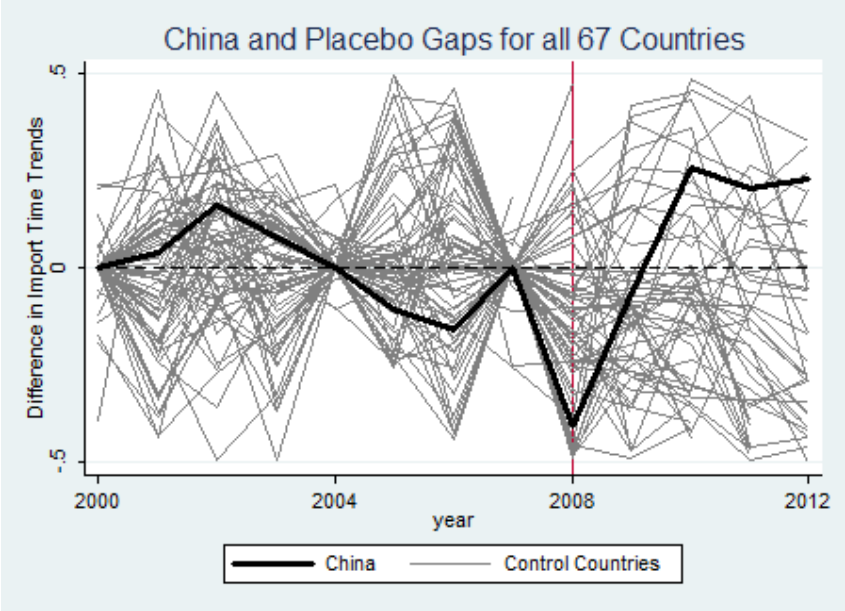

Figure 4.42: Gaps in hardwood imports from suspicious producer countries in China and placebo gaps for all 67 control countries.

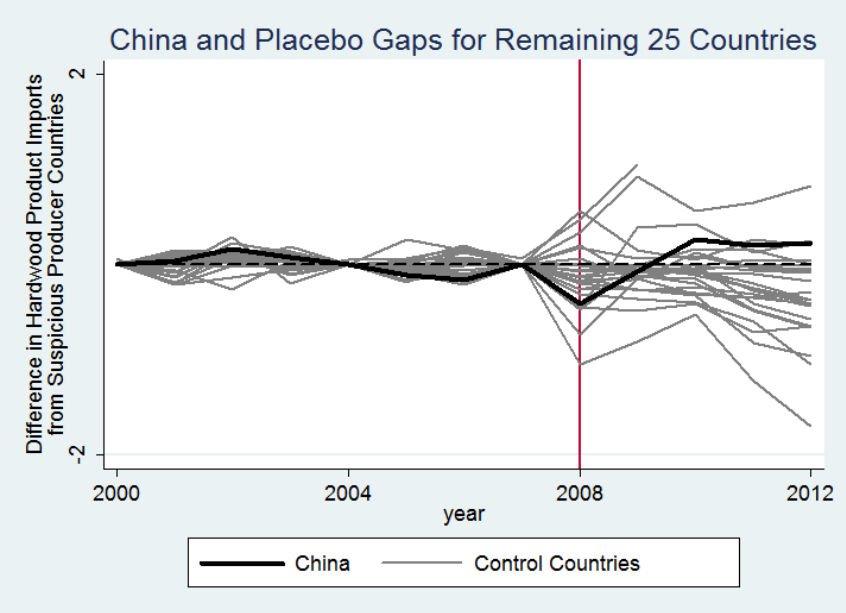

Figure 4.43: Gap in China's hardwood product imports from suspicious producer and placebo gaps for 29 control countries (discards countries with pre-2008 MSPE two times higher than China's).

Table 4.17: Post-policy difference (summed MSPE) between each country and its synthetic control for all countries included in Figure 4.43.
Orange = decrease; Blue = increase; White = mixed increases and decreases

Country	Summed Post-policy MSPE	Country	Summed Post-policy MSPE
Sri Lanka	63.36	Denmark	0.27
Russia	5.32	Greece	0.24
Uruguay	2.27	Italy	0.21
France	1.76	Germany	0.19
Turkey	1.74	**China**	**0.17**
Austria	1.33	Lithuania	0.14
Netherlands	0.72	Japan	0.05
South Korea	0.68	Croatia	0.05
South Africa	0.52	Taiwan	0.05
Mexico	0.46	Malaysia	0.01
Spain	0.42	Canada	0.01
India	0.41	United States	0.01
Poland	0.32	United Kingdom	0.00

Vietnam's Hardwood Imports

Figures 4.44 through 4.47 and Table 4.18 show the results of the analysis of Vietnam's hardwood imports from suspicious producer countries. Despite the increases in imports predicted by the Synthetic Vietnam in the post-policy period, Vietnam's hardwood

product imports from suspicious producer countries remained well-below expected levels throughout the post-policy period (Fig. 4.44). By 2012, these imports were 300% below the levels predicted by the Synthetic Vietnam, despite a very good pre-policy fit between Vietnam and Synthetic Vietnam in the pre-policy period (Fig. 4.45).

When we compare Vietnam and the placebo tests (Fig. 4.46), we see that the magnitude of the post-policy differences in Vietnam's imports of hardwood products is larger than that observed in almost all other countries. When we exclude placebo countries with poor pre-treatment fit (2X greater pre-treatment MSPE than Vietnam's), we see that Vietnam's post-policy differences are the second-largest post-policy differences seen for any country (Fig. 4.47). Only Sri Lanka has a larger post-treatment MSPE (averaged or summed) than Vietnam's. The chance of observing that large of a post-treatment difference in MSPE if the policy treatment were to be applied to a country at random within our sample is 2/42, or 0.0476, which is below the test level typically required to meet statistical significance (5%). For the purposes of our analysis, this is considered a significant post-policy difference. This is the first and only significant result of all the analyses reported. According to these results, Vietnam's post-policy imports of hardwood products from suspicious producer countries were significantly lower than those predicted by the Synthetic Vietnam, indicating that the policy appears to have had some effect on Vietnam's imports of hardwood products from suspicious producer countries.

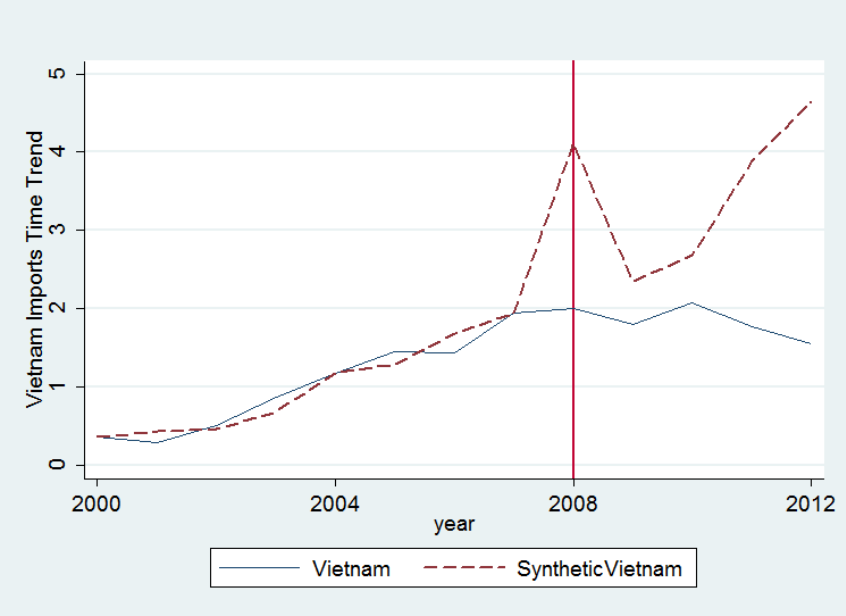

Figure 4.44: Trends in Vietnam's imports of hardwood products from suspicious producer countries: Synthetic Vietnam and Vietnam

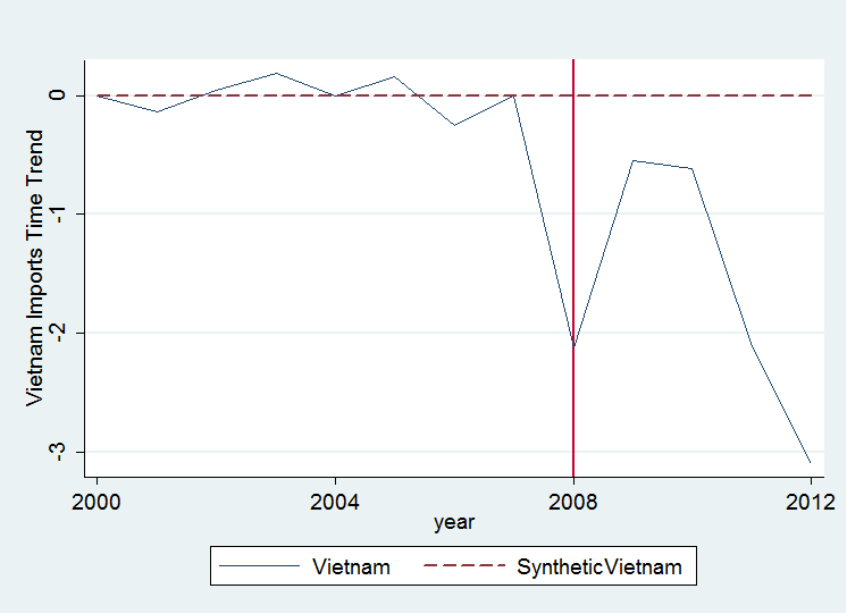

Figure 4.45: Differences in hardwood imports from suspicious producer countries between the Synthetic Vietnam and Vietnam.

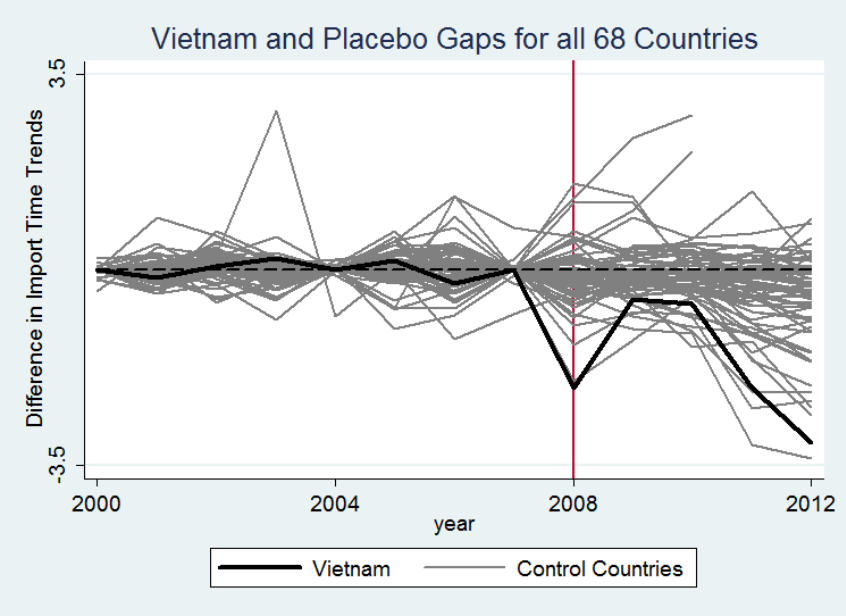

Figure 4.46: Gaps in hardwood imports from suspicious producer countries in Vietnam and placebo gaps for all 68 control countries.

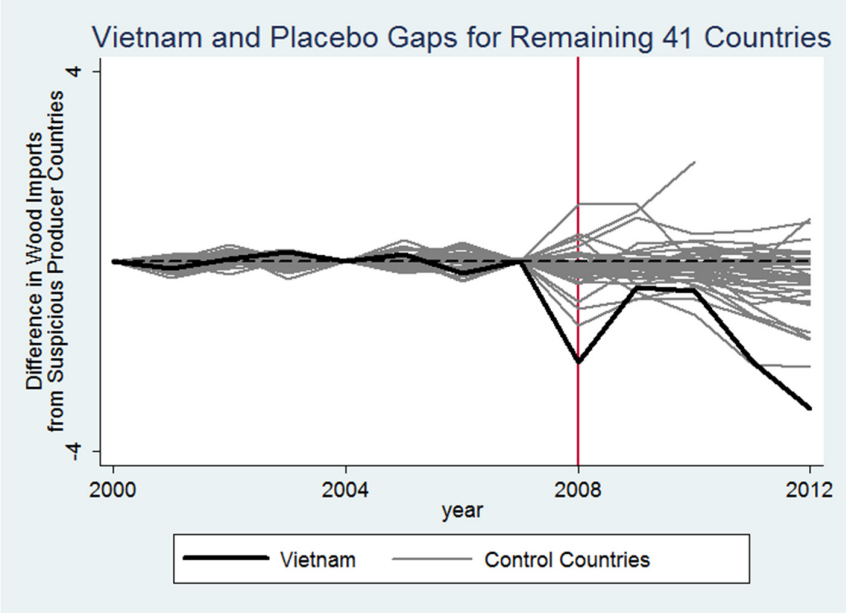

Figure 4.47: Gap in Vietnam's hardwood product imports from suspicious producer and placebo gaps for 41 control countries (discards countries with pre-2008 MSPE two times higher than Vietnam's).

Table 4.18 clarifies the post-policy differences observed in Vietnam and the placebo countries included in Figure 4.47. As seen in the table, the post-policy differences in hardwood imports from suspicious producer countries between Vietnam and the

synthetic Vietnam are the second-largest post-policy differences observed in the placebo tests (as measured by post-policy summed MSPE). Furthermore, Vietnam's post-policy differences show the largest decrease from predicted levels of all the 42 placebo tests (Sri Lanka experienced an increase over predicted levels). This result will be discussed in detail in Chapter 5.

Table 4.18: Post-policy difference (summed MSPE) between each country and its synthetic control for all countries included in Figure 4.47.
Orange = decrease; Blue = increase; White = mixed increases and decreases

Country	Summed Post-Policy MSPE	Country	Summed Post-Policy MSPE
Sri Lanka	63.37	New Zealand	0.40
Vietnam	**14.70**	India	0.39
Iceland	11.28	South Africa	0.33
Singapore	5.36	Poland	0.32
Russia	4.98	Philippines	0.29
Peru	3.67	Denmark	0.28
Jordan	3.60	Greece	0.25
Venezuela	2.27	Italy	0.22
Uruguay	2.27	Germany	0.20
France	1.53	Thailand	0.17
Chile	1.53	Australia	0.16
Portugal	1.48	Lithuania	0.14
Turkey	1.36	China	0.11
Austria	1.16	Belgium	0.11
Netherlands	0.68	Taiwan	0.06
South Korea	0.68	Japan	0.05
Sweden	0.64	Croatia	0.05
Finland	0.48	Malaysia	0.01
Mexico	0.45	Canada	0.01
Spain	0.44	United Kingdom	0.00
Czech Republic	0.40	United States	0.00

Analysis 2B: Third-party Country Tropical Wood Imports from Suspicious Producer Countries

China's Tropical Wood Imports

Figures 4.48 through 4.52 and Table 4.19 show the results of the analysis of China's imports of tropical wood products from suspicious producer countries.

Aside from a dip in 2009, China's tropical wood imports from suspicious producer countries were at or above pre-treatment average import levels for every year between 2003 and 2012 (Fig. 4.48). China's post-treatment imports were well above those predicted by the Synthetic China, except in 2012, when China's tropical wood imports were slightly lower than the levels predicted by the Synthetic China (Table 4.1 and Fig. 4.49).

The placebo tests (Fig. 4.50 and 4.51) show that this post-treatment difference is very large when compared with differences seen in other placebo countries with similar fit in the pre-treatment period. When we eliminate all placebo countries with pre-treatment MSPE two times greater than China, only 9 comparison countries remain (Fig. 4.51). Even within these few remaining countries, some show greater post-treatment differences from their synthetic counterparts (albeit in the opposite direction). This comparison shows that post-treatment differences in China cannot be considered to be significant by our standards (the 95% confidence level requires post-policy differences to be larger than those observed in at least 19 placebo countries with similar pre-treatment fit). Figure 4.52 further proves this point by raising the cut-off and including countries with a pre-treatment MSPE up to five times greater than China's. With more countries included in the placebo test (still not quite enough countries to establish a significant effect at the 95% confidence level), we see that China's post-treatment differences appear within the normal range of differences due to random chance. Table 4.19 shows the post-policy differences observed in the countries included in Figure 4.52, and confirms that China's post-policy differences are within the range of post-policy differences seen in the placebo countries. Similar to China's hardwood imports, it is safe to conclude that China's tropical wood imports from suspicious producer countries have been unaffected by the 2008 U.S. policy, since the post-policy difference is in the

opposite direction from the decreases we would expect to observe as a result of the U.S. policy.

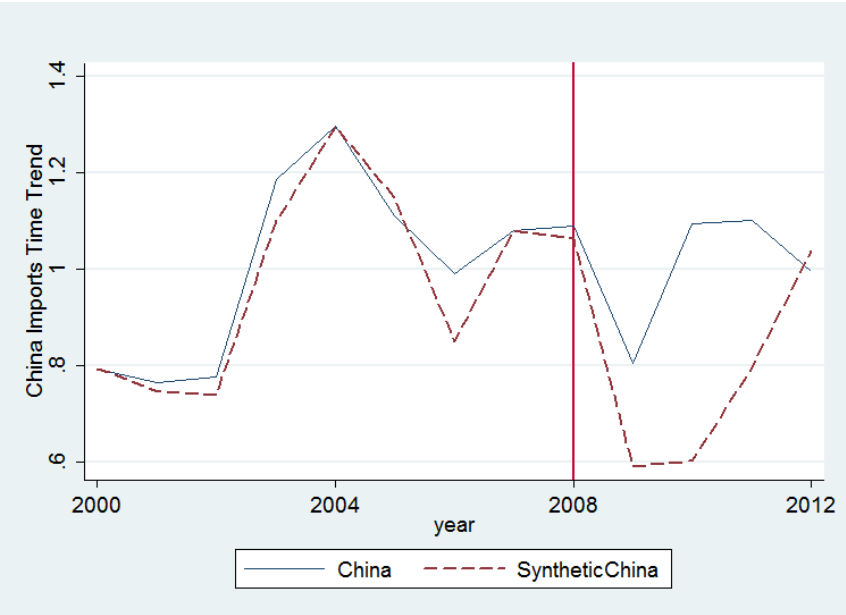

Figure 4.48: Trends in China's imports of tropical wood products from suspicious producer countries: Synthetic China and China.

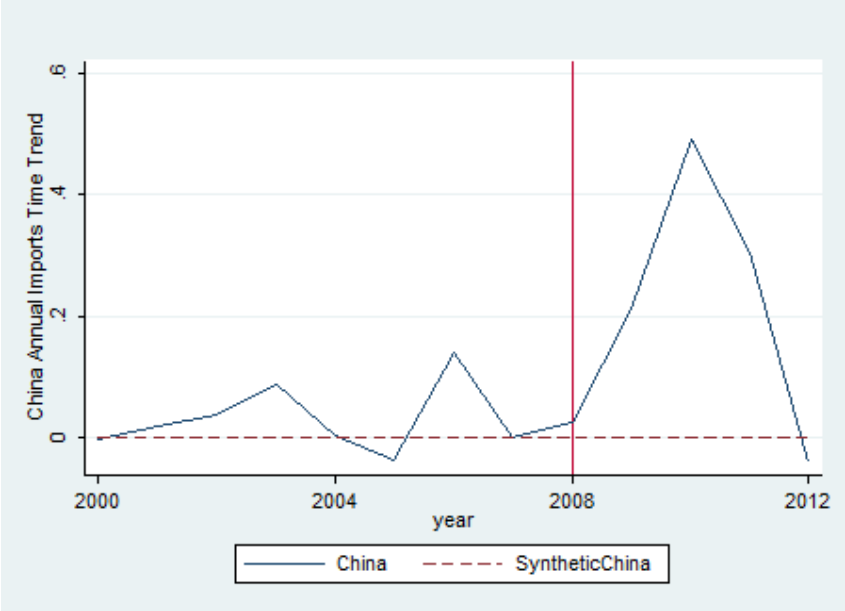

Figure 4.49: Differences in tropical wood product imports from suspicious producer countries between the Synthetic China and China.

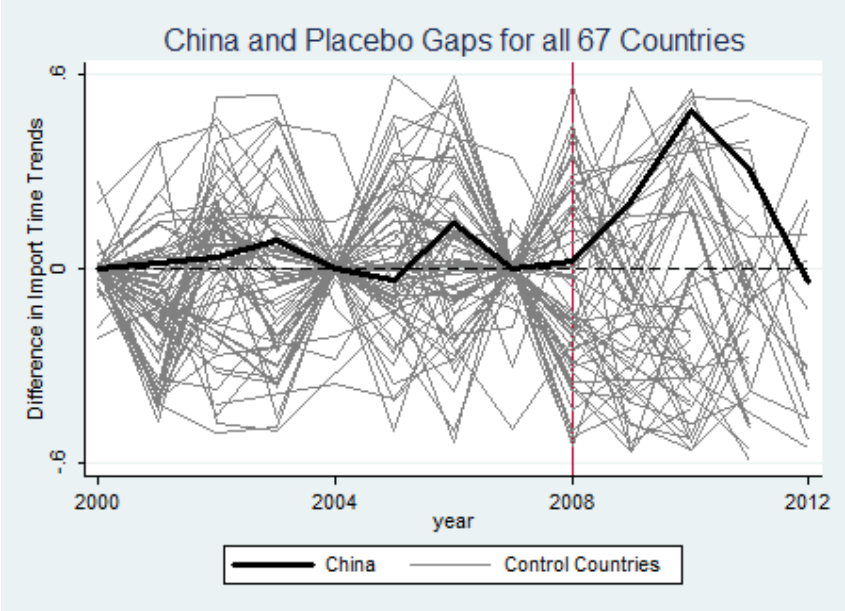

Figure 4.50: Gap in China's tropical wood product imports from suspicious producer countries placebo gaps for all 67 control countries.

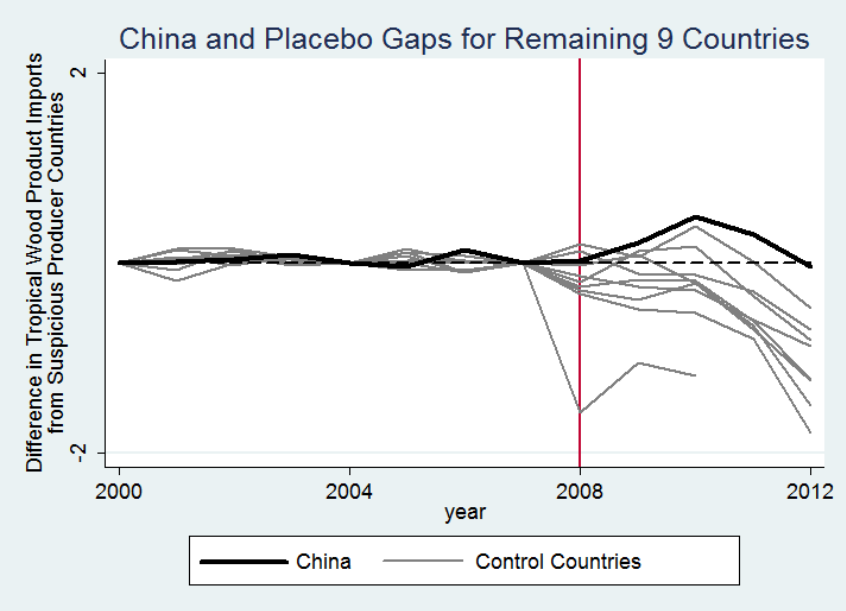

Figure 4.51: Gap in China's tropical wood product imports from suspicious producer countries and placebo gaps for 9 control countries (discards countries with pre-2008 MSPE two times higher than the U.S.').

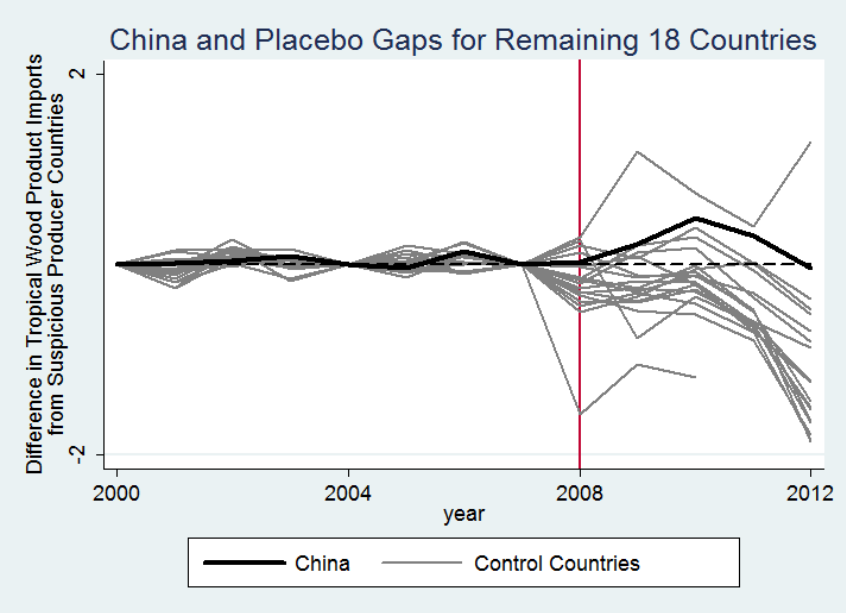

Figure 4.52: Gap in China's tropical wood product imports from suspicious producer countries and placebo gaps for 18 control countries (discards countries with pre-2008 MSPE five times higher than the U.S.').

Table 4.19: Post-policy difference (summed MSPE) between each country and its synthetic control for all countries included in Figure 4.52.
Orange = decrease; Blue = increase; White = mixed increases and decreases

Country	Summed Post-Policy MSPE	Country	Summed Post-Policy MSPE
Sweden	21.50	Greece	2.08
Spain	4.31	France	1.93
Canada	4.11	Italy	1.26
Finland	3.84	South Korea	0.83
Uruguay	3.78	Mexico	0.60
Germany	3.75	Australia	0.41
United States	2.96	**China**	**0.38**
United Kingdom	2.94	Taiwan	0.37
Denmark	2.87	Belgium	0.25
Netherlands	2.31		

Vietnam's Tropical Wood Imports

Figures 4.53 through 4.56 and Table 4.20 show the results of the analysis of Vietnam's tropical wood product imports from suspicious producer countries. Vietnam's imports of tropical wood products rose quickly from 2007 to 2010 to levels much higher than those predicted by the Synthetic Vietnam (Figs. 4.53 and 4.54). However, from 2010 to 2012,

Vietnam's tropical wood imports began returning to levels more similar to those predicted by the Synthetic Vietnam.

The placebo tests show that this large spike in Vietnam's imports was out of the ordinary for post-policy differences (Fig. 4.55). However, the post-policy differences were smaller than the post-treatment differences observed for both Sweden and Ireland in the post-policy period. As a result, the chances of observing as large of a post-treatment difference as that seen in Vietnam is 3/25, or .12, which does not meet the 95% level of confidence in our result necessary to deem the difference significant by normal standards. Furthermore, these post-policy differences are in the opposite direction from the decreases we would expect to observe as a result of the policy.

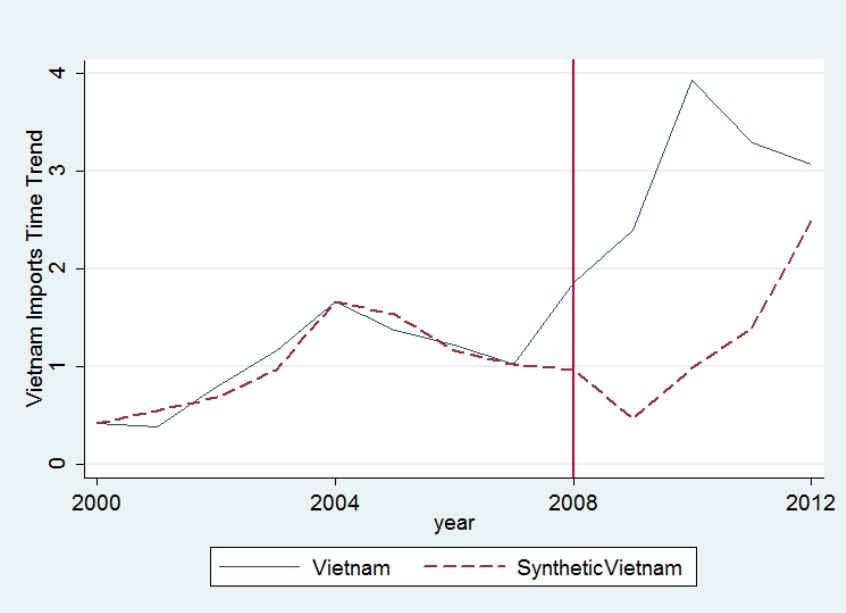

Figure 4.53: Trends in Vietnam's imports of tropical wood products from suspicious producer countries: Synthetic Vietnam and Vietnam

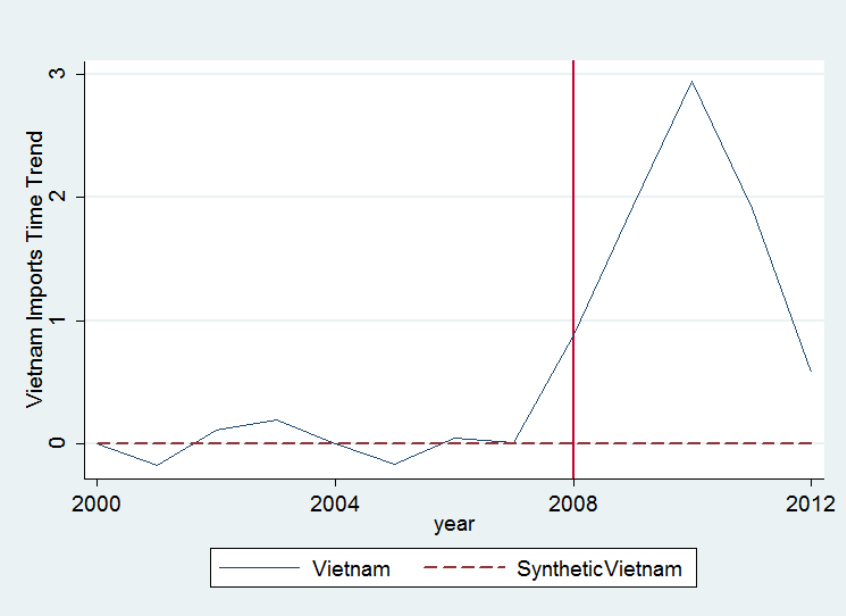

Figure 4.54: Differences in tropical wood product imports from suspicious producer countries between the Synthetic Vietnam and Vietnam.

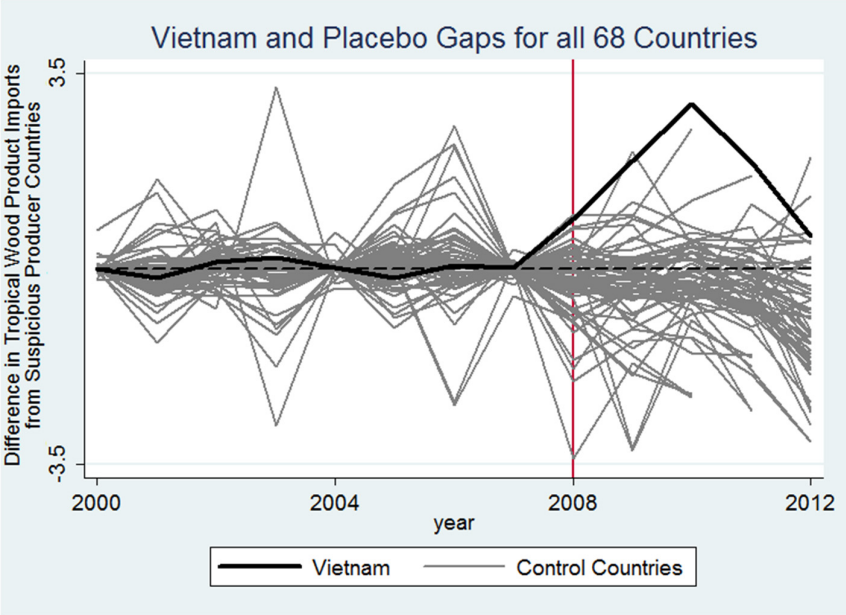

Figure 4.55: Gaps in tropical wood product imports from suspicious producer countries in Vietnam and placebo gaps for all 68 control countries.

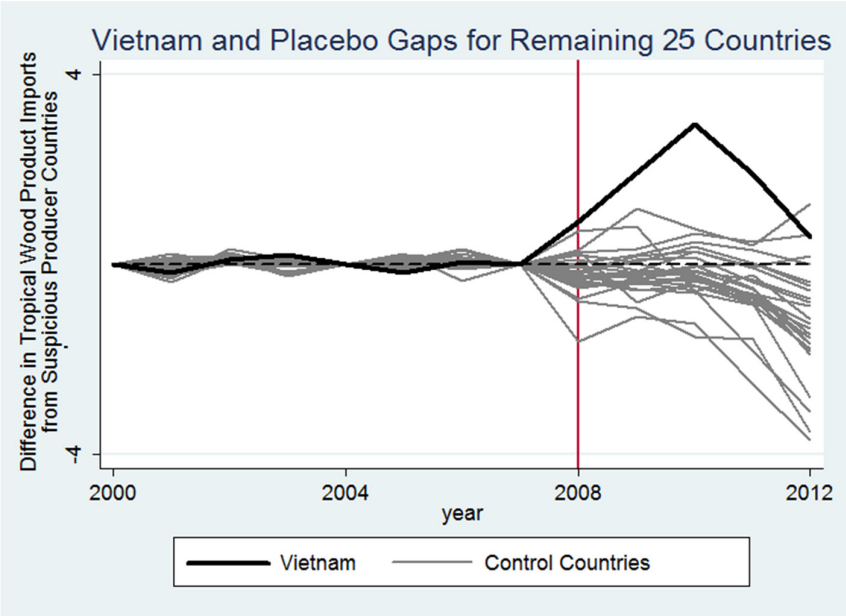

Figure 4.56: Gap in Vietnam's tropical wood product imports from suspicious producer and placebo gaps for 25 control countries (discards countries with pre-2008 MSPE two times higher than Vietnam's).

Table 4.20 quantifies the post-policy differences between each country and its synthetic control observed in Figure 4.56. Vietnam's increases in post-policy tropical wood imports from suspicious producer countries, as compared to the Synthetic Vietnam, are quite substantial, overall. However, Figures 4.53 and 4.54 and Table 4.1 all show that Vietnam's imports of these products appeared to be returning to levels similar to those predicted by the Synthetic Vietnam in 2011 and 2012 after the peak difference observed in 2010. Overall, while these post-policy increases seen for Vietnam are substantial, the mixed trends prevent a clear interpretation of those post-policy differences. However, the fact that Vietnam shows a large post-policy increase in tropical wood imports from suspicious producer countries, as opposed to the decrease expected in response to the U.S. policy, allows us to conclude that the 2008 policy does not appear to be having its intended effect on these imports in Vietnam.

Table 4.20: Post-policy difference (summed MSPE) between each country and its synthetic control for all countries included in Figure 4.56.
Orange = decrease; Blue = increase; White = mixed increases and decreases

Country	Summed Post-policy MSPE	Country	Summed Post-policy MSPE
Sweden	22.74	Greece	2.54
Ireland	17.96	Netherlands	2.47
Vietnam	**16.34**	Venezuela	2.30
Turkey	13.37	France	2.03
Portugal	9.03	Italy	1.37
Spain	4.47	South Africa	1.17
Canada	4.11	South Korea	0.83
Germany	3.98	Mexico	0.65
Finland	3.94	Australia	0.40
Uruguay	3.78	China	0.36
United States	3.12	Taiwan	0.35
United Kingdom	3.12	Belgium	0.26
Denmark	3.05	Thailand	0.13

Chapter 5: Discussion

U.S. Imports

The results of these analyses provide evidence that U.S. imports of wood products from countries identified in the literature as exporters of wood products of suspicious and/or illegal origins were not significantly affected by the 2008 Lacey Act amendment. The analyses tested hypotheses for various wood product groups with differing likelihoods of having arisen from suspicious or illegal origins. Across the analyses of imports of wood furniture, all wood products, hardwood products, and tropical wood products, none showed evidence of significant effects from the policy on U.S. import levels. This was true for U.S. imports from suspicious producer countries (mostly developing countries in the tropical regions), as well as imports from suspicious processing countries (more developed countries with large wood manufacturing sectors). It should be noted that the use of aggregated trade data makes this a macro-level analysis. This analysis is not capable of pinpointing comparatively small changes made by individual suppliers or consumers in an effort to ensure the legality of a specific supply chain for a product.

As discussed in Chapter 2, a 2008 report prepared for the American Hardwood Export Council by Seneca Creek Associates presented strong evidence that the U.S. domestic hardwood industry is free of illegal logging, for all intents and purposes. In this context, the 2008 Lacey Act amendment must be seen as an import ban on wood and wood products of illegal origins in other nations. Our results provide evidence that contradicts the belief that the Lacey Act has had major effects on the wood products industry, represented by the following quote about the effects of the Lacey Act amendment from the Environmental Investigation Agency: “[the approval of the amendment to the Lacey Act] has created dramatic changes in the still heavily unregulated global timber industry

and led to systemic shifts in the practices of importers, manufacturers, and timber companies within both the U.S. and around the world" (EIA, 2014). At the level of aggregated wood imports for products with substantial risk of having arisen from illegal origins, our analysis shows the policy to have had no significant effects beyond those expected as a result of random chance, even when the economic effects of the global recession are accounted for. If we believe that a significant portion of exports from the countries identified in this analysis are of illegal origins, as supported by the literature, then this raises questions about the ability of the policy to affect illegal logging levels in producer countries. If the purpose of the policy is to reduce U.S. demand for illegal wood, then why aren't we seeing significant reductions in wood products imports from these countries?

The coalition of environmental advocacy groups and domestic timber industry representatives that backed the passage of the 2008 policy were largely brought together by their desires to address the economic incentives that consumer countries provide for illegal logging by failing to distinguish between legally-harvested and illegally-harvested wood. The application of the Lacey Act to both industrial round wood and finished wood products was considered a holistic approach to force all U.S. wood product importers to take responsibility for the long supply chains of imported wood products. However, industry groups were largely interested in the policy as a means to stimulate the domestic timber industry and raise prices for domestic wood through the exclusion of illegal wood in the domestic market (as detailed in Seneca Creek Associates, 2004). Our results also call into question the assumption that the 2008 Lacey Act amendment has created positive outcomes for the domestic timber industry (namely, increases in domestic production and higher wood prices), since we see no evidence of the expected drops in U.S. imports of suspicious products.

It is important to note that the research identifying countries as having high levels of suspicious wood in their exports is from the mid-2000s, and is based on various assumptions necessary to provide detailed estimates of "illegal" wood production in developing countries. One other potential explanation for these findings is that the estimates of illegal production in the suspicious countries do not accurately estimate the levels of illegal wood production, nor the levels of illegal products that enter into international trade flows.

Third-party Country Imports

China's Imports

Over the past two decades, China has become the major global importer of primary wood products for use in its vast wood products manufacturing sector. China quadrupled wood imports over the decade leading up to 2008, and as of that year over half of all international wood trade passed through the country (Laurance et al., 2008). Due to a large decrease in domestic timber production in China and a huge growth in domestic demand for wood products over the same period, as well as rapid increases in exports, China is now considered the world's "woodshop," importing wood and manufacturing wood products for enormous domestic and export markets (Laurance et al., 2008). Felbab-Brown (2011) notes that China's rate of domestic wood consumption is growing much more rapidly than wood consumption in other developed markets (such as the U.S.). Trade in wood products between the U.S. and China has also increased rapidly over the past two decades, with Chinese wood products exports to the U.S. (mainly wood furniture) increasing eightfold in the decade leading up to 2006 (Laurance et al., 2008). With this large role that China plays in world wood markets and its resulting demand for raw materials, it is crucial that strategies to reduce illegal logging

provide incentives to China to reduce demand for illegal and suspicious wood. The results of this analysis show that leakage may be blunting any effects on China's imports of suspicious wood that the 2008 U.S. policy might be expected to induce. China's imports of wood products with a high likelihood of arising from illegal origins are above expectations in the post-2008 period, though not significantly. However, we observe no reduction in China's demand for wood from suspicious countries at the aggregate level as a result of the 2008 policy.

A side benefit of this result is that it improves our confidence in the basic assumption of our analysis: that the U.S. policy is not affecting other countries' imports (see Chapter 3 for further discussion of this assumption). However, this result does not support the argument that the U.S. policy is having an effect on the foreign supply chains of wood products bound for the U.S. at an aggregate level. Then again, China's domestic demand is growing and the U.S. is only one of many end consumers of China's wood products exports. From these results, it appears that China is still importing similar levels of suspicious wood, and it is likely that the resulting products are being redirected to markets that do not distinguish between legally- and illegally-sourced wood.

Vietnam's Imports

The results of the analysis of Vietnam's imports from suspicious producer countries are challenging to interpret. The only significant difference in imports found in this analysis is the post-policy decrease in Vietnam's actual imports of hardwood products from suspicious producer countries as compared to those predicted by the Synthetic Vietnam. Also, the difference is in the direction that we would theoretically expect, since the policy should have caused a drop in suspicious imports and Vietnam's post-policy imports from

suspicious producer countries are significantly lower than those predicted by the Synthetic Vietnam.

One confounder, though, is that Vietnam is the only country that is included as both a producer and a processing country. While there is evidence that illegal logging occurs in China (Démurger, 2007), China has also reigned in unlicensed logging over the past few decades as forest management practices have improved (Laurance et al., 2008). As a result, the illegal wood passing through China's manufacturing processes is generally believed to result largely from China's vast imports, rather than domestic illegal logging. Due to Vietnam's dual categorization, we are unsure as to whether Vietnam may be making up for these reduced imports from suspicious producer countries by relying more heavily on domestic production or importing more from countries with lower levels of suspicious wood production. If Vietnam is relying more heavily on domestic wood production, then this post-policy difference loses strength due to the fact that we consider wood harvested in Vietnam also to consist of significant amounts of illegally harvested wood. Follow-up analysis of the percentage of Vietnam's imports coming from suspicious producer countries would shed some light on this issue.

Another consideration is that we are using slightly different data to construct Vietnam's imports, since trade in Vietnam is not reported in detail in the Global Trade Atlas. However, the additional data on exports from non-GTA countries does not seem to be unbalanced toward the post-policy or pre-policy periods in any considerable way that might lead to the creation of an artificial post-policy effect on import levels. Regardless, the data for Vietnam's imports from suspicious producer countries must be pieced together through export data. To verify this effect, the assumption that Vietnam wood products imports not specifically identified as coniferous and coming from non-GTA

suspicious producer countries that have only tropical domestic forests consisted fully of tropical hardwood should be relaxed to create a sensitivity analysis and see whether the post-policy effects are being seriously impacted by the assumptions. It should be noted, though, that any data affected by this assumption should be balanced across both pre- and post-treatment periods. However, there were some non-GTA suspicious producer countries with limited trade reporting in the analysis period, possibly skewing the analysis.

Assuming that the effects on Vietnam's imports are significant in the post-policy period, though, this provides some evidence that major exporters of finished products to the U.S. may be shifting their supply chains in order to maintain access to the U.S. market by ensuring that exports to the U.S. comply with the Lacey Act amendment. This drop in Vietnam's suspicious imports of hardwood products, but not in China's suspicious imports, is further supported by the structure of wood products trade in the two countries. As discussed in Chapter 2, both countries are major exporters of finished products that rely heavily on imported raw material (Lang and Chan, 2006; Laurance et al., 2008; Pepke, 2013). However, only 30% (by value) of China's wood furniture imports were destined for U.S. markets in the year 2012. Furthermore, as just mentioned in the discussion of China's results, China has a strong and growing domestic market for finished wood products. In the case of Vietnam, wood furniture exports to the U.S. accounted for 55% of all wood furniture exports in the same year (by value), and the domestic market for high-value finished wood products is limited. Overall, then, Vietnam is more dependent on the U.S. market for their finished products and therefore more likely to evidence a large-scale response to the 2008 policy. On the other hand, China's more diversified market for finished wood products allows for greater leakage of products sourced from suspicious wood to markets that do not distinguish between legal

and illegal wood. This evidence, if corroborated by further analysis, would provide support for the success of the 2008 Lacey Act amendment in reducing suspicious wood imports at an aggregate level.

Contradicting the evidence from the analysis of Vietnam's hardwood imports, the analysis of Vietnam's tropical wood imports shows them to be above expected levels in the post-policy period, though the difference was not significant. Again, this analysis may be affected by the assumption that all tropical, non-GTA countries are exporting solely tropical wood to Vietnam, unless otherwise specified. However, this finding casts doubt on the inference that Vietnam's hardwood import reductions from suspicious producer countries are evidence of a shift away from suspicious wood sources, since tropical hardwood imports from these countries are believed to contain large amounts of suspicious wood. Overall, the take-away message is that Vietnam should be focused on as a country potentially impacted by the 2008 policy. In both analyses, Vietnam's post-policy imports appear to have differed greatly from the levels predicted by the Synthetic Vietnam. Reliable and consistent data on Vietnam imports would be greatly beneficial in further analyses corroborating these findings that Vietnam, as both a major exporter to the U.S. a major importer of raw wood, may be experiencing significant trade effects from the 2008 U.S. policy.

Limitations of this Analysis

One serious difficulty of interpreting the results of this analysis is due to the use of the value of imports as a proxy for import levels (quantity). The value of imports includes both price and quantity, so the value of imports are being affected by price changes that blur the connection between value and quantity. Unfortunately, international reporting of trade information is not harmonized in such a way as to allow for simple comparisons

between wood products. Products quantified by volume measurements can be compared. However, products recorded with a simple count of units cannot be compared with volume measurements. Both tracking units are used both within products (some countries reporting product amounts, others reporting volume) and between products (all countries track one product by number and another by volume). As a result, the only directly comparable unit of measurement available for all products included in the aggregate product groups analyzed is value.

In order to assess the potential effects of this limitation, we analyzed the quantity of U.S. imports of hardwood and tropical wood products groups, both of which are reported in the GTA database in volume measurements that are comparable across all countries analyzed (cubic meters). While the use of product quantities did change some results of these analyses when compared with the use of product value, in no case did it change the results enough to alter the significance of the post-policy differences observed for the treatment country (the U.S.). In other words, based on these confirmatory analyses the use of trade value as a proxy for trade quantity is a reasonable assumption for the analyses performed in this research.

Focusing the analysis on wood products traded internationally necessarily ignores domestic production and markets. For a more comprehensive analysis, economic information on domestic wood production and consumption should also be compared prior to and following the 2008 Lacey Act amendment. Specifically, additional information from domestic markets would better capture the leakage effects the policy may have had on the U.S.'s most important trade partners.

Trade data are tracked as bilateral interactions between countries. However, as discussed in the Chapter 3, trade in wood products is often extremely complex, with wood inputs passing through various third-party countries for refinement prior to arriving at the country of the final consumer. Bilateral trade data, combined with knowledge of general trade patterns, can provide some insight into macro-level trends in wood products trade. However, a tracking system that traces at least some sub-sample of wood products back to the country of origin would allow an analysis to be much more precise in targeting products that originate from wood harvested in suspicious producer countries (i.e., products with higher likelihoods of having originated from illegal harvest).

Finally, a major concern with the methodology used is the potential for repeated testing effects. Repeated hypothesis testing leads to an increased chance for Type I errors. Type I error occurs when an analysis reveals an effect or relationship between events or variables, when, in fact, no relationship exists. With significance levels of 5% ($\alpha = .05$; 95% confidence), we accept that Type I error has a 1/20 chance of occurring. As we repeatedly retest hypotheses for slightly different analyses of similar variables, the risk increases that an analysis will return spurious results indicating "significant" effects of the policy treatment on the outcome variable. For the purposes of this research, we ran 14 individual analyses. As the number of analyses approaches 20, the likelihood of encountering significant results due to Type I error increases. In order to account for repeated testing effects, any significant differences returned by individual analyses should be probed and corroborated by further testing in an effort to reduce the probability of accepting potentially spurious relationships between the policy treatment and the outcome variable of interest.

Discussion of the Methodology

The use of a quasi-experimental method can eliminate much of the error associated with the study of phenomena that do not lend themselves to randomized and controlled experimental designs. Particularly when probing counterfactuals and questions of causality, this method provides a quantitative means to establish a higher level of confidence that the post-treatment effects measured are related to the treatment, rather than some other characteristics of the treatment unit. Furthermore, the use of a data-driven methodology to select an appropriate control group provides a means to establish a comparison group that is as similar as possible to the treatment group, insofar as the predictor variables included in the model predict the outcome variable. In this way, the researcher does not insert bias into the comparison through the selection of a control group based on criteria that may affect the validity of the comparison.

The comparative case study method used also establishes a meaningful, objective, and rigorous level of significance necessary for distinguishing results from the policy treatment and those differences due to random chance. The falsification tests allow us to directly compare the post-treatment results in the treatment group with those of other units of observation that did not receive the treatment. By employing fictional "policy treatments," we gain access to the levels of post-policy differences from prediction that can be expected as a result of random chance. If our policy had, indeed, affected the outcome variable which our model estimates, then that effect should be directly visible in the post-policy period, and a clear cut-off point for significance prevents the difficulties of interpretation inherent in many case study comparisons.

In the study of real-world phenomena, this method provides analysts with a useful tool for understanding policies and programs that are not suitable for experimental designs.

In the case of this analysis, the development of a suitable control group was critical to the validity of the comparison and the interpretation of results. Relying on a data-driven method that returns results that can be interpreted objectively greatly increases the value of the analysis and any results gathered. Due to these strengths, this methodology holds great promise for the future study of issues related to the international trade of forest products; particularly when combined with a strong understanding of international trade flows in wood products.

Policy Implications

While this research focused on a rigorous test of significance for determining the effects of the 2008 Lacey Act amendment, policymakers may draw different conclusions about the efficacy of the 2008 policy from the results reported. As noted in the results, U.S. imports of tropical wood products from both suspicious producer and processing countries were substantially lower than the levels predicted by the Synthetic U.S. in the post-policy period (150% and 280% below predicted levels, respectively, for the year 2012). This restricted product group is the product group most likely to contain significant proportions of illegal or suspicious wood, so this result is encouraging for those arguing for the efficacy of the policy. Aside from wood furniture, U.S. imports of all wood products analyzed were below the levels predicted by the Synthetic U.S. in the year 2012 (see Table 4.1), although none of the differences were significant. It may be that the policy is having some limiting effects on U.S. imports of suspicious wood products, but not enough to rise to the level of significance required for our test. Furthermore, it may be that international trade in forest products is volatile, resulting in increased variability in imports by country. In Chapter 3, it was pointed out that fixed effects regression models assume that unobserved covariates for each unit of observation (country) are stable over time within that unit. Therefore, country- and

time-specific variability could cause our placebo tests to show large post-policy differences from predicted levels simply due to the time-specific market shifts within specific countries that are not accounted for in our model.

For a policymaker, the apparent reductions in U.S imports of suspicious primary wood products, along with increased imports of finished products from suspicious countries (wood furniture), support the conclusion that an import ban on illegal wood may be more effective at reducing suspicious imports of primary products, which tend to be easier to identify and trace back to source. As discussed in Chapter 2, the few major enforcement actions for violations of the amended Lacey Act have focused on primary products (raw wood and wood flooring). Finished products such as wood furniture, on the other hand, often contain a mixture of a variety wood products from different origins. The U.S. import trends show that U.S. law enforcement agencies may need to identify and pursue methods for establishing the legality of mixed-source products, such as finished products, as U.S. importers and businesses reduce their risk of violating the policy by reducing imports of suspicious primary products.

The significant decrease observed in Vietnam's post-policy hardwood product imports from suspicious countries further supports the assertion that the policy is successfully affecting the supply chains of wood products destined for U.S. markets. Unfortunately, Vietnam's increased suspicious imports of tropical wood products and China's increased suspicious imports of tropical and hardwood products in the post-policy period cloud this interpretation of the policy's efficacy in addressing foreign trade in illegal wood.

As detailed in Chapter 2, consumer countries have taken a variety of approaches to attempt to reduce illegal logging. Import bans and due diligence requirements are seen

as one tool available to consumer countries to reduce demand for illegal logging by distinguishing between legal and illegal wood products. The Lacey Act amendment of 2008 has been lauded by many as one of the first serious attempts by a consumer country to reduce demand for illegal wood. However, the Lacey Act relies on laws in the country of origin to define legal harvest, rather than establishing a unified definition of legality. As discussed in Tibbets (2011), there is preliminary evidence that U.S. importers and experts in the field were unsure about how to comply with the law, as well as how it would be enforced, around the time the policy came into effect. It is possible that U.S. importers have found compliance difficult due to the complexities of both their supply chains and the legal systems in producer countries.

The Voluntary Partnership Agreements pursued by the EU take a more holistic approach to addressing the root causes of illegal logging by supporting developing producer countries in the complex process of building the institutional capacity necessary to address illegal logging. This is a more engaged approach than the supply restriction strategy resulting from the 2008 Lacey Act amendment, which puts importers and companies into the difficult position of establishing the legality of their own supply. In concert with import bans on illegal wood, VPA serve as strong incentives for countries to establish their own governance structures that allow them to gain access to large markets. In addition, these agreements provide clear instruction for companies wanting to comply without losing competitive advantage. Perhaps compliance with the 2008 Lacey Act amendment would be improved if the U.S. were to pursue measures that support producer country efforts to ensure the legality of wood for export.

Furthermore, the Lacey Act amendment does little to clarify what is meant by “legal” versus “illegal” wood. Rather than focusing attention on the illegal harvesting activities,

enforcement of the policy may potentially alienate U.S. businesses trying to comply, but overwhelmed by the burden of securing supply chains for a commodity that is internationally traded at high volumes under various foreign legal systems. The due diligence requirements of the U.S. Lacey Act do require there to be proof of violation of the policy, though. The more aggressive approach taken by the EU Timber Regulation holds that importers are responsible for producing evidence of the legality of their imports (Brack and Buckrell, 2011). However, additional clarification by the government on the definition of legality, as well as a clear path for companies to show due diligence on their parts, might improve compliance and lead to the expected drops in U.S. imports of wood products with suspicious origins. Since the U.S. is not pursuing agreements with individual partner countries, one strategy might include automatic compliance with the Lacey Act for wood products certified by third party groups that include chain of custody inspection, such as that of the Forest Stewardship Council or the Sustainable Forestry Initiative. Although it is understandable that the U.S. government would be reluctant to support one certification scheme over another, providing some guidance about acceptable legality standards might serve to clarify this issue of legality. In time, should an enforcement case go to trial, the judiciary may also provide some clarity for actions that establish compliance with the due diligence requirements of the policy.

Implications for Further Research

To build on and probe the results of this research, three logical follow-up studies of international trade in wood products immediately present themselves. All three of these research questions could be investigated using the same strategy employed in this thesis: a comparative case study method using a synthetic control of comparison countries to investigate post-policy changes in trade. These three studies should analyze:

1. The proportion of U.S. imports made up by wood products from suspicious countries
2. Product substitution within suspicious countries
3. U.S. primary product wood exports to suspicious processing countries

First, this analysis looks only at import levels in the U.S. It would be valuable to know how U.S. imports of wood products from suspicious countries compare with total U.S. imports over the analysis period. While levels of imports from these suspicious countries appear to have remained within expectations in the post-policy period, comparing "suspicious" imports with U.S. imports of these same product groups from non-suspicious countries would provide an understanding of any relative changes in "suspicious" imports. In other words, imports from suspicious countries may have remained steady in the post-policy period, but may have shrunk *in proportion to* total U.S. imports of the product group. If this were the case, a shift in U.S. imports away from suspicious countries may occur with no significant changes apparent in import levels from those countries. These analyses of the proportion of U.S. imports coming from suspicious countries were, in fact, performed, and preliminary results were gathered during the research reported in this thesis. However, the results require further analysis beyond the scope of the research for this thesis, and therefore they will be reported in future publications.

Secondly, it may be that U.S. importers are maintaining their relationships with suppliers in these suspicious countries, but shifting product purchases toward wood sources with lower risks of containing wood of illegal origins. The Lacey Act amendment of 2008, unlike the 2013 European Timber Regulation, does not place all responsibility for ensuring the legality of wood and wood products on the "first-placer" or, in the case of international trade, the importer of the wood or wood products. Therefore, companies further down the supply chain within the U.S. could shift their demand away from

products with a high likelihood of originating illegally, for example by replacing products containing tropical hardwood with those containing temperate hardwood. For some wood products and manufacturing processes, softwood can be used as a substitute for hardwood. In response to this shift in demand, we would see a drop in the relative contribution of suspicious products, as compared to other substitute products within the same product category.

One way to approach this second research question would be to investigate whether U.S. wood product imports from suspicious countries are changing as suppliers substitute away from specific wood products that are at a higher risk of having arisen from illegal or suspicious origins. In order to do so, one could analyze U.S. imports from suspicious countries, focusing on products at high risk of having originated illegally (e.g., tropical hardwood) as a proportion of all wood products imports from suspicious countries. This analysis would provide evidence indicating whether or not U.S. importers and companies might be shifting imports away from suspicious products while maintaining their trade relationships with suppliers in "suspicious" countries.

Thirdly, as discussed, the 2008 Lacey Act amendment may have been supported by the domestic timber industry because the policy had a strong potential to boost the use of U.S. wood in foreign manufacturing of finished products that would then be re-imported by the U.S. The 2004 and 2008 reports prepared by Seneca Creek Associates showed that (1) the presence of illegally harvested wood in international trade flows depresses world wood prices and reduces the competitiveness of wood from the U.S. and other countries with overwhelmingly legal timber production, and (2) the legality of hardwood exports from the U.S. is more or less assured. The combined implications of these reports are that one simple method for U.S. importers and companies to comply with the

2008 law is to demand products incorporating wood that originated in the U.S. It may be the case that the 2008 policy led to suppliers in suspicious producer countries securing the legality of their supply chains by increasing imports of primary wood products from the U.S. This might not be reflected in the analysis of import levels contained in this thesis, although some preliminary evidence of these potential effects can be gathered from the analysis of import levels in China and Vietnam; two of the 5 suspicious processing countries. However, a more detailed analysis of U.S. primary wood product exports to suspicious processing countries would yield results that could be used to better understand the effects of the 2008 policy on U.S. wood exports.

It will be interesting to run these analyses again in a few years when more post-treatment import data are available by which to judge the effects of the policy. However, countries that implement their own import bans should be excluded from the donor pool, since we expect that their own imports of suspicious products will be affected by their own policies. For example, with the implementation of the EU Timber Regulation in 2013, all EU countries would need to be excluded from the donor pool to maintain the validity of post-treatment comparisons that include data from 2013 on. Similarly, Australia will need to be excluded from the donor pool when their import ban comes into effect in 2014. At the time of this analysis, no EU Voluntary Partnership Agreements had entered into the final Licensing Phase, which indicates that systems are in place and functioning to ensure the legality of wood exports to the EU (FLEGT Voluntary Partnership Agreements, 2013). Once a suspicious producer country enters into this final phase of the EU VPA, future researchers using this method will have to decide whether or not to remove them from the group of "suspicious" countries. However, it must be remembered that VPA only guarantee the legality of exports to the EU, leaving open the continued possibilities for leakage discussed earlier (see Chapter 2).

In addition, pre-treatment data for years prior to 2000 would allow researchers to establish longer pre-policy trends and potentially improve the composition of the synthetic control groups. Unfortunately, it is unlikely that additional detailed pre-treatment data on international trade in wood products will become available.

Appendix A: Equations Explaining the Fixed Effects Regression Model

The following is a summary of the basis for the use of fixed effects regression models in the social sciences, and was adapted from a presentation by Berry (2011).

Ordinary Least Squares (OLS) models use the following equation to estimate the average treatment effect of a binary treatment on the treatment group, as compared with the control group, where Y_i is the outcome variable, D_i is the effect of the binary treatment, η_i is the error term, and α is a constant:

$$Y_i = \alpha + \rho D_i + \eta_i \tag{1}$$

To estimate the effect of the treatment, then, we can write the equation this way, where Y_1 is the outcome variable for the treatment group (D = 1), and Y_0 is the outcome variable for the control group (D = 0).

$$\overline{Y_1} = \alpha + \rho + \overline{\eta_1}$$
$$\overline{Y_0} = \alpha + \overline{\eta_0}$$

This leads to the following OLS estimate of the treatment effect (ρ):

$$\overline{Y_1} - \overline{Y_0} = \rho + (\overline{\eta_1} - \overline{\eta_0}) \tag{2}$$

So long as D_i is uncorrelated with η, then the estimate of the average treatment effect is unbiased, since $\eta_1 = \eta_0$.

However, without random assignment, we cannot assume that D_i and η are uncorrelated, and therefore the error terms do not cancel out in Equation 2 and the difference in the means of the outcome variables for the treatment and control do not equal ρ (the treatment effect). In this case, the OLS estimate will biased.

For fixed effects models, then, we deconstruct the error term into a linear function, where X_i is a vector of observed covariates, β is a vector of population coefficients (defined by the regression of η on X_i), and v_i is the remaining unobserved error.

$$\eta_i = \mathbf{X}_i\boldsymbol{\beta} + v_i \tag{3}$$

v_i and X_i are uncorrelated and D_i and X_i are uncorrelated with the residual of the following equation:

$$Y_i = \alpha + \rho D_i + \mathbf{X}_i \boldsymbol{\beta} + v_i \quad (4)$$

Now we add in the assumption that we have cross-sectional time-series or panel data, and we can rewrite Equation 4, where *i* designates units and *t* designates time periods, D_{it} is treatment status (capable of varying with units of time), X_{it} is a vector of covariates that vary over time within units, and Zit is a vector of covariates that vary across units but not over time, and ε_{it} is the error term:

$$Y_{it} = \rho D_{it} + \beta X_{it} + \delta Z_i + \varepsilon_{it} \quad (5)$$

We can then remove the Z covariates using the following equation, removing unit-level averages from both sides:

$$Y_{it} - \overline{Y_i} = \rho\left(D_{it} - \overline{D_i}\right) + \beta\left(X_{it} - \overline{X_i}\right) + \delta\left(Z_i - Z_i\right) + \varepsilon_{it} - \overline{\varepsilon_i} \quad (6)$$

Equation 6 is the same as estimating a fixed effect (dummy variable) for each unit (labelled α_i):

$$Y_{it} = \alpha_i + \rho D_{it} + \beta X_{it} + \varepsilon_{it} \quad (7)$$

Using Equation 7, we can interpret ρ as the effect of a within-unit change in treatment. The only remaining sources of bias are the unobserved covariates that vary over time within units (X_{it}).

Appendix B: HS Codes for Wood Products

All descriptions of HS Codes are taken from the HS Nomenclature 2012 Edition, available online at http://www.wcoomd.org/en/topics/nomenclature/instrument-and-tools/hs_nomenclature_2012/hs_nomenclature_table_2012.aspx.

Chapter 44

Wood and articles of wood; wood charcoal

Notes.

1.- This Chapter does not cover :

(a) Wood, in chips, in shavings, crushed, ground or powdered, of a kind used primarily in perfumery, in pharmacy, or for insecticidal, fungicidal or similar purposes (heading 12.11);

(b) Bamboos or other materials of a woody nature of a kind used primarily for plaiting, in the rough, whether or not split, sawn lengthwise or cut to length (heading 14.01);

(c) Wood, in chips, in shavings, ground or powdered, of a kind used primarily in dyeing or in tanning (heading 14.04);

(d) Activated charcoal (heading 38.02); (e)

Articles of heading 42.02;

(f) Goods of Chapter 46;

(g) Footwear or parts thereof of Chapter 64;

(h) Goods of Chapter 66 (for example, umbrellas and walking-sticks and parts thereof); (ij)

Goods of heading 68.08;

(k) Imitation jewellery of heading 71.17;

(l) Goods of Section XVI or Section XVII (for example, machine parts, cases, covers, cabinets for machines and apparatus and wheelwrights' wares);

(m) Goods of Section XVIII (for example, clock cases and musical instruments and parts thereof); (n) Parts

of firearms (heading 93.05);

(o) Articles of Chapter 94 (for example, furniture, lamps and lighting fittings, prefabricated buildings); (p)

Articles of Chapter 95 (for example, toys, games, sports requisites);

(q) Articles of Chapter 96 (for example, smoking pipes and parts thereof, buttons, pencils) excluding bodies and handles, of wood, for articles of heading 96.03; or

(r) Articles of Chapter 97 (for example, works of art).

2.- In this Chapter, the expression “densified wood” means wood which has been subjected to chemical or physical treatment (being, in the case of layers bonded together, treatment in excess of that needed to ensure a good bond), and which has thereby acquired increased density or hardness together with improved mechanical strength or resistance to chemical or electrical agencies.

3.- Headings 44.14 to 44.21 apply to articles of the respective descriptions of particle board or similar board, fibreboard, laminated wood or densified wood as they apply to such articles of wood.

4.- Products of heading 44.10, 44.11 or 44.12 may be worked to form the shapes provided for in respect of the goods of heading 44.09, curved, corrugated, perforated, cut or formed to shapes other than square or rectangular or submitted to any other operation provided it does not give them the character of articles of other headings.

5.- Heading 44.17 does not apply to tools in which the blade, working edge, working surface or other working part is formed by any of the materials specified in Note 1 to Chapter 82.

6.- Subject to Note 1 above and except where the context otherwise requires, any reference to “wood” in a heading of this Chapter applies also to bamboos and other materials of a woody nature.

Subheading Notes.

1.- For the purposes of subheading 4401.31, the expression “wood pellets” means by-products such as cutter shavings, sawdust or chips, of the mechanical wood processing industry, furniture-making industry or other wood transformation activities, which have been agglomerated either directly by compression or by the addition of a binder in a proportion not exceeding 3 % by weight. Such pellets are cylindrical, with a diameter not exceeding 25 mm and a length not exceeding 100 mm.

2.- For the purposes of subheadings 4403.41 to 4403.49, 4407.21 to 4407.29, 4408.31 to 4408.39 and 4412.31, the expression “tropical wood” means one of the following types of wood :

Abura, Acajou d'Afrique, Afrormosia, Ako, Alan, Andiroba, Aningré, Avodiré, Azobé, Balau, Balsa, Bossé clair, Bossé foncé, Cativo, Cedro, Dabema, Dark Red Meranti, Dibétou, Doussié, Framiré, Freijo, Fromager, Fuma, Geronggang, Ilomba, Imbuia, Ipé, Iroko, Jaboty, Jelutong, Jequitiba, Jongkong, Kapur, Kempas, Keruing, Kosipo, Kotibé, Koto, Light Red Meranti, Limba, Louro, Maçaranduba, Mahogany, Makoré, Mandioqueira, Mansonia, Mengkulang, Meranti Bakau, Merawan, Merbau, Merpauh, Mersawa, Moabi, Niangon, Nyatoh, Obeche, Okoumé, Onzabili, Orey, Ovengkol, Ozigo, Padauk, Paldao, Palissandre de Guatemala, Palissandre de Para, Palissandre de Rio, Palissandre de Rose, Pau Amarelo, Pau Marfim, Pulai, Punah, Quaruba, Ramin, Sapelli, Saqui-Saqui, Sepetir, Sipo, Sucupira, Suren, Tauari, Teak, Tiama, Tola, Virola, White Lauan, White Meranti, White Seraya, Yellow Meranti.

Heading	H.S. Code	
44.01		**Fuel wood, in logs, in billets, in twigs, in faggots or in similar forms; wood in chips or particles; sawdust and wood waste and scrap, whether or not agglomerated in logs, briquettes, pellets or similar forms.**
	4401.10	- Fuel wood, in logs, in billets, in twigs, in faggots or in similar forms
		- Wood in chips or particles :
	4401.21	-- Coniferous
	4401.22	-- Non-coniferous
		- Sawdust and wood waste and scrap, whether or not agglomerated in logs, briquettes, pellets or similar forms :
	4401.31	-- Wood pellets
	4401.39	-- Other
44.02		**Wood charcoal (including shell or nut charcoal), whether or not agglomerated.**
	4402.10	- Of bamboo
	4402.90	- Other
44.03		**Wood in the rough, whether or not stripped of bark or sapwood, or roughly squared.**
	4403.10	- Treated with paint, stains, creosote or other preservatives
	4403.20	- Other, coniferous
		- Other, of tropical wood specified in Subheading Note 2 to this Chapter :
	4403.41	-- Dark Red Meranti, Light Red Meranti and Meranti Bakau
	4403.49	-- Other
		- Other :

4403.91	--	Of oak *(Quercus spp.)*
4403.92	--	Of beech *(Fagus spp.)*
4403.99	--	Other

44.04		**Hoopwood; split poles; piles, pickets and stakes of wood, pointed but not sawn lengthwise; wooden sticks, roughly trimmed but not turned, bent or otherwise worked, suitable for the manufacture of walking-sticks, umbrellas, tool handles or the like; chipwood and the like.**
4404.10	-	Coniferous
4404.20	-	Non-coniferous

44.05	4405.00	**Wood wool; wood flour.**

44.06		**Railway or tramway sleepers (cross-ties) of wood.**
4406.10	-	Not impregnated
4406.90	-	Other

44.07		**Wood sawn or chipped lengthwise, sliced or peeled, whether or not planed, sanded or end-jointed, of a thickness exceeding 6 mm.**
4407.10	-	Coniferous
	-	Of tropical wood specified in Subheading Note 2 to this Chapter :
4407.21	--	Mahogany (*Swietenia spp.*)
4407.22	--	Virola, Imbuia and Balsa
4407.25	--	Dark Red Meranti, Light Red Meranti and Meranti Bakau
4407.26	--	White Lauan, White Meranti, White Seraya, Yellow Meranti and Alan
4407.27	--	Sapelli
4407.28	--	Iroko
4407.29	--	Other
	-	Other :
4407.91	--	Of oak *(Quercus spp.)*
4407.92	--	Of beech *(Fagus spp.)*
4407.93	--	Of maple *(Acer spp.)*
4407.94	--	Of cherry *(Prunus spp.)*
4407.95	--	Of ash *(Fraxinus spp.)*
4407.99	--	Other

44.08		**Sheets for veneering (including those obtained by slicing laminated wood), for plywood or for similar laminated wood and other wood, sawn lengthwise, sliced or peeled, whether or not planed, sanded, spliced or end-jointed, of a thickness not exceeding 6 mm.**

	4408.10	- Coniferous
		- Of tropical wood specified in Subheading Note 2 to this Chapter :
	4408.31	-- Dark Red Meranti, Light Red Meranti and Meranti Bakau
	4408.39	-- Other
	4408.90	- Other
44.09		**Wood (including strips and friezes for parquet flooring, not assembled) continuously shaped (tongued, grooved, rebated, chamfered, V-jointed, beaded, moulded, rounded or the like) along any of its edges, ends or faces, whether or not planed, sanded or end-jointed.**
	4409.10	- Coniferous
		- Non-coniferous :
	4409.21	-- Of bamboo
	4409.29	-- Other
44.10		**Particle board, oriented strand board (OSB) and similar board (for example, waferboard) of wood or other ligneous materials, whether or not agglomerated with resins or other organic binding substances.**
		- Of wood :
	4410.11	-- Particle board
	4410.12	-- Oriented strand board (OSB)
	4410.19	-- Other
	4410.90	- Other
44.11		**Fibreboard of wood or other ligneous materials, whether or not bonded with resins or other organic substances.**
		- Medium density fibreboard (MDF) :
	4411.12	-- Of a thickness not exceeding 5 mm
	4411.13	-- Of a thickness exceeding 5 mm but not exceeding 9 mm
	4411.14	-- Of a thickness exceeding 9 mm
		- Other :
	4411.92	-- Of a density exceeding 0.8 g/cm³
	4411.93	-- Of a density exceeding 0.5 g/cm³ but not exceeding 0.8 g/cm³
	4411.94	-- Of a density not exceeding 0.5 g/cm³
44.12		**Plywood, veneered panels and similar laminated wood.**
	4412.10	- Of bamboo
		- Other plywood, consisting solely of sheets of wood (other than bamboo), each ply not exceeding 6 mm thickness :
	4412.31	-- With at least one outer ply of tropical wood specified in Subheading Note 2 to this Chapter

	4412.32	-- Other, with at least one outer ply of non-coniferous wood
	4412.39	-- Other
		- Other :
	4412.94	-- Blockboard, laminboard and battenboard
	4412.99	-- Other
44.13	4413.00	**Densified wood, in blocks, plates, strips or profile shapes.**
44.14	4414.00	**Wooden frames for paintings, photographs, mirrors or similar objects.**
44.15		**Packing cases, boxes, crates, drums and similar packings, of wood; cable-drums of wood; pallets, box pallets and other load boards, of wood; pallet collars of wood.**
	4415.10	- Cases, boxes, crates, drums and similar packings; cable-drums
	4415.20	- Pallets, box pallets and other load boards; pallet collars
44.16	4416.00	**Casks, barrels, vats, tubs and other coopers' products and parts thereof, of wood, including staves.**
44.17	4417.00	**Tools, tool bodies, tool handles, broom or brush bodies and handles, of wood; boot or shoe lasts and trees, of wood.**
44.18		**Builders' joinery and carpentry of wood, including cellular wood panels, assembled flooring panels, shingles and shakes.**
	4418.10	- Windows, French-windows and their frames
	4418.20	- Doors and their frames and thresholds
	4418.40	- Shuttering for concrete constructional work
	4418.50	- Shingles and shakes
	4418.60	- Posts and beams
		- Assembled flooring panels :
	4418.71	-- For mosaic floors
	4418.72	-- Other, multilayer
	4418.79	-- Other
	4418.90	- Other
44.19	4419.00	**Tableware and kitchenware, of wood.**
44.20		**Wood marquetry and inlaid wood; caskets and cases for jewellery or cutlery, and similar articles, of wood; statuettes and other ornaments, of wood; wooden articles of furniture not falling in Chapter 94.**
	4420.10	- Statuettes and other ornaments, of wood

4420.90 - Other

44.21 **Other articles of wood.**

4421.10 - Clothes hangers

4421.90 - Other

Chapter 94

Furniture; bedding, mattresses, mattress supports, cushions and similar stuffed furnishings; lamps and lighting fittings, not elsewhere specified or included; illuminated signs, illuminated name-plates and the like; prefabricated buildings

Notes.

1.- This Chapter does not cover :

(a) Pneumatic or water mattresses, pillows or cushions, of Chapter 39, 40 or 63;

(b) Mirrors designed for placing on the floor or ground (for example, cheval-glasses (swing-mirrors)) of heading 70.09;

(c) Articles of Chapter 71;

(d) Parts of general use as defined in Note 2 to Section XV, of base metal (Section XV), or similar goods of plastics (Chapter 39), or safes of heading 83.03;

(e) Furniture specially designed as parts of refrigerating or freezing equipment of heading 84.18; furniture specially designed for sewing machines (heading 84.52);

(f) Lamps or lighting fittings of Chapter 85;

(g) Furniture specially designed as parts of apparatus of heading 85.18 (heading 85.18), of headings 85.19 or 85.21 (heading 85.22) or of headings 85.25 to 85.28 (heading 85.29);

(h) Articles of heading 87.14;

(ij) Dentists' chairs incorporating dental appliances of heading 90.18 or dentists' spittoons (heading 90.18);

(k) Articles of Chapter 91 (for example, clocks and clock cases); or

(l) Toy furniture or toy lamps or lighting fittings (heading 95.03), billiard tables or other furniture specially constructed for games (heading 95.04), furniture for conjuring tricks or decorations (other than electric garlands) such as Chinese lanterns (heading 95.05).

2.- The articles (other than parts) referred to in headings 94.01 to 94.03 are to be classified in those headings only if they are designed for placing on the floor or ground.

The following are, however, to be classified in the above-mentioned headings even if they are designed to be hung, to be fixed to the wall or to stand one on the other :

(a) Cupboards, bookcases, other shelved furniture (including single shelves presented with supports for fixing them to the wall) and unit furniture;

(b) Seats and beds.

3.- (A) In headings 94.01 to 94.03 references to parts of goods do not include references to sheets or slabs (whether or not cut to shape but not combined with other parts) of glass (including mirrors), marble or other stone or of any other material referred to in Chapter 68 or 69.

(B) Goods described in heading 94.04, presented separately, are not to be classified in heading 94.01, 94.02 or 94.03 as parts of goods.

4.- For the purposes of heading 94.06, the expression "prefabricated buildings" means buildings which are finished in the factory or put up as elements, presented together, to be assembled on site, such as housing or worksite accommodation, offices, schools, shops, sheds, garages or similar buildings.

Heading	H.S. Code	
94.01		**Seats (other than those of heading 94.02), whether or not convertible into beds, and parts thereof.**
	9401.10	- Seats of a kind used for aircraft
	9401.20	- Seats of a kind used for motor vehicles
	9401.30	- Swivel seats with variable height adjustment
	9401.40	- Seats other than garden seats or camping equipment, convertible into beds
		- Seats of cane, osier, bamboo or similar materials :
	9401.51	-- Of bamboo or rattan
	9401.59	-- Other
		- Other seats, with wooden frames :
	9401.61	-- Upholstered
	9401.69	-- Other
		- Other seats, with metal frames :
	9401.71	-- Upholstered
	9401.79	-- Other
	9401.80	- Other seats
	9401.90	- Parts
94.02		**Medical, surgical, dental or veterinary furniture (for example, operating tables, examination tables, hospital beds with mechanical fittings, dentists' chairs); barbers' chairs and similar chairs, having rotating as well as both reclining and elevating movements; parts of the foregoing articles.**
	9402.10	- Dentists', barbers' or similar chairs and parts thereof
	9402.90	- Other
94.03		**Other furniture and parts thereof.**
	9403.10	- Metal furniture of a kind used in offices
	9403.20	- Other metal furniture
	9403.30	- Wooden furniture of a kind used in offices
	9403.40	- Wooden furniture of a kind used in the kitchen
	9403.50	- Wooden furniture of a kind used in the bedroom
	9403.60	- Other wooden furniture
	9403.70	- Furniture of plastics

		- Furniture of other materials, including cane, osier, bamboo or similar materials :
	9403.81	-- Of bamboo or rattan
	9403.89	-- Other
	9403.90	- Parts
94.04		**Mattress supports; articles of bedding and similar furnishing (for example, mattresses, quilts, eiderdowns, cushions, pouffes and pillows) fitted with springs or stuffed or internally fitted with any material or of cellular rubber or plastics, whether or not covered.**
	9404.10	- Mattress supports
		- Mattresses :
	9404.21	-- Of cellular rubber or plastics, whether or not covered
	9404.29	-- Of other materials
	9404.30	- Sleeping bags
	9404.90	- Other
94.05		**Lamps and lighting fittings including searchlights and spotlights and parts thereof, not elsewhere specified or included; illuminated signs, illuminated name-plates and the like, having a permanently fixed light source, and parts thereof not elsewhere specified or included.**
	9405.10	- Chandeliers and other electric ceiling or wall lighting fittings, excluding those of a kind used for lighting public open spaces or thoroughfares
	9405.20	- Electric table, desk, bedside or floor-standing lamps
	9405.30	- Lighting sets of a kind used for Christmas trees
	9405.40	- Other electric lamps and lighting fittings
	9405.50	- Non-electrical lamps and lighting fittings
	9405.60	- Illuminated signs, illuminated name-plates and the like
		- Parts :
	9405.91	-- Of glass
	9405.92	-- Of plastics
	9405.99	-- Other
94.06	9406.00	**Prefabricated buildings.**

Appendix C: Products Included in the Hardwood Product Group

Hardwood Logs:	**Continuously Shaped Hardwood Lumber:**	**Hardwood Plywood (at least one ply of hardwood):**
4403.31		
4403.32	440920.0003	4412.13
4403.33	440920.11	4412.14
4403.34	4409.2011a	4412.22
4403.35	4409.2011b	4412.29
4403.41	4409.2011c	4412.99
4403.49	4409.2011d	
4403.91	4409.2019	
4403.92	4409.20200	
4403.99	4409.202530	
	4409.202540	
	4409.202550	
	4409.202560	
	4409.2030	
	4409.204000	
	4409.204500	
	4409.205000	
	4409.20910	
	4409.20911	
	4409.20912	
	4409.20913	
	4409.20914	
	4409.20915,	
	4409.20919	
	4409.2099	
	4409.292530	
	4409.292550	
	4409.294560	

Hardwood Lumber: 4407.21 4407.22 4407.23 4407.24 4407.25 4407.26 4407.29 4407.91 4407.92 4407.99	**Hardwood Builder's Joinery & Carpentry of Wood (Wood panels and Flooring Panels):** 4418.300000 4418.711000 4418.712000
Hardwood Veneer: 4408.20 4408.31 4408.39 4408.90	

Appendix D: Stata Coding Used in the Analysis

The following codes and accompanying explanations can be copied into a Stata .do file.

```
*If not installed, download "synth" statistical package
ssc install synth, replace all
help synth

*designate data file
cd F:\Data

use BridegamReducedMasterFile1.28.dta, clear

*declare stata to be panel data, indicate units of observation and time variables
tsset country2 year

*Run synthetic control creation: Synthetic US
**See synth help file for information about each of these options
synth  imphwprod gdp imphwprod(2000) imphwprod(2004) imphwprod(2007), trunit(66)
trperiod(2008) xperiod(2000(1)2007) /*
*/mspeperiod(2000(1)2007) resultsperiod(2000(1)2012) keep(imphwprodSYNTH.dta)
matrix A=e(Y_synthetic)
matrix B=e(Y_treated)
matrix C=[A, B]
matrix list C

*Graph US and Synthetic US
preserve
clear
svmat C
rename C1 SyntheticUS
rename C2 US
gen year=1999+_n
line US  SyntheticUS year, lwidth(thin medthick) lpattern(solid dash) xline(2008)
xlabel(2000(4)2012) ytitle("US Imports Time Trend") ylabel(#4) title(" ")
graph export imphwprodgraph1.png, replace

*Graph Differences between US and Synthetic US
replace US=US- SyntheticUS
replace SyntheticUS=0
line US  SyntheticUS year, lwidth(thin medthick) lpattern(solid dash) xline(2008)
xlabel(2000(4)2012) ytitle("US Imports Time Trend") ylabel(#4) title(" ")
graph export imphwprodgraph2.png, replace
```

```
restore

*Falsification tests or placebo tests
**This will run synth for every unit in the donor pool, and create a new data set containing the differences between each unit and its own synthetic control
**for each unit in the time period.  These differences can be squared to retrieve MSPE for each unit and time.  Taking the square root of the MSPE and averaging
** over the pre-treatment period will provide the RMSPE (Root Mean Squared Percentage Error).  Post-treatment MSPE can also be gathered from this file for comparison.
sum country2
quietly forvalues X=1/`r(max)' {
preserve
quietly synth imphwprod gdp imphwprod(2000) imphwprod(2004) imphwprod(2007), trunit(`X') trperiod(2008) xperiod(2000(1)2007) /*
*/mspeperiod(2000(1)2007) resultsperiod(2000(1)2012)
matrix A=e(Y_synthetic)
matrix B=e(Y_treated)
matrix C=[A, B]
clear
svmat C

if `X' ==1 {
gen year=1999+_n
}
gen diff`X'=C2-C1
if `X'==1 {
keep year diff`X'
}
if `X'>1 {
keep diff`X'
merge 1:1 _n using imphwprodDIFF.dta
drop _merge
}
save imphwprodDIFF.dta, replace
restore
}


*Graph Falsification Tests on a single plot, with treatment country in bold and placebos in light gray
clear
use imphwprodDIFF.dta
gen diff0=0
local range 1.5
```

```
local plotline1
local plotline2
forvalues i = 1/68{
   if `i' != 66{
      local plotline1 `plotline1' line diff`i' year if diff`i'>-`range' & diff`i'<`range', lc(gray)
lwidth(medium) ||
   }
   else{
      local plotline2 line diff`i' year if diff`i'>-`range' & diff`i'<`range', lc(black) lwidth(thick)
legend(order(68 "US" 1 "Control Countries")) xlabel(2000(4)2012) /*
                  */xline(2008) title("US and Placebo Gaps for all 67 Countries") xtitle("year")
ytitle("Difference in Import Time Trends") ylabel(-`range' `range')||
   }
}

twoway `plotline1' `plotline2' line diff0 year, lwidth(medthick) lcolor(black) lpattern(dash)

graph export imphwprodFALS.png, replace
```

Appendix E: Country Weights for Treatment Countries in Analysis 2

Analysis 2A: Hardwood Imports from Suspicious Producer Countries

Country Weights in the Synthetic China for Analysis 2A:

Country	Weight	Country	Weight	Country	Weight
Algeria	0	Hong Kong	0.002	Philippines	0.002
Argentina	0.042	Hungary	0.002	Poland	0.004
Australia	0.009	Iceland	0.075	Portugal	0.006
Austria	0.004	India	0.04	Romania	0.005
Belgium	0.006	Indonesia	0.012	Russia	0.005
Brazil	0.049	Ireland	0.006	Serbia	0.051
Bulgaria	0.004	Italy	0.004	Singapore	0.466
Canada	0.004	Japan	0.002	Slovakia	0.002
Chile	0.008	Jordan	0.002	Slovenia	0.01
China	0.002	Latvia	0.002	South Africa	0.005
Colombia	0.004	Lithuania	0.004	South Korea	0.002
Costa Rica	0.001	Luxembourg	0.001	Spain	0.004
Croatia	0.007	Malaysia	0.004	Sri Lanka	0.037
Cyprus	0.003	Malta	0.002	Sweden	0.008
Czech Republic	0.003	Mexico	0.003	Switzerland	0.006
Denmark	0	Morocco	0.002	Taiwan	0.006
Ecuador	0.002	Netherlands	0.005	Thailand	0.008
Estonia	0.005	New Zealand	0.005	Turkey	0.008
Finland	0.005	Norway	0.004	Ukraine	0.001
France	0.004	Panama	0.001	United Kingdom	0.004
Germany	0.004	Paraguay	0.003	Uruguay	0.004
Greece	0.001	Peru	0.002	Venezuela	0.002
Guatemala	0				

Country Weights in the Synthetic Vietnam for Analysis 2A:

Country	Weight	Country	Weight	Country	Weight
Algeria	0	Hong Kong	0	Philippines	0
Argentina	0	Hungary	0	Poland	0
Australia	0	Iceland	0.296	Portugal	0
Austria	0	India	0	Romania	0
Belgium	0	Indonesia	0	Russia	0
Brazil	0.594	Ireland	0	Serbia	0
Bulgaria	0.109	Italy	0	Singapore	0
Canada	0	Japan	0	Slovakia	0
Chile	0	Jordan	0	Slovenia	0

China	0	Latvia	0	South Africa	0
Colombia	0	Lithuania	0	South Korea	0
Costa Rica	0	Luxembourg	0	Spain	0
Croatia	0	Malaysia	0	Sri Lanka	0
Cyprus	0	Malta	0	Sweden	0
Czech Republic	0	Mexico	0	Switzerland	0
Denmark	0	Morocco	0	Taiwan	0
Ecuador	0	Netherlands	0	Thailand	0
Estonia	0	New Zealand	0	Turkey	0
Finland	0	Norway	0	Ukraine	0
France	0	Panama	0	United Kingdom	0
Germany	0	Paraguay	0	United States	0
Greece	0	Peru	0	Uruguay	0
Guatemala	0			Venezuela	0

Analysis 2B: Tropical Wood Imports from Suspicious Producer Countries

Country Weights in the Synthetic China for Analysis 2B:

Country	**Weight**	**Country**	**Weight**	**Country**	**Weight**
Algeria	0.205	Hong Kong	0	Philippines	0.002
Argentina	0.001	Hungary	0.004	Poland	0.003
Australia	0.007	Iceland	0.001	Portugal	0.003
Austria	0.006	India	0.018	Romania	0.093
Belgium	0.004	Indonesia	0.001	Russia	0.004
Brazil	0.003	Ireland	0.005	Serbia	0.003
Bulgaria	0.007	Italy	0.003	Singapore	0.117
Canada	0.004	Japan	0.003	Slovakia	0.004
Chile	0.004	Jordan	0.005	Slovenia	0.241
China	0.03	Latvia	0.002	South Africa	0.002
Colombia	0.002	Lithuania	0.003	South Korea	0.004
Costa Rica	0.007	Luxembourg	0.005	Spain	0.004
Croatia	0.004	Malaysia	0.005	Sri Lanka	0.002
Cyprus	0.002	Malta	0.004	Sweden	0.003
Czech Republic	0.003	Mexico	0.003	Switzerland	0
Denmark	0.003	Morocco	0.004	Taiwan	0.003
Ecuador	0.002	Netherlands	0.003	Thailand	0.005
Estonia	0.003	New Zealand	0.004	Turkey	0.003
Finland	0.004	Norway	0.003	Ukraine	0.004
France	0.003	Panama	0.005	United Kingdom	0.003
Germany	0.004	Paraguay	0.003	Uruguay	0.004
Greece	0.089	Peru	0.001	Venezuela	0.008
Guatemala	0.205				

Country Weights in the Synthetic Vietnam for Analysis 2B:

Country	Weight	Country	Weight	Country	Weight
Algeria	0	Hong Kong	0	Philippines	0
Argentina	0	Hungary	0	Poland	0
Australia	0	Iceland	0	Portugal	0
Austria	0	India	0	Romania	0.695
Belgium	0	Indonesia	0	Russia	0
Brazil	0	Ireland	0.025	Serbia	0
Bulgaria	0.002	Italy	0	Singapore	0
Canada	0	Japan	0.001	Slovakia	0
Chile	0	Jordan	0	Slovenia	0.086
China	0	Latvia	0	South Africa	0.001
Colombia	0.183	Lithuania	0	South Korea	0
Costa Rica	0	Luxembourg	0	Spain	0
Croatia	0	Malaysia	0.001	Sri Lanka	0
Cyprus	0	Malta	0	Sweden	0
Czech Republic	0	Mexico	0	Switzerland	0
Denmark	0	Morocco	0	Taiwan	0
Ecuador	0	Netherlands	0	Thailand	0
Estonia	0	New Zealand	0	Turkey	0
Finland	0	Norway	0	Ukraine	0
France	0	Panama	0.001	United Kingdom	0
Germany	0	Paraguay	0	United States	0
Greece	0	Peru	0	Uruguay	0
Guatemala	0.001			Venezuela	0

Chapter 6: Bibliography (APA Format)

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