

The Influence of Timber Legality Regulations
on Chinese and Vietnamese Wood Products Manufacturers

Benjamin Roe

A thesis submitted in partial fulfillment of the requirements for the degrees of:

Master of Science in Forest Resources
&
Master of Public Administration

University of Washington

2015

Committee:
Dr. Ivan Eastin
Dr. Indroneil Ganguly
Dr. David Layton

Programs Authorized to Offer Degrees:
School of Environmental and Forest Sciences
Evans School of Public Policy and Governance

© Copyright 2015

Benjamin Roe

University of Washington

Abstract

The Influence of Timber Legality Regulations
on Chinese and Vietnamese Wood Products Manufacturers

Benjamin Roe

Chair of the Supervisory Committee:
Dr. Ivan Eastin
School of Environmental and Forest Sciences

Reports that a substantial proportion of the wood raw materials used by Chinese and Vietnamese manufacturers are from illegal sources have drawn significant criticism from major consumer countries who have recently implemented timber legality regulations. These regulations, which include the Japanese ‘Goho-wood’ policy, the U.S. Lacey Act, the EU Timber Regulation and the Australian Illegal Logging Prohibition Act restrict the import of illegally harvested wood and are expected to have a direct impact on major wood processing countries such as China and Vietnam.

Surveys were conducted at trade shows in Ho Chi Minh, Shanghai and Guangzhou in 2013 and 2014 to assess how these regulations influence attitudes and perceptions regarding regulations, firms’ use of chain of custody certification, and impacts on the material sourcing and export market decisions of industry managers. Survey responses were evaluated using descriptive statistics, regression analyses, cluster analysis, non-metric multidimensional scaling and analysis of similarity.

The analysis showed that as firms increase in size they reduce domestic sales and show increased awareness and support for regulation, and that firms' awareness of timber legality regulations plays a significant role in whether a firm decides to obtain certification. Analyses showed that Vietnamese firms have lower awareness of regulations while being more supportive of regulations. Chinese firms have higher awareness while having a more negative attitude towards regulations. The findings also highlighted a split between firms with a domestic focus and firms which export to foreign markets suggesting a split in the market which may reduce the impact of regulations. This segmenting of the Chinese market and to a lesser extent the Vietnamese market supports the idea that regulatory leakage is taking place, wherein sales of wood products from suspicious sources are shifting away from regulated markets and towards unregulated markets which are experiencing rapid increases in demand for wood products.

Table of Contents

ABSTRACT	3
TABLE OF CONTENTS	5
TABLE OF TABLES	8
TABLE OF FIGURES	9
INTRODUCTION	11
BACKGROUND	13
THE ISSUE OF ILLEGAL LOGGING	13
IMPACTS OF ILLEGAL LOGGING	13
ISSUE DEVELOPMENT	14
RESPONSES TO ILLEGAL LOGGING	16
INTERNATIONAL AGREEMENTS	16
CONSUMER COUNTRY RESPONSES	17
Japanese Initiative – “Goho-Wood”	17
United States Initiative –U.S Lacey Act Amendment	18
European Union Initiatives – FLEGT & the EU Timber Regulation	21
Australian Initiative - Illegal Logging Prohibition Act	23
MARKET RESPONSES – FSC AND PEFC	24
LITERATURE REVIEW	26
EVALUATING THE ILLEGAL LOGGING SUPPLY CHAIN	26
ECONOMIC MODELING OF TIMBER REGULATION IMPACTS	29
REGULATORY LEAKAGE AND SHIFTS TOWARD LESS SENSITIVE MARKETS	31
SURVEY BASED RESEARCH ON THE IMPACTS OF TIMBER REGULATIONS	33
TRADE FLOW ANALYSIS	36
ILLEGAL LOGGING SUPPLY CHAIN	36
EVALUATION OF TRADE FLOWS	37
DATA SOURCES	38
PRODUCT CATEGORIES	39
CONSUMER COUNTRY TRADE FLOWS	41
FLOORING IMPORT TRENDS	41
FURNITURE IMPORT TRENDS	44
PROCESSING COUNTRY TRADE FLOWS	48
CHINESE RAW MATERIAL IMPORTS	48
VIETNAMESE RAW MATERIAL IMPORTS	51
DISCUSSION	53

RESEARCH OBJECTIVES AND QUESTIONS	55
METHODOLOGY	57
SURVEY INSTRUMENT	57
DATA STRUCTURE	58
SURVEY RESPONSES	59
DATA ANALYSES	60
DESCRIPTIVE ANALYSIS	60
REGRESSION ANALYSES	61
MULTIVARIATE ANALYSES	62
RESULTS AND DISCUSSION	64
GEOGRAPHIC DISTRIBUTION	64
RESPONDENT DEMOGRAPHICS	65
DESCRIPTIVE ANALYSES OF SURVEY RESPONSES	68
CHAIN-OF-CUSTODY CERTIFICATION	68
CHAIN-OF-CUSTODY USAGE RATE	69
TROPICAL HARDWOODS USAGE RATE	70
CHANNELS OF DISTRIBUTION	71
AWARENESS OF TIMBER LEGALITY REGULATIONS	73
PERCEPTIONS REGARDING TIMBER LEGALITY REGULATIONS	76
LACEY ACT SPECIFIC PERCEPTION QUESTIONS	78
SHIFTS IN SALES AND SOURCING	79
FIRMS' SOURCES OF INFORMATION	87
LOGISTIC REGRESSION: DRIVERS OF CERTIFICATION USAGE	90
LOGISTIC REGRESSION	90
DATA PREPARATION	90
BIVARIATE CORRELATIONS	91
MODEL RESULTS	92
Drivers of Forest Stewardship Council Usage	92
Drivers of Programme for the Endorsement of Forest Certification Usage	94
DISCUSSION	96
FACTOR ANALYSIS OF PERCEPTIONS	97
FACTOR SCORES AND COUNTRY EFFECT	99
MODEL SELECTION	100
EFFECT OF FIRM CHARACTERISTICS ON 'INTEND TO SHIFT' FACTOR	101
EFFECT OF RESPONSE VARIABLES ON 'INTEND TO SHIFT' FACTOR	103
LINEAR REGRESSION	108
Data Preparation	108
Bivariate Correlations	110
MODEL RESULTS	111
Results of Chinese Regression Model	113
Results of Vietnamese Regression Model	114
DISCUSSION	115

MULTIVARIATE ANALYSIS TO IDENTIFY BROAD TRENDS	117
DATA STRUCTURE	118
STATISTICAL ANALYSES	119
MODEL RESULTS	120
Cluster Analysis	120
Nonmetric Multidimensional Scaling (NMDS)	122
Analysis of Similarity (ANOSIM)	128
DISCUSSION	128
CONCLUSIONS	130
SHORT-RUN POLICY IMPLICATIONS	138
BROAD POLICY RECOMMENDATIONS	138
LIMITATIONS OF THE ANALYSIS	139
IMPLICATIONS FOR FUTURE RESEARCH	140
ACKNOWLEDGEMENTS	141
REFERENCES	142
APPENDICES	151
APPENDIX A. SURVEY IN ENGLISH	151
APPENDIX B. SURVEY IN CHINESE	153
APPENDIX C. SURVEY IN VIETNAMESE	155

Table of Tables

Table 1. Suspicious producer and processing countries by region.	28
Table 2. Furniture product group HS Codes and descriptions.	39
Table 3. Flooring product group HS Codes and descriptions.	39
Table 4. UNFAO product classification groupings, wood types and product descriptions.	40
Table 5. Data structure detailing questions and variable types.	58
Table 6. Trade show dates, locations and number of firms sampled.	59
Table 7. Summary of Results for Chinese and Vietnamese Companies.	89
Table 8. Coding for variables included in logistic regression model of certification use.	91
Table 9. Bivariate Correlation Table - Logistic Regression Using Sequential Predictor Entry	92
Table 10. Multiple Logistic Regression for ‘Obtained FSC Certification’	93
Table 11. Multiple Logistic Regression for ‘Obtained PEFC Certification’	94
Table 12. Correlation Table comparing perception statements regarding timber regulations.	97
Table 13. Factor loadings based on a principle component analysis with Varimax rotation.	99
Table 14. Mean Factor Scores by Country.	100
Table 15. Coding for variables included in linear regression model	109
Table 16. Correlations between independent variables for Chinese respondents.	110
Table 17. Correlations between independent variables for Vietnamese respondents.	111
Table 18. Multiple Linear Regression with Standard and Sequential Predictor Entry	112
Table 19. Coding for variables included in multivariate analysis.	118
Table 20. Cluster descriptions based on the relative differences in proportions of responses.	121
Table 21. ANOSIM results for pairwise comparisons of firms’ annual sales revenue.	128

Table of Figures

Figure 1. Illegal logging supply chain	37
Figure 2. Japanese flooring imports by country 2004-2013.	41
Figure 3. United States flooring imports by country 2004-2013.	41
Figure 4. United States flooring imports: Percent market share by country.	42
Figure 5. European Union flooring imports by country 2004-2013.	42
Figure 6. European Union flooring imports: Percent market share by country.	43
Figure 7. Australian flooring imports by country 2004-2013.	43
Figure 8. Japanese furniture imports by country 2004-2013.	44
Figure 9. Japanese furniture imports: Percent market share by country.	44
Figure 10. United States furniture imports by country 2004-2013.	45
Figure 11. United States furniture imports: Percent market share by country.	45
Figure 12. EU furniture imports from external sources by country 2004-2013.	46
Figure 13. EU furniture imports from external sources: Percent market share by country.	46
Figure 14. EU furniture imports from internal external sources: Percent Market Share.	47
Figure 15. Australian furniture imports by country 2004-2013.	47
Figure 16. Australian furniture imports: Percent market share by country.	48
Figure 17. Chinese raw material imports by product type.	48
Figure 18. Chinese raw material imports: Percent market share by product type.	49
Figure 19. Chinese imports of coniferous raw materials by country.	49
Figure 20. Chinese imports of coniferous raw materials: percent market share by country.	50
Figure 21. Chinese Imports of Non-Coniferous Raw Materials by Country.	50
Figure 22. Vietnamese raw material imports by product type.	51
Figure 23. Vietnamese raw material imports: percent market share by product type.	51
Figure 24. Vietnamese Imports of Coniferous Raw Materials by Country.	52
Figure 25. Vietnamese Imports of Non-Coniferous Raw Materials by Country.	52
Figure 26. Response rate of Chinese firms by region.	64
Figure 27. Response rate of Vietnamese firms by region.	65
Figure 28. Reported business types of Chinese and Vietnamese firms.	65
Figure 29. Response rates of Vietnamese furniture subcategories.	66
Figure 30. Number of main business types reported by Chinese and Vietnamese firms.	66
Figure 31. Annual sales revenue reported by Chinese and Vietnamese firms.	67
Figure 32. Number of full time workers employed.	67
Figure 33. Percent of firms reporting FSC and PEFC usage.	68
Figure 34. Firms' reported use of FSC and PEFC by annual sales revenue.	68
Figure 35. Firms' use of CoC Certification by business type.	69
Figure 36. Vietnamese firms' reported use of FSC and PEFC across furniture subcategories.	69
Figure 37. Percentage of tropical hardwood usage by annual sales revenue.	70
Figure 38. Percentage of tropical hardwood use by business type.	70
Figure 39. Average percent of sales derived from different channels of distribution.	71
Figure 40. Percent of sales derived from different channels by annual sales revenue.	72
Figure 41. Percent of sales derived from different markets by business type.	72
Figure 42. Firms' awareness of timber legality regulations	73
Figure 43. Awareness of timber legality regulations and firm's annual sales revenue	74
Figure 45. Awareness of timber legality regulations and business types.	75

Figure 46. Awareness of timber legality regulations and channels of distribution.	75
Figure 47. Awareness of timber legality regulations and proportion of firms using certification.....	76
Figure 48. Firms’ perceptions regarding illegal logging and timber legality regulations.	77
Figure 49. Firms’ perceptions and experiences specific to the U.S. Lacey Act.	79
Figure 50. Changes to Firm’s Sales over the Last 5 Years.....	80
Figure 51. Changes to Firm’s Sourcing over the Last 5 Years.....	80
Figure 52. Changes in firms’ sales to the US by annual sales revenue.	81
Figure 53. Changes in Chinese firms’ sourcing from Southeast Asia by annual sales revenue.	81
Figure 54. Comparison of sales to U.S. and EU against awareness of the Lacey Act and EUTR.	82
Figure 55. Firms’ sales to the U.S. and SE Asia and awareness of the U.S. Lacey Act and EUTR.	83
Figure 57. Sales to SE Asia and Russia and firms intending to increase sales to unregulated markets.	84
Figure 56. Sales to the U.S. and SE Asia and firms who intend to increase domestic sales.	84
Figure 58. Chinese sales and percent of firms that believe regulations are a trade barrier.	85
Figure 59. Sales to the U.S. and EU and regulatory leakage questions responses.	86
Figure 60. Where firms reported they would go to get information about timber legality regulations.	87
Figure 61. Reported sources of information on timber legality regulations by business type.....	87
Figure 62. Reported sources of information on timber legality regulations by annual sales. revenue..	88
Figure 63. Interaction of PEFC usage and annual sales revenue.....	95
Figure 64. Scree plot of Eigenvalues against potential factors.	98
Figure 65. Mean scores on ‘Intend to Shift’ factor for Chinese and Vietnamese firms.	100
Figure 66. Mean factor scores and annual sales revenue.....	101
Figure 67. Mean factor scores by furniture manufacturer category.....	101
Figure 68. Factor scores for Chinese furniture and flooring firms by annual sales revenue.	102
Figure 69. Mean factor scores and usage of FSC certification.	103
Figure 70. Mean factor scores & familiarity with the Lacey Act.	103
Figure 71. Mean factor scores and familiarity with the EU Timber Regulation.	104
Figure 72. Mean factor scores and sales to the United States over the last 5 years.....	104
Figure 73. Mean factor scores and domestic sales over the last 5 years.....	105
Figure 74. Mean factor scores and sourcing from the United States over the last 5 years.	106
Figure 75. Mean factor scores and sourcing from Russia over the last 5 years.....	106
Figure 76. Mean factor scores and sourcing from Southeast Asia over the last 5 years.	107
Figure 77. Mean factor scores and sourcing from the Domestic market over the last 5 years.	107
Figure 78. Hierarchical cluster dendrogram with four optimal clusters highlighted.	120
Figure 79. Comparison of cluster responses to perceptual and demographic questions.	121
Figure 80. Vector plot of firms’ awareness of timber legality regulations.	123
Figure 81. Vector plot of firms’ responses to perceptual questions.	123
Figure 82. NMDS quadrant descriptors.	124
Figure 83. NMDS ordination of overall firm responses plotted by firm location.	125
Figure 84. NMDS ordination of firm responses and percent sales revenue from domestic market. ...	126
Figure 85. Plots of firms’ annual sales revenue overlaid over NMDS ordination.....	127

Introduction

Illegal logging is one of the most prominent global forest policy issues of the day, and refers to the harvest, transport, purchase or sale of timber in violation of local, national or international regulations (Sheikh, 2007). The practice of illegal logging has wide ranging environmental effects and results in deforestation, decreased biodiversity and the loss of endangered species (Nellemann 2012). These practices have severe social and economic impacts, resulting in the marginalization and expulsion of indigenous communities who depend on forests for their livelihoods (The World Bank 2006b), undermining the rule of law by aiding criminal organizations and promoting corruption (Nellemann 2012) and causing an estimated \$15 billion in lost assets and government tax revenues annually (The World Bank 2006a).

In response to the problem of illegal logging several major consumer countries have implemented timber legality regulations which restrict the import of illegally harvested wood products and have imposed requirements on importers and exporters to ensure legality. These approaches include the Japanese 'Goho-Wood' policy in Japan, the Lacey Act Amendment in the United States, the European Union's Timber Regulation, and most recently Australia's Illegal Logging Prohibition Bill. These programs use a variety of mechanisms to regulate wood products which include fines and penalties, partnership agreements between importing and exporting nations, as well as the use of certifications by third party organizations.

Past research on timber legality regulations have primarily used economic models to estimate the economic and market effects of timber legality regulations globally (Seneca Creek Associates 2004; Moiseyev 2010; Bosello et al. 2013; Prestemon 2014). However, to date there has been little assessment of the impacts of these regulations at the national level or by sectors within the wood products industry, and emerging markets for wood products have largely been overlooked. This study focuses on "suspicious processing countries," nations that are noted in the literature as being major importers of illegally harvested wood as well as major manufacturers and re-exporters of primary and secondary wood products (Li et al. 2008; Lawson and MacFaul 2010; Bridegam and Eastin 2014). This limited set of countries serves as a chokepoint in the illegal timber supply-chain, and as a result targeting this subset of countries allows for a more focused assessment of the impacts of policies on wood products manufacturers and traders and in turn the effects these regulations may have further down the supply chain.

Specifically, this study will focus on China and Vietnam, and targets individual furniture and flooring manufacturers and wood products traders as a way to evaluate the impacts of policy instruments on business practices in these processing countries. China is the largest furniture manufacturer and exporter in the world, the largest furniture supplier to the United States as well as the largest external supplier of furniture to the European Union (GTIS 2015a). Vietnam is an emerging market with a large and rapidly growing wood furniture manufacturing sector whose exports are strongly directed towards the United States. In recent years, numerous reports have been published which detail that a substantial proportion of the raw materials used by Chinese and Vietnamese manufacturers are from illegal sources (Seneca Creek Associates 2004; EIA and Telepak 2008; EIA 2011, 2015b). This has been met with backlash from major consumer countries and there has been increasing pressure by China and Vietnam's trading partners for industry reform. Due to this political pressure, the strong connection between these countries and the U.S. and European markets, as well as

China and Vietnam's geographic proximity to Japan and Australia, it is expected that China and Vietnam will be directly impacted by recently enacted timber legality policies.

In order to better understand the impact of timber legality regulations on business practices in Vietnam and China, researchers from the Center for International Trade in Forest Products (CINTRAFOR) at the University of Washington administered surveys in 2013 and 2014 at home and furniture trade shows in Ho Chi Minh, Vietnam and Shanghai and Guangzhou, China. The sample population for this study was comprised of individual companies based in Vietnam and China which are involved in the manufacture of wood furniture and flooring products as well as firms which import and export wood products. The survey results were evaluated using descriptive statistics to assess response frequencies, regression analyses were used to identify relationships between dependent and independent variables, and finally multivariate analysis was performed to highlight groupings of firms with regard to their perceptions and identify broad patterns in the dataset. In addition, an analysis of trade flows was performed to address recent trends in the global forest products market as they relate to the illegal logging supply chain.

This study aims to provide evidence to clarify the effects of timber legality regulations on the Chinese and Vietnamese wood products industry, with a specific focus on the U.S. Lacey Act and the EU Timber Regulation. Of particular interest are firms' attitudes and perceptions regarding regulations, the impacts these may have on sourcing and sales decisions and the choice to obtain chain-of-custody certification and how demographic characteristics influence firm behavior. The overarching goal of this research is to identify how Chinese and Vietnamese firms have changed their behavior in response to timber legality regulations, and whether there are fundamental differences in the drivers of behavior between firms in the two countries. Of particular interest is the issue of regulatory leakage and this research will consider whether firms have made a conscious choice to shift away from regulated markets and toward unregulated and domestic markets as well as the characteristics of firms which have this intention to shift.

Background

The Issue of Illegal Logging

Illegal logging is one of the most prominent global forest policy issues of the day (Tacconi 2007). While it has a variety of definitions, in its broadest sense the term illegal logging refers to the harvest, transport, purchase, or sale of timber in violation of local, national or international regulations (Sheikh 2007). Illegal logging covers a wide variety of activities and because of differences in the domestic laws which govern forest practices, there is no international definition of illegal logging. As a result, the term covers a broad array of activities ranging from more minor violations of the law such as illegally harvesting of firewood and transport of forest products without a permit to more serious acts such as logging large areas within national parks or harvesting endangered tree species (Seneca Creek Associates 2004). However, there are a few practices which rise to a level of international significance due to their severe impacts on the environment and the extent to which they counteract efforts to implement sustainable forest management. These significant activities include, harvesting in protected areas, harvesting timber in excess of concession limits, tax fraud, coercion of local communities, bribery of local leaders, and violations of international agreements (Seneca Creek Associates 2004).

Impacts of Illegal Logging

The practice of illegal logging has wide ranging negative environmental, social and economic impacts at both the local and global scale. The immediate effects of illegal logging include loss of biodiversity, soil erosion and subsequent water pollution, forest fires, flash flooding and landslides (Lawson and MacFaul 2010). A large amount of illegal logging occurs in formally protected forests, especially in tropical countries which are home to a large proportion of the world's biological diversity (Nellemann et al. 2007) and illegal logging in these areas results in significant biodiversity loss and environmental degradation. Leading world economies have recognized that illegal logging contributes to unregulated deforestation which in turn impacts climate systems through the reduction of forest cover (G8 Summit 2005). This tropical deforestation has been found to contribute significantly to greenhouse gas emissions and climate change (Harris et al. 2012) and threaten the survival of nearly half the earth's biodiversity (Global Witness 2013). As a result of poor management associated with deforestation and huge carbon emissions caused by the clearing of peat forests, illegal logging is thought to be responsible for an estimated 20% of global CO₂ emissions and is a major driver of climate change (Lawson and MacFaul 2010).

Illegal logging has direct impacts on the livelihoods of indigenous residents who rely on forests for food, building materials, fuel, non-timber forest products and the ecosystem services associated with intact forest ecosystems (The World Bank 2006b). These practices result in the marginalization and expulsion of indigenous communities who depend on forests for their livelihoods, leading to food insecurity and poverty (SUHAKAM 2007) which is thought to threaten the existence of nearly one billion forest dependent peoples worldwide (Lawson and MacFaul 2010). A 2012 report by INTERPOL and the United Nations Environment Program provides extensive evidence of the strong connections between illegal logging and organized crime groups (Nellemann 2012). Criminal groups involved in illegal logging harm local communities through the environmental damage caused by logging practices, and also through threats of violence, murders, corruption of officials, fraud,

extortion and money laundering (INTERPOL/World Bank 2009). Countries with weak governance structures and high levels of corruption have been found to supply the highest proportion of illegally harvested wood (Seneca Creek Associates 2004). Illegal logging also undermines the rule of law and has been identified as a major source of financing for conflicts in parts of Africa and Southeast Asia, where it is referred to as blood timber or conflict timber (Thomson and Kanaan 2003).

As a result of this corruption, money is diverted from local communities and governments to the benefit of a small group of individuals and corrupt organizations (EIA 2010). The World Bank estimates that illegal logging on public land results in over \$10 billion in lost assets and revenue annually and an additional \$5 billion lost annually to governments from evasion of taxes and permitting fees (The World Bank 2006a). The lower cost structure of illegal logging operations puts producers of legitimate wood products who operate in compliance with national laws at a competitive disadvantage compared to less scrupulous firms (Seneca Creek Associates 2004; European Commission 2007).

Due to its illicit nature, it is difficult to estimate the market share of illegal wood within the global timber trade. Studies of the global timber market suggest that illegal products make up 5-10% of global roundwood production, including 2-4% of the softwood lumber and plywood and 23-30% of the hardwood lumber and plywood traded globally. Illegal timber results in a 7-16% reduction in world timber prices (Seneca Creek Associates 2004). A recent report by INTERPOL suggests that illegal logging accounts for 50-90% of the volume of all forestry in key tropical producer countries and as much as 15-30% of global forest production (INTERPOL/World Bank 2009). While it is difficult to evaluate the financial losses from illegal logging, one estimate puts the environmental and social costs associated with illegal logging at \$60 billion a year and values the financial losses to legal producers at \$46 billion a year (Park 2010). This value is largely captured by the perpetrators of illegal logging as well as consumers of wood products.

Issue Development

Illegal logging is currently a focus of the international community, and the practice is framed with regards to its harmful impacts on the environment, rule of law and the global economy. However, illegal logging hasn't always been given such a high level of attention and the framing of this issue has changed dramatically over the last twenty-five years. The current emphasis comes as a result of concerted efforts to expand and redefine the issue of forest conservation and global warming.

In the early 1990s, the issue of illegal logging was not a major focus of forest policymakers at the global scale. In response to the increasing threat posed by global environmental problems, the United Nations Conference on Environment and Development was held in Rio De Janeiro in 1992 (Guha 2000). The 'Earth Summit,' with one hundred and eighty countries present, was the largest conference ever held focusing on environmental policy at the global scale. The main focuses of the Rio conference were deforestation, climate change and biodiversity loss. At the time, illegal logging was recognized to be an underlying condition that contributed to deforestation but since it was tolerated, it did not play a prominent role in the summit agenda. While environmentalists representing developed countries from the Northern hemisphere sought to strengthen global control over forest resources, they were met with significant pushback by their Southern counterparts. Opponents to global governance of forest resources argued that forests were a community resource and pushed for

devolution of the issue of deforestation and biodiversity loss to the national level. In the end, the disputes at the Earth Summit resulted in gridlock and the opposing sides were unable to come to an agreement on the issue of forest conservation.

In spite of major campaigns in the early 1990s by environmental organizations like the World Wildlife Fund and Greenpeace to save the rainforest and protect biodiversity, framing the issue of forest conservation in these terms generated continued pushback from developing countries which were the largest contributors to forest loss. Throughout the early 1990s, the debates over deforestation and loss of biodiversity were framed by local governments as a sovereign domestic issue, which resulted in resistance to international efforts to address the problem (Ravenel et al. 2005).

In the late 1990s, environmental NGOs re-defined the issue of forest conservation by shifting the emphasis towards illegal logging. This effort was initiated by the Environmental Investigation Agency in 1996, which expanded the issue of illegal logging to include weak governance, corruption and rule-of-law issues (Tacconi 2007). Reframing illegal logging as a threat to the efforts of fledgling democracies to gain both political and economic stability moved the debate from that of a contentious sovereignty issue to a problem for which relief should be sought. This also shifted the scope of the issue from a domestic focus, to an international focus that required a concerted effort by the global community. The efforts of the Environmental Investigation Agency were reinforced by organizations like Greenpeace, the World Resource Institute and the World Wide Fund for Nature who started public awareness campaigns designed to provide illegal logging with a more prominent position on the policy agenda.

In 1997, Indonesia was struck with one of the world's largest wildfire events in the last two centuries, lasting ten months and resulting in the destruction of over ten million hectares of forest that created a haze which covered an area almost the size of Europe (Schroeder-Wildberg and Carius 2005). Environmental NGOs used this as a framing event to move illegal logging into a more prominent position on the global agenda. The World Resource Institute created a causal story that the Indonesia fires were the direct result of the unsustainable forest practices associated with illegal logging, practices which were perpetuated by a culture of corruption within the Indonesian government (Barber and Schweithelm 2000). The estimate that the Indonesia fires caused approximately 30% of all manmade CO₂ emissions between 1997 and 1998 successfully linked illegal logging to the broader issue of global warming, further strengthening the need for the global community to take action.

This causal story propelled the issue of illegal logging to the top of the international environmental agenda and led to the organizing of the Forest Law Enforcement and Governance Process which was held in Bali in 2001. This conference, sponsored by the UN Food and Agriculture Organization and the World Bank, brought together ten Pacific Rim nations, the United States and Great Britain and resulted in the adoption of the 'Bali Declaration' also known as the Declaration on Forest Law Enforcement and Governance (FLEG) in which timber producing and consuming countries agreed to intensify national efforts, and strengthen multilateral collaboration to address illegal logging and its associated trade (Contreras-Hermosilla 2007). Subsequent conferences resulted in the establishment of regional FLEG processes in East Asia and the Pacific, Africa, Latin America, Europe and North Asia, as well as the European Neighborhood Policy Initiative (ENPI) which encompasses a number of eastern European nations.

In 2005, members of the G8 Summit supported the Gleneagles Communique which recognized “the impacts that illegal logging, associated trade, and corruption have on environmental degradation, biodiversity loss, and deforestation and hence climate systems,” and committed to take steps to “halt the import and marketing of illegally logged timber” through action from both timber producing and timber consuming countries (G8 Summit 2005). These processes have put a spotlight on illegal logging and led to an increase in efforts to combat illegal logging by consumer nations and international institutions.

Responses to Illegal Logging

International Agreements

Until recently, the only mechanisms with enforcement provisions to regulate international trade in timber products have been the World Trade Organization’s (WTO) trade policies and the Convention on the International Trade in Endangered Species (CITES). The WTO was established in 1995 and oversees a set of agreements to regulate and liberalize international trade based around the General Agreement on Tariffs and Trade (GATT). These agreements set out broad principles that must be interpreted and applied in disputes between member states (WTO 2015). While the WTO generally forbids restrictions on trade, there are a few exceptions where trade restrictions can be imposed, including the trade in illegal products. These exceptions are outlined in GATT Article XX and include circumstances related to customs enforcement, the prevention of deceptive practices and measures related to the conservation of exhaustible natural resources (GATT 1986). While it would be feasible for the WTO to address trade in illegally harvested timber, there has never been a dispute case involving trade measures taken to reduce illegal logging, or to keep illegal timber products out of international markets and it is not known exactly how a dispute panel would rule on the case (Brack 2013).

Established in 1973, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an international agreement aimed at ensuring that the international trade in wild plants and animals does not threaten their survival (Tibbets 2011). CITES is a voluntary international treaty between governments which includes provisions for the protection of both endangered species as well as species that may become threatened with extinction unless trade is closely controlled (CITES 2005). The convention has been ratified by 180 countries, however due to differences in how the treaty is implemented between participating countries there are varying levels of control in the trade of species identified in the convention (CITES 2012). While CITES does provide a mechanism for the international community to address the trade of 28,000 threatened plant species, the treaty has been difficult to enforce systematically and has not succeeded in eliminating illegal logging activities (Bridegam and Eastin 2014). The convention only restricts the trade of listed species and only a few commercially important timber species are listed under CITES (Seneca Creek Associates 2004). In addition there have been allegations of issuance of fake permits, misclassification of listed species as well as a lack of correlation between CITES data and official trade data (Seneca Creek Associates 2004). Blundell et al. found large customs discrepancies between U.S. imports of timber and source exporting countries and noted that customs officials rely heavily on CITES documents to verify legality. As a result, improperly awarded CITES permits may provide a false veneer of legality and in essence ‘legalize’ wood which was harvested in violation of the law in its country of origin (Blundell and Rodan 2003).

Consumer Country Responses

Following the 2001 Bali Declaration and adoption of the FLEG declaration, a number of approaches have been implemented by consumer nations to respond to the problem of illegal logging. These approaches include the Goho-Wood policy in Japan, the Amendment to the Lacey Act in the United States, the European Union's FLEGT and Timber Regulation policies, and most recently Australia's Illegal Logging Prohibition Bill. These programs use a variety of mechanisms to regulate wood products by targeting different segments of the timber supply chain. The following section will discuss the details of these regulations and studies to date which have evaluated these timber legality policies.

Japanese Initiative – “Goho-Wood”

Based on the discussions at the 2005 G8 summit in Gleneagles, the Japanese government committed to establishing public timber procurement policies that favor legal timber and passed the Policy on Promoting Green Purchasing as part of the Japanese Green Purchasing Law in 2006 (Japan Federation of Wood Industry Associations 2006). This policy is commonly referred to as *Goho-Wood* or 'Legal-wood' and is aimed at promoting government procurement of wood products with verified legality. The policy evaluates products on the criteria that the item is in compliance with forestry laws in its country of origin and that it is obtained from a forest where it is “possible to reasonably explain that sustainability is secured” (Japanese Ministry of Environment 2007).

The Japanese Forestry Agency verifies legality and sustainability through three principal methods (Forestry Agency of Japan 2006). These include verification through:

- i. A third party forest certification system such as Forest Stewardship Council (FSC), Programme for the Endorsement of Forest Certification (PEFC), or the Sustainable Green Ecosystem Council (SGEC), a certification scheme developed by the Japanese Forest Ministry which is now a member of the PEFC (PEFC 2014a) . Proof of legality is shown with a certification seal from a third party institution and documentation of payments related to the chain of custody.
- ii. An industry association's voluntary code of conduct wherein the association certifies individual companies who then show proof of legality through a series of documents and receipts passed from seller to purchaser at each transaction, creating a chain of verification.
- iii. By an original measure set up by corporations wherein proof of legality is shown through documentation of the distribution process from harvesting to delivery.

Goho-Wood is a highly co-operative policy which encourages trade associations to participate in the regulatory process, resulting in guidelines which clearly state the steps companies must take to achieve compliance. However, this policy does not give regulators strong enforcement tools as there are no fines or penalties imposed for companies which continue to import illegal products (EIA 2013c; Momii 2014a).

Following implementation the policy, Japan has faced significant criticism regarding the efficacy of Goho-wood. Japan is the world's fourth largest consumer of imported timber products and second largest importer of tropical timber behind China (Lawson and MacFaul 2010). However, in spite of the Goho-wood policy, a 2010 report concluded that Japan was the largest per capita consumer of illegal wood products among major consumer countries and that approximately 9% of wood-based products imported into Japan were at high risk of illegality (Lawson and MacFaul 2010). Follow-up reporting has found that the proportion of high-risk imports of timber-sector products into Japan remained constant from 2010 to 2013 (Momii 2014a).

Criticisms of Goho-wood include the fact that the policy has no enforceable provisions or penalties for non-compliance (EIA 2013c; Momii 2014a). While under the regulation suppliers are merely required to disclose records of their supply chain, a recent survey revealed that 25% of the suppliers required to disclose this information failed to check the legality of their wood product supply (Global Environmental Forum 2013; Momii 2014a). The Goho-wood policy only prohibits the use of illegal timber products by Japanese central government agencies which only make up 5% of total Japanese timber consumption (Global Witness 2013). While regional agencies carry out three times as many economic activities as the central government, they are only required to 'make efforts' to conform to Goho-wood. A 2012 survey by the Ministry of the Environment found that only one-third of local governments had applied procurement policies to public works (Momii 2014a). Additionally, while Japan uses large volumes of plywood for concrete forming (which commonly is made from tropical wood), plywood is excluded from the Goho-wood regulation (Japanese Ministry of Environment 2007).

Under the Goho-wood system, buyers are only required to verify legality through the documentation provided by their immediate supplier and government and industry associations have claimed an increasing percent of their wood products as legal under the Goho-wood policy (Global Witness 2013). A large proportion of these 'legal' products make use of export permit documents from Sarawak in Malaysia and the Russian Far East as proof of legality. However recent investigations have revealed that the forestry sector in Sarawak and Russia are responsible for carrying out well-documented and systematic illegal logging and false permitting (EIA 2013b; Global Witness 2013). Together, these deficiencies in the Goho-wood policy call into question the reliability of Japan's system for verifying the legality of its timber and have resulted in calls for the Japanese government to implement reforms and close its market to illegal timber (EIA 2013c).

United States Initiative –U.S. Lacey Act Amendment

Following the 2001 Bali Declaration, concern over the contribution of illegal logging to climate change began to gain traction in the United States, which led to President George W. Bush's introduction of the "President's Initiative Against Illegal Logging" in 2002, which called illegal logging 'a practice that destroys biodiversity and releases millions of tons of greenhouse gases into the atmosphere' (Bush 2002). In spite of the increasing profile of illegal logging on the U.S. policy agenda, there were few moves by the U.S. Executive or Legislative branch to take steps to address the problem at the domestic level. However, this began to change in 2004, when the American Forest and Paper Association (AF&PA), the national trade association of the U.S. forest products industry became involved in the issue of illegal logging. The AF&PA commissioned a report by Seneca Creek Associates which indicated that "illegal material depresses world prices by 7% - 16% on average, and

U.S. prices by 2% to 4%, depending on the product” (Seneca Creek Associates 2004). The report found that the financial costs of illegal logging to U.S. forest products firms were more than \$460 million annually. This report expanded the issue of illegal logging to include direct impacts to the U.S. economy and influential industry interests. The AF&PA supported an import ban on illegally harvested forest products with the belief that removal of illegal products from the supply chain would directly increase revenues of U.S. timber producers (Seneca Creek Associates 2004).

The Seneca Creek Associates report made a direct connection between illegal logging and harm to the U.S. economy which pushed industry groups to lobby Congress to take action. This economic argument worked in tandem with calls by academics (Ravenel and Granoff 2004) and NGOs such as Greenpeace (Greenpeace 2000), the Environmental Investigation Agency/Telepak Indonesia (Newman et al. 2000), Global Witness (Global Witness 1999) and World Resources International (WRI 2003) for major consumer nations to take action to address the social and environmental impacts of illegal logging. The support by academic groups, NGOs and industry groups for the U.S. government to take action culminated in the 2008 action by the United States Congress to expand the scope of the Lacey Act to prohibit the import of illegally harvested wood and non-wood forest products.

The Lacey Act was originally enacted in 1900 and made it a federal crime to hunt or trade endangered animals and wild birds. Subsequent amendments to the bill allowed for the inclusion of reptiles, amphibians and indigenous plants (Shelley 2012). However, the 2008 Amendment to the Lacey Act, which the U.S. Congress implemented as part of the 2008 Farm Bill significantly changed the original Act (US Congress 2008). The 2008 Amendment extended the Lacey Act’s definition of plants to include trees and added protections against products made from illegally harvested plants (Shelley 2012). Under the Act, to qualify as a violation, a plant must first be harvested, sold or exported in violation of United States law or the law of a foreign country, then the product must be imported into the U.S. or be exchanged in interstate commerce (EIA 2010).

The Lacey Act sets out rules requiring importers to submit an import declaration form stating the specific sourcing information of all wood materials included in their products. This documentation must include information regarding the plant’s genus and species, the country from which it was taken and the quantity and value of the wood. The penalties for violations of the Lacey Act include potential criminal felony charges, fines up to \$250,000 for individuals and \$500,000 for organizations, forfeiture of goods and up to five years imprisonment (USDA/APHIS 2012).

The Lacey Act does not include specific compliance standards against which firms are evaluated. Instead, the Lacey Act sets a "due care" standard to evaluate companies’ efforts in securing legality. *Due care* is defined as “the degree of care at which a reasonably prudent person would exercise under similar circumstances” (Saltzman 2010). Under such a definition, importers' efforts are evaluated based on whether regulators believe they took the appropriate actions to minimize the risk of purchasing illegally harvested materials. Thus, compliance is a flexible concept, and it cannot be guaranteed by any specific documents or checklist (Saltzman 2010).

Although the Lacey Act was amended in 2008, over the last seven years it has only been enforced on a limited basis, with one small initial seizure in 2009 (USDOJ 2010), two charges brought against Gibson guitar (Shelley 2012) and an ongoing investigation against Lumber Liquidators (EIA

2013b). The first enforcement action under the Lacey Act Amendment occurred in August 2009, when agents of the U.S. Fish & Wildlife Service seized three pallets of tropical hardwood as they entered the Port of Tampa, Florida from Iquitos, Peru (Hanson 2010). The pallets contained numerous species of decorative woods which violated the Lacey Act's declaration requirements and showed substantial evidence of using stolen and forged documents. The shipment, valued at \$7,150, was seized and following an appeal, the goods were forfeited to the United States government (USDOJ 2010).

Gibson Guitar was raided a few months later in November 2009 and again in 2011 by federal agents and charged with importing illegally harvested ebony from Madagascar and rosewood from India. In 2012, Gibson guitar settled the first case under a criminal enforcement agreement, wherein the company acknowledged that they illegally purchased and imported ebony wood from Madagascar (USDOJ 2012). U.S. prosecutors opted to not pursue charges related to the rosewood imported from India as the tariff rules were found to be inconsistent and required clarification (Alexander 2014). As part of the settlement agreement Gibson paid \$350,000 in penalties and forfeited \$260,000 in wood seized over the course of the criminal investigation (USDOJ 2012).

Lumber Liquidators was raided by federal investigators in September 2013 (Lumber Liquidators 2013) and is currently being investigated for importing illegally harvested wood from Russia through a Chinese middleman in the form of hardwood flooring (EIA 2013b). In a U.S. Securities and Exchange Commission (SEC) annual report filed in February 2015, Lumber Liquidators revealed that the U.S. Department of Justice is contemplating criminal charges under the Lacey Act for importing illegally harvested wood (Lumber Liquidators Inc. 2015). This report closely followed the December 2014 announcement that the Russian suppliers for Lumber Liquidators, the Russian timber company Beryozoviy, were found guilty by a Russian criminal court of fifteen counts of illegal logging from 2010-2012 and participation in a criminal network. The individuals charged received sentences of up to 15 years imprisonment (Russian Federation 2014; EIA 2015b).

The 2008 Lacey Act has drawn criticism for its lack of clear standards and inconsistent enforcement (Shelley 2012). Industry advocates argue that the policy makes it impossible for importers to be sure they are operating within the law (Sheikh 2012; US House of Representatives 2013). In addition, the Lacey Act lacks a mechanism for collaboration between the U.S. and exporting countries to clarify foreign laws (Shelley 2012). As part of the Act, importers must not only conform with United States law but also all foreign laws and treaties (Alexander 2014). This puts companies at risk because through the Lacey Act they are subject not only to U.S. laws but also to U.S. courts' interpretations of foreign laws which relate to the timber trade. The U.S. Department of Agriculture has stated that "it is the responsibility of the importer to be aware of any foreign laws that may pertain to their merchandise prior to its importation into the United States" (USDA/APHIS 2012). The USDA has stated that it has no plans to release comprehensive guidelines for Lacey Act compliance and has no plans to create a single database containing foreign laws that pertain to the Lacey Act (USDA/APHIS 2012).

In addition, while it is relatively straightforward for importers of raw materials to denote the sourcing of their products, for more highly processed products, it can be prohibitively difficult to identify the source countries of all of the materials included, let alone prove their legality (Shelley 2012). With the increased frequency of forged paperwork in the timber industry (Nellemann 2012), even the use of certified wood and receipts provided by suppliers is not necessarily sufficient to meet

the standard of due care. Importers must not only obtain documentation regarding the chain of custody of their product, but they must also investigate the legitimacy of these documents (Shelley 2012).

Not knowing how the US government will enforce the policy results in a situation where every transaction carries the risk of product seizure, forfeiture, fines and penalties (Shelley 2012). Businesses which import wood products to the United States have reported high compliance costs as well as difficulty managing risk as they are unsure what steps they must take to operate within the law (Shelley 2012; US House of Representatives 2013). This uncertainty has made it necessary for firms to implement risk management procedures to ensure the legality of their supply chain. Not only do businesses face considerable costs as a result of the U.S. Lacey Act Amendment, but implementation costs are high for the U.S. government. Under the Act, the U.S. government bears the burden of proof and to prosecute criminal charges they must demonstrate beyond a reasonable doubt that a firm knowingly traded in 'tainted' material (APHIS 2009). In reaction to these criticisms, there have been several attempts by Republican senators to alter the Lacey Act Amendment and reframe the debate. These senators argue that the Lacey Act is detrimental to business interests and causes undue legal risk and expense. The RELIEF Act was placed on the House Calendar in 2012, which sought to re-amend the Lacey Act (US Congress 2012). However, Republican leaders later canceled plans for a floor vote and effectively pulled the bill from further consideration by the 112th Congress (FSC 2013b).

European Union Initiatives – FLEGT & the EU Timber Regulation

Following the 2001 FLEG process in Bali which resulted in an initial agreement to address illegal logging and related trade, the European Union widened the scope of its commitment to include the implementation of policies which restrict imports of illegal timber into the EU (Contreras-Hermosilla 2007). The European Commission adopted the *Forest Law Enforcement, Governance and Trade* (FLEGT) Action Plan in May 2003 which served as a policy platform for combatting trade in illegally logged timber and provides a number of measures to exclude illegal timber from European markets (URS 2013).

The two main instruments of the FLEGT Action Plan included Voluntary Partnership Agreements (VPAs) between the EU and timber exporting countries and Timber Legality Assurance Systems (TLAS) for felled timber (Pfeil 2007). Voluntary partnership agreements are bilateral agreements between the European Union and timber exporting countries which aim to improve forest governance and guarantee that timber and timber products exported to the EU from partner countries are legally harvested (van Dam and Savenije 2011). VPAs are voluntary in nature but once entered into they are legally binding and commit both parties to trade only in legally harvested timber. The concept behind VPAs was that timber producing countries would enter into a VPA as a way to ensure access to European markets. EU member states saw VPAs as a way to provide economic incentives for improving forest governance globally (EFI 2009). There are currently six countries which have established VPAs and signed legally binding trade agreements with the EU to ensure timber legality. Signatories include Cameroon, the Central African Republic, Ghana, Indonesia, Liberia and the Republic of the Congo. Nine other countries are currently in negotiations with the EU to establish VPAs (EFI 2015).

An important part of the VPA was the establishment of Timber Legality Assurance Systems (TLAS) which set out a program to identify and license legally-produced timber and ensure that exports to the EU exclude any illegal timber products. VPA partner countries committed to regular

auditing of legal compliance by partner governments as well as independent third party inspections. The EU has implemented these agreements in a series of phases which include (1) Preparation, (2) Negotiations, (3) Development of Timber Legality Assurance Systems, and finally (4) Full implementation. At this time all six VPA partner countries are still in the process of full implementation and have not established a final FLEGT licensing scheme (EFI 2015).

The EU Timber Regulation (EUTR) legislation was developed to bring the FLEGT Action Plan into the full implementation across all EU member states. The EUTR, which was passed in 2010 and came into full effect on March 3rd, 2013 prohibits the import of illegally harvested timber or timber products into EU markets (URS 2013). The EUTR covers both operators who place timber products on the EU market for the first time and traders who buy or sell timber products produced within the EU market. Both groups are legally responsible for using *due diligence* to minimize the risk of bringing illegally harvested timber products into the market. Operators are required to make efforts to prove that legality is reasonably demonstrated by gathering information describing the timber products used, their country of harvest, species and details of the supply chain and compliance with national legislation in the country of origin. This information is used in conjunction with a risk assessment which evaluates the risk that there is illegal timber in their supply chain. Finally, if operators face more than a negligible risk they must implement a risk mitigation system which can include procuring additional information and documents or using third party certification to verify the legality of products. Traders are only required to keep information on their suppliers and customers so that wood can be traced by EU authorities (European Commission 2013b)

Since its establishment in 2013, enforcement of the EUTR has been limited and only three enforcement actions have received significant attention in the media (ClientEarth 2015). In 2013, the German authorities seized two shipments of timber from the Democratic Republic of Congo based on information from Greenpeace that the timber was illegally logged (NEPCon 2013a; ClientEarth 2015). The German authorities found that the timber had been shipped to the EU using falsified documents. The defendants lost their appeal and the wood, valued at €120,000 will be auctioned and proceeds will go to the state (GTF 2015).

In October 2014, the Belgium authorities seized six containers of timber from Brazil after receiving notice from Greenpeace that the contents were illegally harvested products that had been laundered through a sawmill in Brazil. However, the Brazilian government retroactively sanctioned the sawmill from which the timber had been exported to the EU. In response, the Belgian authorities accepted the legality of the timber and the seized products were released (ClientEarth 2015; ETTF 2015).

The most recent action was in February 2015, when the United Kingdom's National Measurement Office checked a number of operators trading Chinese plywood to determine if there was a match between the species declared on import documentation and the products' actual species. The results found that the majority of the products' species were incorrect and that 14 out of the 16 companies investigated had insufficient due diligence systems in place to comply with the EUTR. The UK authorities issued warnings requiring the companies to take steps to ensure compliance or face prosecution. The firms face sanctions including closer inspection and random tests as well as requirements to work with third parties to build stronger monitoring systems (ClientEarth 2015; NEPCon 2015b).

The EU Timber Regulation has faced a number of criticisms since its 2013 implementation. The regulation states that wood carrying a FLEGT license is considered to be fully compliant with the EUTR due diligence requirements and is exempt from risk assessment (European Commission 2013b). However, the EUTR came into full effect before any VPA partner country had successfully obtained a FLEGT license, resulting in a gap between demand for licensed timber and available supply (ITTO 2013). This resulted in criticisms that the EUTR had been rushed and would cause European buyers to shift away from legitimate suppliers in the tropics and towards more traditional lower risk markets (ITTO 2013). In addition, following implementation of the EUTR, Indonesia and Malaysia began to sell wood to Europe with national certifications including SVLK, V-Legal and MY-TLAS. Critics noted that these certifications did not constitute FLEGT licenses and only served to further complicate the FLEGT license system (NEPCon 2013b).

Finally, one of the most commonly criticized issues with the EUTR is the problem of uneven enforcement across EU member states. The EUTR requires that member states set penalties, establish monitoring and accreditation organizations, and develop national level ‘competent authorities’ to carry out checks and enforcement of the regulation (European Commission 2012). Since August 2014, the European Commission has released a scorecard which shows the progress of the 28 member states in implementing the EUTR (European Commission 2015). While at present there are 22 countries which have competent authorities, penalties and rules for regular checks in place, six are lagging behind. Critics argue that a lack of widespread implementation of the EUTR legislation creates a situation where requirements are in place but there are no means to enforce the law. This creates an uneven playing field which has limited the efficacy of enforcement and may encourage safe havens in Europe for illegal timber imports (NEPCon 2015c).

Australian Initiative - Illegal Logging Prohibition Act

Until recently, the Australian government relied on the CITES convention and self-regulation by companies to verify the legal origins of imported timber. These arrangements were considered by many in the timber industry to be ineffective because not all businesses undertook legality verification and there was uncertainty as to what constituted an adequate level of compliance under voluntary arrangements (Ludwig 2012). As a result of pressure by industry and environmental groups, the Australian parliament passed the Illegal Logging Prohibition Act in November 2012 which banned the import or processing of any raw log that has been illegally logged (Ludwig 2012). The Illegal Logging Prohibition Regulation Amendment came into effect in November 2014 and requires that importers of timber products or processors need to assess and manage the risk that timber has been illegally logged (Australian Government 2014a).

Together the Illegal Logging Prohibition Act, along with its code of regulations, restrict the importation of illegally logged timber products into Australia, implement a code of conduct to ensure suppliers carry out the proper tests to determine whether wood coming into the country is legal and establish a trade description for legally verified timber products which specifies the circumstances under which certain products can be used legally. Similar to the European Union’s approach, the Australian Bill is based upon *due diligence*, wherein importers are required to document their product’s chain of custody, including information related to the forest product, its area of harvest, applicable laws that apply, copies of harvesting licenses and evidence that appropriate taxes were made at the point of harvest. The Australian Bill includes a comprehensive monitoring, investigation

and enforcement regime to ensure compliance and provide for seizure of suspect timber products and forfeiture of timber products proven to be in violation of the Bill. Violators who import or process illegal timber will face up to five years imprisonment, fines of \$57,500 for individuals and up to \$287,500 for corporations. Violators who do not comply with due diligence requirements or fail to make the proper customs declarations also face significant penalties (Ludwig 2012).

In practice the ‘due diligence’ requirement under the Australian Illegal Logging Prohibition Act is very similar to that of the EU Timber Regulation, however there are a few key differences (NEPCon 2015a). Under the Australian law, while the prohibition on importing illegally logged timber applies to all timber products, the requirement to carry out due diligence and risk management only applies to a fixed list of timber products (see Illegal Logging Prohibition Regulation 2012 - Schedule 1: Regulated timber products)(Australian Government 2014c). In addition the Australian government decided to gradually implement enforcement of the law, allowing for an 18 month phase-in period from November 2014, where the focus is on enabling industry to adjust to the regulations rather than prosecuting violations (FSC 2015a). Finally while the EU has recognized the value of certified wood as a tool for risk assessment, the Australian government has explicitly recognized FSC and PEFC as a ‘fast-track’ mechanism (NEPCon 2014).

Market Responses – FSC and PEFC

A number of private organizations have established voluntary systems which use criteria and indicators to certify forest management units as sustainable. The two largest certification programs currently in use around the world are the Forest Stewardship Council (FSC) and the Program for the Endorsement of Forest Certification (PEFC) (Bowers 2012). The Forest Stewardship Council (FSC) was founded as a non-profit organization as a response to the UN “Earth Summit” held in Rio de Janeiro in 1992 (Nussbaum and Simula 2005). With the support of Friends of the Earth, the World Wide Fund for Nature and the Rainforest Action Group, FSC was launched in 1993 and established a standard set of principles and criteria to describe and promote sustainable forest management (URS 2013). Drawing upon standards set by the International Tropical Timber Organization in 1990, FSC set out ten principles which contain a range of criteria for ensuring environmentally appropriate, socially beneficial and economically viable forest management (Tollefson et al. 2008). These criteria and indicators have been used by FSC assessors to certify 460 million acres of forest land (FSC 2014a) and FSC is considered to be the fastest-growing certification system in the world (FSC 2013a). Of this area approximately 83% of FSC certified forests are located in North America and Europe, 7% are in South America, 3% are in Africa, and 7% are in Asia and Oceania (FSC 2014a). FSC also certifies the supply chain management systems of timber processing and trading companies to ensure that they are able to maintain the sourcing and ownership history of their products. As of 2015, FSC chain-of-custody (CoC) certificates had been used by 28,822 companies to provide a link between responsible production and consumption of FSC certified products (FSC 2014a).

The Programme for the Endorsement of Forest Certification (PEFC) was established in 1999 and shares some characteristics with FSC. PEFC is an international non-profit which promotes sustainable forest management through independent third-party certification (URS 2013). Unlike FSC, which implements its own forest certification and chain-of-custody programs, the PEFC operates as an umbrella organization which works by endorsing national forest certification systems which are assessed against PEFC’s international standards to ensure consistency with international requirements (Nussbaum and Simula 2005). Currently PEFC includes 38 endorsed national certification systems

and more than 625 million acres of certified forests (PEFC 2014c). PEFC chain-of-custody certified products, which are designed to provide assurances that products entering the marketplace are not from illegal wood sources, were used by 15,800 companies in 2013 (PEFC 2014c).

While obtaining certification of sustainable forest management and chain-of-custody are one strategy to monitor wood materials in the supply chain, it is important to note that certification is not always enough to demonstrate the legality of the product. Certification systems offer the possibility of monitoring along every step of the supply chain, however this does not necessarily ensure the legality of harvested wood (Brack 2002). Even though FSC and PEFC offer chain of custody certification, they are not accepted universally as proof of legality. Under the Japanese Goho-Wood policy, third party forest certification systems such as FSC and PEFC are accepted as proof of legality alongside documentation of payments related to chain of custody (Forestry Agency of Japan 2006).

Under the Australian Illegal Logging Prohibition Act, purchasing certified products does not exempt Australian operators from doing due diligence and they must still gather information and assess the risk that the timber was illegally logged (Australian Government 2013). However, the Australia Department of Agriculture, Fisheries and Forestry recently confirmed that FSC and PEFC certified products are an effective way of identifying products that are at low risk of being sourced illegally (Australian Government 2014b). Thus both certification systems meet the due diligence requirements for importing timber into the Australian marketplace and serve as a mechanism to fast-track a company's due diligence arrangements (PEFC 2014b; FSC 2015b).

Similar to the Australian regulation, although the EU Timber Regulation does not contain a 'green-light' for certified products, the regulation does say that certification or other third party verified schemes can serve as potential tools in assessing the risk of timber under a due diligence system (SFI 2013; FSC 2014b). While the EU will not formally endorse market based instruments such as FSC and PEFC, it has recognized the value of certification as a potential tool for risk assessment and mitigation and in practice certified wood is considered to have a negligible risk of being illegal. As long as the operator has a proper due diligence system and has gathered the required documentation, certified wood can be placed on the market with no further mitigation measures (European Commission 2013a, 2013c).

Unlike the other major consumer country policies, the U.S. Lacey Act does not specifically detail the steps importers should take to approach the 'due care' standard (Saltzman 2010). As such, while certified products can be part of a company's 'due care' it is not a guarantee against violation of export laws (FSC 2012). The U.S. Animal and Plant Health Inspection Service states that the government cannot determine the accuracy of certification systems for forest legality. However, certification systems may provide information useful to manufacturers and importers in their efforts to exercise due diligence regarding sources and species of timber (USDA/APHIS 2012). Thus, even companies importing certified wood products must remain vigilant in determining whether the exporting company behaved in compliance with the laws of their product's country of origin (FSC 2012). In addition, use of certified wood products does not relieve importers of the requirement to submit import declaration information or obtain documentation proving their product's chain of custody (WRI 2009).

Literature Review

Depending on the definitions of illegal logging used and the methodologies and assumptions employed to measure the practice, estimates of the extent of illegal logging worldwide vary widely (Park 2010). While more conservative reports suggest that illegal wood products make up 5-10% of global roundwood production (Seneca Creek Associates 2004), other widely cited analyses suggest that illegal logging accounts for 15-30% of global forest production and as much as 50-90% of the volume of all timber harvests in key tropical producer countries (INTERPOL/World Bank 2009). This wide range in estimates draws into question the reliability of these figures and the methods used in their analysis. The lack of clarity on the extent of illegal logging is attributed to poor tracking of critical indicators as a result of inadequate transparency in producer countries (Lawson and MacFaul 2010) as well as differences in definitions of legality from country to country (Seneca Creek Associates 2004). As a result of these informational limitations a number of methods have been employed to evaluate rates of illegal logging worldwide and the impacts of timber legality regulations on the illegal wood products supply chain.

Evaluating the Illegal Logging Supply Chain

The most widely cited study on illegal logging remains the Seneca Creek Associates report published in 2004. This report evaluated the rates and locations of illegal logging globally, with a focus on a few key tropical countries and countries with economies in transition (Seneca Creek Associates 2004). The report highlighted several key supplier countries/regions, including Brazil, Indonesia, Malaysia, West/Central Africa and Russia as well as a number of major consuming countries which included China, Japan, and Europe. The Seneca Creek report sought to estimate the level and impacts of suspicious wood products globally based on an analysis of wood fiber flows, interviews, examination of literature and available data, and consultation with stakeholders in these key countries. Together these key countries represent nearly 40% of global industrial softwood roundwood production and nearly 50% of global industrial hardwood roundwood production but represented over 75% of illegal logging activity worldwide. The Seneca Creek report estimated that about 4% of softwood roundwood production and 15% of global hardwood roundwood production are of suspicious origin and that this depresses world prices by 7%-16% on average with a total value as high as \$23 billion (Seneca Creek Associates 2004). The estimated levels of illegal logging included in the Seneca Creek report have largely been the basis for further analyses of the illegal logging supply chain and its impacts on the global economy.

In reaction to the findings of the Seneca Creek report, a series of studies were carried out to evaluate the economic impacts of illegal logging across producer and consumer countries. In 2006, the World Bank published a study which updated the findings of Seneca Creek and expanded the analysis to evaluate a larger number of producer/supplier countries (The World Bank 2006a). This report estimated that illegal logging on public lands causes an estimated \$10 billion in lost assets and revenue yearly while a further \$5 billion is lost annually due to evasion of taxes and royalties (The World Bank 2006a). In 2007, an analysis of the global wood product supply chain by Contreras-Hermosilla et al. found that the forest products sector makes up an estimated 1% of world GDP and about 3% of all international trade (Contreras-Hermosilla 2007). The report noted that a large proportion of illegally harvested wood is used domestically and that such practices for household use are widespread. However, the report highlighted concern over wood removed for industrial purposes and identifies a

number of high-risk countries including China, Russia and all countries in tropical regions. The Contreras-Hermosilla publication notes that illegal logging in these high-risk countries makes up between 20%-90% of wood production and that on average 50% of illegal wood removals in these countries are exported either as roundwood or processed wood products (Contreras-Hermosilla 2007). Taking these previous publications into account, a 2008 report by Li et al. gave comprehensive estimations of illegal logging levels for 180 individual countries including a range of illegal production rates so as to include both conservative and liberal estimates (Li et al. 2008). The assessment showed that the world rate of illegal logging of industrial roundwood was between 6% and 12% of global production in 2004.

In 2010, a report by the British policy institute Chatham House released an evaluation of illegal logging, which subdivided the illegal logging supply chain to consider producer countries, countries where illegal logging occurs on the ground, processing countries which import illegally sourced timber primarily for re-export and consumer countries which serve as the end market for illegal wood products. Based on a wood balance analysis which compared the legal supply of timber with actual consumption, this report identified markets where real consumption outstripped legal supply as a way to measure the percentage of logging which is legal (Lawson and MacFaul 2010). The report focused on a few key producer countries including Brazil Cameroon, Ghana, Indonesia and Malaysia, and the two largest processing countries, China and Vietnam. The analysis found that for the selected producer countries between 20% and 50% of timber consumption and exports could not be accounted for by legal domestic production and imports and thus was considered to be illegal. Looking at wood flows from producing countries to end-markets in consumer countries, the Chatham House report found that the majority of consumer country imports of illegally sourced wood product arrive via processing countries. China was found to have imported as much as \$3.7 billion of illegally sourced timber and wood products in 2008, comprising 20% of total imports, however this amount had declined steadily since 2004. Vietnam on the other hand showed a steady increase in usage of illegally sourced wood products between 2000 and 2008, with illegally sourced wood comprising 17% of total imports in 2008. Finally, the analysis addressed five major consumer countries, including the Netherlands, France, the UK, Japan and the U.S. Japan was found to have 9% of imports from illegal origins in 2008, the highest of the evaluated countries, compared with between 2% and 4% for the other four consumer countries examined (Lawson and MacFaul 2010). A study in 2012 by INTERPOL found that major consumer markets for wood products, which include the U.S., EU, China and Japan together receive 80% of the world's illegally logged wood (Nellemann 2012).

The 2010 report by Chatham House was updated and expanded in a series of reports issued in 2014 which addressed the same key consumer, processor and producer countries. These 2014 reports estimated imports of wood products at a high risk of illegality based on an 'import source analysis' which evaluates bilateral flows of wood products and combined this with interviews and surveys of local experts to develop a broader picture of the state of illegal logging across the supply chain (Hoare 2014c). The evaluation of consumer countries showed a marked decline in estimated percent of imports at a high risk of illegality across the U.S., UK, France, Netherlands and Japan from 2010 to 2014 (Brack 2014a, 2014b; Momii 2014b, 2014c; Wellesley 2014c). The evaluation of producer countries showed mixed results with some countries showing improvement and others deteriorating significantly in terms of illegal logging rates. Ghana stood out as having shown major improvement in illegal logging rates due to significant efforts in recent years to tackle illegal logging as part of its VPA with the EU (Hoare 2014a). Indonesia showed modest improvement in illegal logging rates, however

domestic policies which have expanded plantation forests have led to ambiguity regarding legality and threaten to undermine the progress made in improving management of the country’s natural forests (Hoare 2014b). Cameroon and Malaysia demonstrated only limited progress which has stalled due to corruption and poorly designed tenure and land use policies (Hoare 2015a, 2015b). Brazil showed a marked worsening of illegal logging rates, with an increase from 60% in 2010 to 75% in 2013, largely due to poor coordination between government agencies and limited resources and training for enforcement officials (Wellesley 2014a).

The 2014 Chatham House report detailed a small but significant drop in Vietnamese imports of illegal wood products as well as higher levels of awareness of illegal logging and the associated trade since 2010 (Saunders 2014). Similarly the Chinese market had experienced a marked drop in the proportion of illegal wood imports and a significant increase in imports from low-risk countries including Canada, the U.S., EU and New Zealand. However, while the proportion of illegal trade has declined in China, due to the huge expansion of the Chinese market the overall value of illegal wood imports has increased from \$3.7 billion in 2010 to \$6.6 billion in 2013 (Wellesley 2014b). In particular there has been a marked increase in high risk imports of sawlogs, particularly high value hardwood logs such as rosewood as well as logs sourced from countries with export bans in place.

The results of these various analyses of the illegal logging supply chain were compiled in a paper by Bridegam et al. in 2014 (Bridegam and Eastin 2014). This analysis compiled estimates across major producer and processing countries and identified “suspicious producer countries” as countries where greater than 15% of production and exports were comprised of illegally harvested logs and primary wood products. The report also noted “suspicious processing countries” as countries which had been noted in the literature as being major importers of illegally harvested wood as well as major manufacturers and re-exporters of both primary and secondary wood products. These processing countries did not necessarily have significant levels of domestic illegal timber harvesting (Bridegam and Eastin 2014). These countries are outlined in **Table 1**.

Table 1. Suspicious producer and processing countries by region.

Suspicious Producer Countries						Suspicious Processing Countries
<u><i>Africa</i></u>		<u><i>South America</i></u>	<u><i>Southeast Asia</i></u>		<u><i>Europe</i></u>	
Benin	Congo	Bolivia	Cambodia	Myanmar	Estonia	China
Cameroon	Gabon	Brazil	Indonesia	Laos	Latvia	India
Central African Republic	Ghana	Colombia	Malaysia	Thailand	Russia	Japan
Equatorial Guinea	Liberia	Ecuador	Papua New Guinea	Vietnam		Taiwan
Democratic Republic of the Congo	Nigeria	Peru				Vietnam
Cote d’Ivoire	Togo					

Economic Modeling of Timber Regulation Impacts

As noted previously, even the most widely accepted estimates of illegal logging rates are based on anecdotal information and supposition and the extent of illegal forest activity is impossible to know with any degree of certainty (Seneca Creek Associates 2004). Taking the significant information limitations regarding timber legality into account, the impacts and effectiveness of timber legality regulations have largely been evaluated using economic models which simulate economic effects as a way to infer policy impacts. These ‘global trade models’ are based on the assumption that import bans on illegal wood products will lead to reallocation of global demand and imports (Bosello et al. 2013). If regulations are effective, there should be a decrease in imports of illegal wood products which will in turn restrict the supply of available wood worldwide and increase the price for all wood products globally. The broadest and most widely cited of these economic analyses was released by Seneca Creek Associates in 2004, which used an economic simulation based on the Global Forest Products Model (GFPM) from the University of Wisconsin. The study found that elimination of illegal wood products globally would cause world wood prices to rise 7-16% and result in a 2-4% increase in U.S. wood prices (Seneca Creek Associates 2004). The report also showed that illegal logging largely benefits the producers of illegal wood as well as end-consumers of wood products.

A study in 2007 used the Global Forest Product Model to determine the impacts of illegal logging on the competitiveness of New Zealand’s forest products (Turner et al. 2007). This study determined that the elimination of illegal logging would result in significant increases in wood prices and production levels in countries without illegal logging, such as New Zealand. This was followed by a report published in 2008 which used the same GFPM to evaluate how markets would react to the elimination of illegal wood products from the global supply chain over a five year period (Li et al. 2008). This report found that a gradual elimination of illegal products would only lead to modest changes in forest product prices and production globally, with world prices increasing by 2% to 4% depending on the product. However, the analysis found that there would be substantial differences in impact across countries, with developing countries bearing the brunt of reductions in production while developed countries would experience major production increases (Li et al. 2008). This production increase in developed countries would not totally compensate for the production decline in developing countries, resulting in higher prices for wood products worldwide.

A 2008 report prepared by the Finnish consulting firm Indufor Oy for the European Commission focused on the EU FLEGT policy and used the European Forest Institute’s Global Forest Sector Model to simulate how four potential scenarios would impact prices of wood products and affect shifts in trade flows globally (Indufor 2008). The model simulated market mechanisms based on changes to supply and demand across European and global markets under the assumption of perfect markets. The baseline scenario modeled the impacts of the EU establishing VPAs with Indonesia, Malaysia, Ghana, Cameroon, Gabon, and the Democratic Republic of the Congo and assumed that there would be no direct exports of illegal wood products from these countries to the EU following implementation. The alternative scenarios considered what would occur if the EU established twelve VPAs, what would happen if an import ban was imposed which eliminated imports of illegal timber from all non-EU countries, and what would occur if an import ban eliminated all illegal timber imports as well as all illegal logging within the EU. The study found that the baseline with six VPAs and the option of twelve VPAs were found to have the most significant impact on illegal logging in tropical countries. These options were expected to result in a decline in the volume of output in source countries which would be compensated for by price increases and would make a major contribution to

the reduction of illegal logging in VPA countries. The two import ban scenarios were found to have a neutral effect on timber prices and levels of illegal logging and due to the difficulty in implementing these options they were not recommended (Indufor 2008).

Using the same Global Forest Sector Model, a report by Moiseyev et al. in 2010 expanded upon the work published by Indufor in 2008 and showed that the baseline option with six VPAs would result in log price increases as high as 60%-70% in partner countries due to the current high levels of illegal logging that occur in these regions (Moiseyev 2010). However the expansion of VPAs to twelve partners would moderate these increases and would only result in 15% price increases among partner countries. The study estimated that the baseline option would result in an 8% increase in global industrial roundwood prices from 2016 to 2020. The study suggested that the European Commission should focus on expanding VPAs to a wider set of partner countries while simultaneously implementing a licensing scheme to restrict imports of illegal wood products into the EU (Moiseyev 2010).

The Centre for International Economics released a report in 2010 written for the Australian Department of Agriculture, Forestry and Fisheries to inform government consideration of the proposed Australian Illegal Logging Prohibition Act. This report, based largely on data from the Seneca Creek report, used the Global Trade Analysis Project global general equilibrium model to estimate the global financial costs of eliminating illegal logging and global non-market benefits (CIE 2010). These results were further analyzed to determine Australia's potential share of global benefits and costs as well as reductions in illegal logging that might result from the implementation of an Australian timber legality regulation. The study found that if Australia unilaterally imposed an import regulation it would face significant overall net costs, and due to its small part of the global market this action would likely be ineffective in reducing illegal logging. Even within the context where other consumer countries are implementing timber legality regulations, the report found that while the effectiveness of the Australian policy would increase, its costs would still exceed its benefits (CIE 2010).

Using the Computable General Equilibrium (CGE) model, in 2013 Bosello et al. estimated the reallocation of global demand and imports of timber following the implementation of the EU Timber Regulation. This CGE model evaluated supply and demand shifts caused by changing prices in response to timber import restrictions and the analysis focused on potential effects to income flows and CO₂ emissions (Bosello et al. 2013). The results of the model showed a reshuffling of timber flows, with 'illegal logging prone areas' experiencing a contraction of exports to the EU, while the 'legal logging regions' which include the U.S., Canada, Japan and Finland would have a proportional increase in exports. However, the analysis found that illegal logging regions would compensate for the ban by increasing their timber exports to non-EU countries and increasing sales to the domestic market. This redistribution of illegal timber in the simulation led the authors to suggest that the EU Timber Regulation would not be particularly effective in reducing illegal logging activities in general. Given the minimal effect on overall economic activity, the paper found that impacts on CO₂ emissions would be limited (Bosello et al. 2013).

Implementation of the U.S. Lacey Act was widely expected to reduce U.S. imports of wood products from countries perceived to be most at risk for illegal logging. Due to the fact that implementation of the U.S. Lacey Act corresponded with the global recession of 2007-2009 and the subsequent contraction of the wood trade globally it is exceedingly difficult to evaluate the impacts of

this policy on the global illegal logging supply chain. In order to evaluate whether U.S. importers reduced purchases from countries whose products are at a high risk of illegality, Bridegam et al. used a differences-in-differences method to compare international trade levels pre and post Lacey Act implementation (Bridegam and Eastin 2014). The results of this analysis did not show any significant differences in post-policy U.S. imports of wood products from suspicious origins. However, there were marked changes to imports by major processing countries which in turn export to the United States. Vietnam was shown to have reduced its imports of hardwood products from suspicious producer countries; however this pattern was not evident in the Chinese import data.

In a similar study, Prestemon et al. sought to detect the effects of the U.S. Lacey Act Amendment on the quantities and prices of products imported into the U.S. from suspected source countries. This analysis ran an economic simulation using intervention analytical methods on time series import price data to evaluate the magnitude and temporal dynamics of economic shocks incurred by the implementation of the Lacey Act Amendment (Prestemon 2014). The simulations estimated what prices and import levels would have been if the Lacey Act was not implemented and compared these with post-implementation imports. With regard to U.S. imports of lumber and hardwood plywood from countries at high risk for illegal logging, the study showed that prices increased and the quantity of imports decreased following enactment of the Lacey Act Amendment. The authors note that these effects demonstrate that as a result of this policy, producers of illegal timber face lower prices and demand which reduces their incentives to continue these practice while legal exporters face high prices and demand, evidence that the Lacey Act has met some of its original objectives (Prestemon 2014).

Regulatory Leakage and Shifts Toward Less Sensitive Markets

The economic simulation models used to evaluate the impacts of timber legality regulations generally evaluate the effects of eliminating illegal wood production completely across all suspicious producer countries. However, in reality closing off developed consumer markets to illegally sourced wood will not prevent all trade in illegal timber. Rather, reductions in imports of illegal wood by consumer countries will likely cause suspicious producer and processor countries to shift their supply chain and sell their products somewhere else. This phenomenon is known as “Regulatory Leakage” or simply “Leakage” and refers to the redistribution of illegally-sourced products in reaction to the implementation of a regulation, wherein illegal products shift away from regulated markets towards unregulated markets that do not discriminate between legal and illegal timber products (Bridegam and Eastin 2014).

This shift towards less scrupulous markets can take two forms, as firms can either increase exports to unregulated markets or sell more of their products within the domestic market. The influence of an unregulated domestic market should not be overlooked. A 2010 report by the Center for International Economics estimated that since only about 15% of illegal timber products are traded internationally, a significant share of illegally logged timber is consumed within the country where it is harvested (CIE 2010). As a result, any regulation aimed at targeting illegal timber will only impact about 15% of illegal timber volume. It is also important to note that suspicious producer and processing countries can experience substitution effects, where exporters in those countries begin to exclusively sell their legal wood products to regulated markets and divert illegal production towards domestic consumers or unregulated markets (Prestemon 2014). The Chinese market, which does not

place regulations on timber legality, has shown notable growth in demand over the last two decades and exports from VPA countries to China have increased fivefold between 1995 and 2007 (Moiseyev 2010). Illegal wood products are often routed through major processing countries, such as China which in turn re-export a large proportion of the wood it imports (The World Bank 2006a). These large processing countries can choose to shift sales of wood products from suspicious sources away from regulated markets and towards unregulated markets which are experiencing rapid increases in demand for wood products.

As a result of leakage effects there may be a significant reduction in the efficacy of timber legality regulations. An economic simulation of the Australian timber regulation showed that a unilateral import restriction would clearly be ineffective due to the diversion of illegally logged timber into less discerning markets, causing the overall reduction in illegal logging to be small (CIE 2010). Similarly, a recent simulation of the impacts of the EU Timber Regulation showed that while exports to the EU from suspicious producer countries would decline, these illegal logging regions would compensate by increasing timber exports to non-EU countries and the domestic market (Bosello et al. 2013). One interesting finding from these economic simulations was that joint implementation of illegal logging import restrictions by consumer countries would reduce the ability of suspicious producers and processors to shift exports to unregulated markets (CIE 2010). However, analyses of joint implementation conflicted over whether the benefits of such an effort would outweigh the costs (CIE 2010; Bosello et al. 2013).

A 2010 evaluation by Chatham House which surveyed timber manufacturers and government officials was one of the first studies to address the issue of regulatory leakage as a principal research question. The researchers sought to determine if exports from suspect producer countries were shifting towards less sensitive countries such as India, South Korea and Japan, or towards intermediate processing countries such as China and Vietnam which lack demand-side timber legality controls and could be used to obscure illegal wood products within a complex supply chain (Lawson and MacFaul 2010). Interviews with exporters from major processing countries found that in Vietnam, respondents were divided as to whether there was a shift towards sensitive or a shift towards less sensitive markets with a slight indication that exports had moved towards regulated markets. The authors proposed that this slight change may reflect an effort by Vietnamese firms to clean up their supply chains in response to an NGO exposé in 2008 which revealed the prevalence of illegal timber in the Vietnamese furniture market and found that producers of outdoor furniture had used fake documents to mask the origin of wood in their products (EIA and Telepak 2008). In China, on the other hand, a majority of survey respondents felt there had been a shift towards less sensitive markets (Lawson and MacFaul 2010).

In 2014, Chatham House released a series of reports on the trade in illegal timber which included a trade-flow analysis as well as the results of surveys asking experts if they believed that their country's timber industry was shifting towards less sensitive export markets. Experts from Cameroon reported that since 2000, trade has shifted away from sensitive markets and towards non-sensitive markets, with a reduction in the role of the EU market and increasing emphasis on Chinese exports. Trade data from Cameroon showed that exports to sensitive markets fell from more than 70% during 2000-2007 to just over 40 per cent in 2012, and during the same period Cameroon's exports of logs to China has increased nearly six hundred percent (Hoare 2015a). Similarly, seventy-five percent of expert respondents from Ghana reported that they believed there had been a shift in exports towards

non-sensitive markets, largely due to growing demand from new markets (Hoare 2014a). Opinions of Malaysian experts were mixed regarding the shift in trade, as production in the region of Sabah has mainly focused on sensitive markets whereas the Sarawak forest sector mainly targets non-sensitive markets in Asia (Hoare 2015b). Interviews of experts in major processing countries showed marked differences between the Vietnamese and Chinese markets. Respondents from Vietnam overwhelmingly answered that there has been a shift in trade towards more sensitive markets, particularly within the outdoor furniture sector which mainly exports to the U.S. and EU (Saunders 2014). However, experts from China had mixed perceptions regarding shifts in trade, with some indicating a shift towards sensitive markets, others a shift away from these regulated markets and a large number indicating that there have been no dramatic market changes (Wellesley 2014b).

A recent study on the impacts of timber procurement policies was released in 2015 by the International Tropical Timber Organization (ITTO) and included an analysis of changes to trade flows from tropical timber export markets. The report evaluated exports of primary and secondary timber products and found a notable shift in trade away from traditional markets such as the U.S. and EU, towards emerging and domestic markets (Martin and Ghazali 2015). While the United States, EU, Japan and Republic of Korea remain major markets for tropical timber products, the market share of tropical timber producing countries has declined in these major consumer countries. In particular, the EU has shown a sharp decline in trade with tropical timber countries. Meanwhile China's share of the global tropical timber market has expanded from 15% of total import value in 2004 to 28% in 2013, becoming the top importer of tropical wood products worldwide. This in combination with dramatic increases in other emerging markets, indicates a dramatic change in the timber supply chain which may be related to conscious shifts away from regulated markets in response to timber legality regulations. Taking these market shifts into consideration, it is clear that in order to judge the impacts of timber legality regulations it will be necessary to determine the impacts of leakage effects before the efficacy of these policies can be determined (Prestemon 2014). This suggests that in order to effectively address the issue of illegal logging it may be necessary for broad action to be taken across producer and processing countries to further restrict markets for illegal products and thus curtail the problem of regulatory leakage (Elias 2012).

Survey-Based Research on the Impacts of Timber Regulations

It is difficult to directly measure the flow of illegal wood products across the global timber supply chain, and as such policymakers have generally used indirect measures to evaluate the effects of regulations, largely using global trade models to evaluate economic impacts. In addition it is next to impossible to capture illegalities which are obscured within legal timber production and researchers cannot evaluate these levels based on wood-balance or global trade models (Monteiro and Souza 2006; Lawson and MacFaul 2010). However, a few studies have directly assessed the impacts of timber legality regulations on the principal actors in the timber supply chain, specifically manufacturers and traders to determine the extent to which local actors are aware of policies, are avoiding controls or are shifting trade towards less sensitive markets.

One of the first studies to use a social science approach to evaluate the impacts of timber legality regulations was carried out in 2010 by Chatham House (Lawson and MacFaul 2010). This study included surveys of industry experts across major producer, processor and consumer countries and targeted government officials, non-government organizations and wood products firms in order to

obtain evidence of the effects of the U.S. Lacey Act and EU FLEGT policies. Their perceptions survey provided information on firms' responses to regulations, use of chain-of-custody (CoC) certification and the perceived extent to which trade may be shifting towards less sensitive markets. The study showed that for almost all types of company in almost all countries, the majority of respondents felt there was at least some pressure to act, and among larger companies and companies supplying sensitive markets respondents believed there had been an improved response to illegal logging. In producer countries, the respondents felt that the government response in Malaysia was relatively good, Brazil, Ghana and Indonesia were in between and the response by the government in Cameroon was judged to be relatively bad. In order to address illegal logging, the survey respondents highlighted several areas of greatest potential for future development including small timber harvesting firms and companies supplying less sensitive markets.

In evaluating processing countries, the Chatham House study addressed the number of customer enquiries regarding legality of timber supplies and found a sharp distinction between China and Vietnam (Lawson and MacFaul 2010). The vast majority of respondents in China reported that such enquiries by customers either happened rarely or never occurred. In contrast, most respondents in Vietnam reported that such questions by customers are made regularly with a significant increase from 2008 to 2010. The authors suggest that this can be attributed to the implementation of the U.S. Lacey Act in 2008. The report also notes the greater importance of the domestic market in China and the fact that Chinese wood-product exporters have faced less criticism by NGOs in recent years than their counterparts in Vietnam. In spite of the lack of demand-side pressure on Chinese companies, they showed significant growth in use of chain-of-custody certification. Another significant difference highlighted in the reports was the fact that Chinese companies did not consider that legality and sustainability demands would be major drivers of the competitiveness of the wood products industry in the future, whereas Vietnamese firms considered both of these issues to be very important. The study attributes this to the Vietnamese industry's export focus on sensitive markets relative to the more domestically focused Chinese market.

A 2011 study by Tibbets evaluated the specific impacts that the Lacey Act Amendment has had on the U.S. wood products industry based on an analysis of a series of questionnaires and interviews of industry representatives which included governmental and legal representatives, wholesalers, importers and exporters (Tibbets 2011). Respondents reported that the Lacey Act Amendment had caused wood importers to make small changes to operational practices but the Amendment would not ultimately reduce global illegal logging. The firms noted that due diligence requirements were not communicated effectively and suggested that federal agencies increase communication with U.S. wood products companies and focus the Lacey Act on specific high-risk regions.

A study on the response of Chinese manufacturers to the U.S. Lacey Act in 2014 evaluated reported increases in the cost of exporting as a result of the implementation of the policy as well as changes to wood material sourcing and sales (Lu et al. 2014). Based on the results of surveys administered in Shanghai, the analysis found that smaller firms reported a higher average increase in cost of exports to the U.S. as a result of implementation of the Lacey Act Amendment. However, the author found that while a high proportion of large Chinese firms did not report a cost increase, those large firms that did report a cost increase experienced a higher cost increase than that reported by the small manufacturers. The report also found that there was a strong relationship between a firm's

awareness of the Lacey Act and sales to the U.S. market, with smaller firms showing lower awareness of the Act, generally reducing sales to the United States and increasing domestic sourcing. Larger firms on the other hand showed higher awareness of the Lacey Act and were increasing U.S. sales.

A survey of expert perceptions was carried out in 2014 by Chatham House which evaluated the views and experiences of private-sector representatives in China and Vietnam regarding the importance of illegal logging and its impact on prices, customer preferences and the competitiveness of the national market (Saunders 2014; Wellesley 2014b). Companies were asked whether customers enquired about the legality of products, and the results showed that while there had been a marked increase in interest by Chinese companies' customers, the proportion was still relatively low as compared to the Vietnamese market which reported that customers routinely made such enquiries. Chinese firms reported that the cost implications of supplying legal or certified timber were insignificant, with only minimal increases in expenditure and the results from both China and Vietnam showed significant increases in the use of certified wood from 2010 to 2014.

A recent study released in 2015 by the International Tropical Timber Organization evaluated lack of understanding of timber legality regulations among small and medium forest enterprises in China (Xinjian and Qian 2015). The researchers administered questionnaires and interviewed 133 wood processing enterprise in Jiangsu and Zhejiang provinces, including wood flooring, plywood, furniture and laminate flooring manufacturers. Only 28% of the firms had heard of the U.S. Lacey Act or EU Timber Regulation and most reported that they were likely to purchase raw materials from local timber markets, and as a result were 2 to 3 steps removed from the original importer along the supply chain. Only a small minority of firms reported that buyers were asking for proof of legality, and this small group was largely comprised of laminate flooring firms. The report indicates that there is widespread confusion regarding timber legality policies among small and medium forest enterprises and most of these small firms are reliant on the internet and trade fairs for this type of information. The authors note that small firms in China face significantly greater challenges than their larger counterparts and that their inexperienced management and lack of negotiating power make it difficult for these firms to be part of the policy making process. Therefore, the article suggests that trade associations may be a better way for these small firms to increase their bargaining power while increasing their understanding of the implications that timber legality policies may have on their firms.

Trade Flow Analysis

This analysis looks at recent trends in the global forest products market as they relate to the issue of illegal logging, in order to evaluate changes in trade flows between major wood processor countries and consumer countries suspected of using a high proportion of illegal wood products in the years following the implementation of timber legality policies. As the implementation of the Japanese Goho-wood policy in 2006 and U.S. Lacey Act Amendment in 2008 roughly coincided with the global economic crisis of 2008, it is difficult to parse out which changes in market trends are specifically due to timber legality policies (Bridegam and Eastin 2014). However, this analysis will evaluate broad overall changes to the supply chain of the major wood products processor and consumer countries over the past decade in an effort to assess the broad implications of policy implementation and general market shifts.

Illegal Logging Supply Chain

As discussed earlier in the literature review and outlined in **Table 1**, various analyses of the illegal logging supply chain have identified a large pool of countries as “suspicious producer countries” where greater than 15% of production and exports are comprised of illegally harvested timber (Bridegam and Eastin 2014). At the other end of the supply chain, there are a relatively small number of countries which are major consumers of illegally sourced wood products. The United States, European Union, China and Japan together import over eighty percent of the world’s illegally logged industrial wood (Nellemann 2012). These consumer nations in turn are supplied by a small pool of “suspicious processing countries,” which are major importers of illegally harvested wood as well as major manufacturers and re-exporters of both primary and secondary wood products (Bridegam and Eastin 2014). This group includes China, India, Japan, Taiwan and Vietnam (Seneca Creek Associates 2004; Li et al. 2008; Bridegam and Eastin 2014). A map outlining the illegal logging supply chain is shown in **Figure 1**.

This analysis of trade flows will highlight changes in imports by major consumer countries which have recently implemented timber legality regulations, and will further focus on those countries which are major processors of illegally harvested wood, specifically China and Vietnam. China and Vietnam are respectively the first and second largest furniture suppliers to the United States and China is the largest external supplier of furniture to the European Union (GTIS 2015a). Not only are these countries two of the largest “suspicious processing countries” but China is also a major consumer of illegally sourced wood products while Vietnam is a major producer and consumer of illegally sourced wood. Further, this evaluation will consider imports of raw materials by the Chinese and Vietnamese market in order to identify changes in the products and sources of raw materials in recent years.

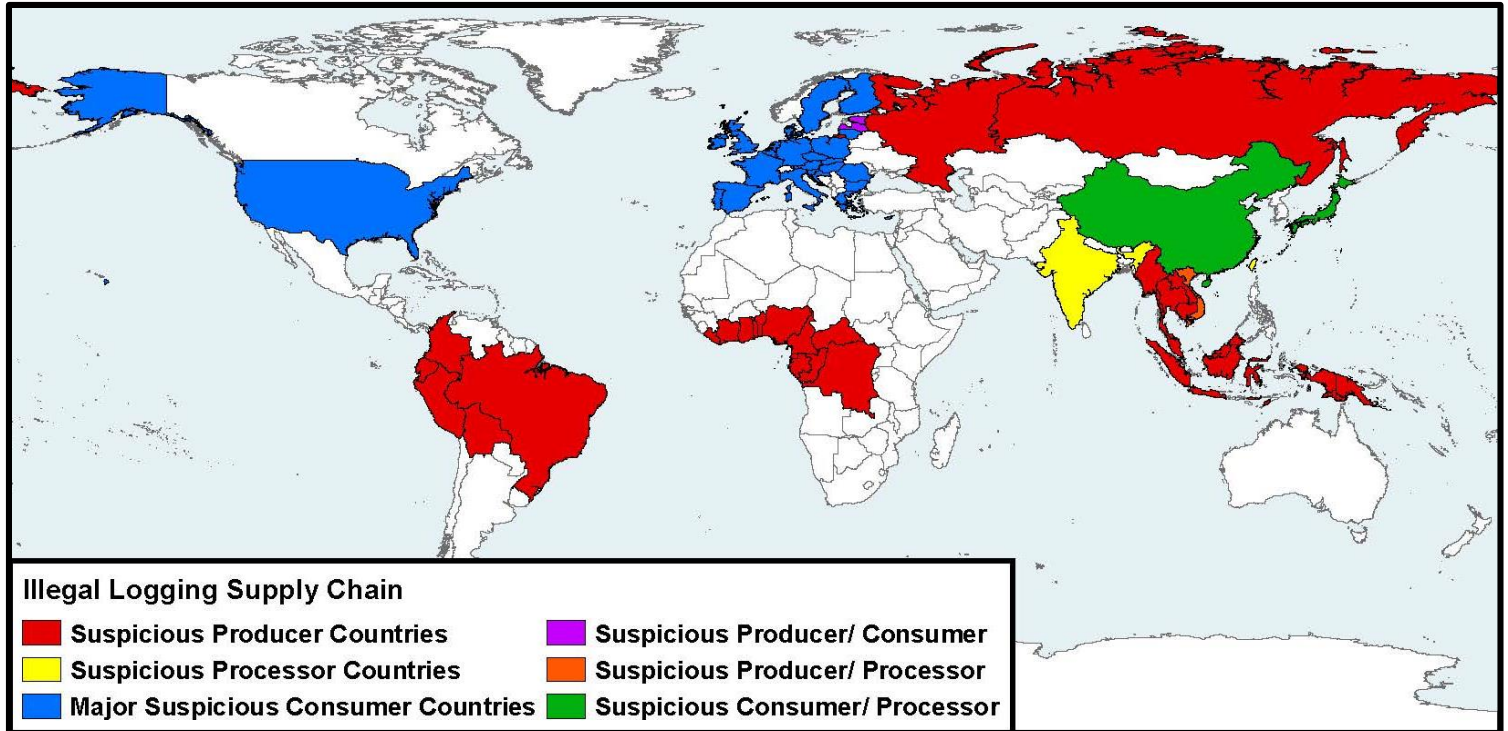


Figure 1. Illegal logging supply chain (Note the central position of China and Vietnam in the supply chain as suspicious processing countries).

Evaluation of Trade Flows

This analysis will focus on the trade flows between the two largest processing countries in the global forest products supply chain, China and Vietnam, and the four consumer markets which have recently implemented timber legality regulations: the United States, European Union, Japan and Australia. First, this evaluation will look at recent changes to furniture and flooring imports by the U.S., EU, Japan and Australia and consider changes following implementation of recent timber legality regulations. This assessment will include analyses of total import levels across the U.S., EU, Japan and Australia as well as the top source countries for each market. The top source countries for the four consumer markets will be evaluated to consider changes in market share and the analysis will seek to identify trends which may impact the use of suspicious timber products as well as assess differential impacts between the furniture and flooring markets.

The Chinese and Vietnamese markets will be analyzed to evaluate total levels of raw material imports used in the production of furniture and flooring. Imports will be analyzed to determine how Chinese and Vietnamese imports have changed their sourcing in terms of the amount of raw materials used in specific product categories as well as the producer countries from which these raw materials originate.

Data Sources

Trade data on imports and exports are collected by national customs and statistics agencies on an annual basis. This information can be sourced directly from domestic agencies or it can be obtained from organizations which compile and disseminate global trade data. Goods are most commonly classified using the Harmonized Commodity Description and Coding System (HS), which uses a nomenclature of ‘HS Codes’ developed by the World Customs Organization to classify commodity groups (World Customs Organization 2015). This system is used by more than 200 countries and economies as a basis for customs tariffs and for the collection of international trade statistics. The HS Code allows for subdivision of wood products both by product type as well as by species.

Trade data on consumer country imports were obtained using the Global Trade Atlas, which is a propriety system using data collected by Global Trade Information Services, Inc. (GTIS). GTIS is a private organization which purchases, collects and publishes trade data from over 80 countries and regions going as far back as 1990. GTIS data are gathered from the official customs or national statistics agency of each reporting country responsible for tracking and managing trade. The system provides information on value, quantity, unit price, reporting country and trading partner country on more than ninety per cent of the world’s trade in any commodity and is classified using the Harmonized System (GTIS 2015b).

While the Chinese General Administration of Customs provides import and export data to the GTIS database, this is not the case for the General Department of Vietnam Customs (Honnold 2009). As a result, additional steps were taken to evaluate Vietnamese market trends. Using the GTA system, Vietnamese exports were estimated by evaluating imports of Vietnamese products from major trading partners, rather than reported exports which are not available. However, customs data on Vietnamese imports of wood products were not available on the GTA system and it was therefore necessary to seek other information sources to carry out further analyses.

While Vietnam does not provide customs data to private organizations, it is a member of the United Nations and provides information on annual production and trade statistics for forest products to the Food and Agriculture Organization of the United Nations (FAO). The FAO Statistics Division (FAOSTAT) provides time-series records on wood products, with historical data available as far back as 1961 (FAO 2015a). FAO forestry trade data are collected from over 100 UN member states through an annual survey conducted by the FAO Forestry Department in partnership with the International Tropical Timber Organization (ITTO), the Statistical Office of the European Union (Eurostat) and the UN Economic Commission for Europe (UNECE).

FAOSTAT re-classifies each country’s trade figures into the Standard International Trade Classification (SITC) in order to standardize their data into broad commodity groupings. As a result, it is not possible to do a direct one-to-one comparison of the HS Coded data from the Global Trade Atlas and SITC classified data from the UNFAO. In addition, UN member countries often do not provide all of the information requested in the FAO questionnaire, requiring the FAO to estimate annual trade based on trade journal reports, statistical yearbooks or other sources or alternatively, where data is unavailable, FAO repeats historical figures until new information is found, which results in a step-like pattern in FAOSTAT data. While the FAO data is problematic, it is the only available data to evaluate raw material imports used in the manufacturing of furniture and flooring in Vietnam. As such this data will be used to assess imports into both China and Vietnam, so as to allow for comparison across the two countries as well as for identification of broad trends across the industry.

Product Categories

As one of the main focuses of this analysis is to evaluate differences in market flows by type of manufacturer, consumer country import data has been separated into furniture and flooring categories. Imports were subdivided based on HS Codes for these two groups and are detailed in **Table 2** and **Table 3**. The wood furniture product group includes wooden furniture, seats with wooden frames and decorative and inlaid wood pieces. This category includes marquetry which refers to pieces with wood veneer applied to form patterns or designs. The wood flooring product group includes planed and shaped wood pieces as well as parquet flooring, which refers to flooring panels with wood used in geometric patterns. This product group includes both coniferous and non-coniferous wood materials but excludes products made from bamboo.

Table 2. Furniture product group HS Codes and descriptions.

HS Code	Description
442090	Wood Marquetry, Inlaid Wood and Wooden Articles of Furniture Not in Chapter 94
940169	Seats, With Wooden Frames
940330	Wooden Furniture (Except Seats) Of A Kind Used In Offices
940340	Wooden Furniture (Except Seats) Of A Kind Used In The Kitchen
940350	Wooden Furniture (Except Seats) Of A Kind Used In The Bedroom
940360	Wooden Furniture, Not Elsewhere Specified or Included (Nesoi)

Table 3. Flooring product group HS Codes and descriptions.

HS Code	Description
440910	Wood Continuously Shaped along Any Of Its Edges, Coniferous
440920	Lumber Continuously Shaped, Non-Coniferous
440929	Non-coniferous Wood, Continuously Shaped Along Any Of Its Edges, Ends Or Faces
441830	Parquet Panels, Including Tiles Of Wood
441871	Assembled Flooring Panels, Of Wood, For Mosaic Floors
441872	Assembled Flooring Panels, Of Wood, Multilayer, Nesoi
441879	Assembled Flooring Panels, Of Wood, Nesoi
441890	Builders' Joinery And Carpentry Of Wood, Nesoi

In evaluating the raw material imports of China and Vietnam, product groups were developed using United Nations Food and Agriculture Organizations data, which makes use of Standard International Trade Classification (SITC) product groups. **Table 4** details the wood raw materials classifications used in this evaluation. Included in this analysis were sawnwood, roundwood, fiberboard, particle board, plywood and veneer sheets. Other trade classifications of products used in the manufacture of furniture and flooring with negligible value were excluded, such as insulating board and hardboard.

Products were further evaluated based on their use of coniferous and non-coniferous wood material (FAO 2015b), which is also included in **Table 4**. Separation of products into Coniferous and Non-Coniferous categories allows for further analysis of wood raw materials based on general geographic origin and the relative likelihood of containing endangered or threatened tree species is considered to be higher for non-coniferous species which are often from tropical regions. While the FAO identifies several product categories as specifically containing coniferous or non-coniferous products, several product categories can contain a mix of wood types. For the purposes of this analysis, medium density fiberboard and particleboard are grouped together with coniferous products, while plywood and veneer sheets are grouped as non-coniferous products based on the principal source countries for these products.

Table 4. UNFAO product classification groupings, wood types and product descriptions.

Product Classification	Product Type	Description
Sawnwood	Coniferous	Wood produced from roundwood that has been sawn lengthways, > 6mm
Industrial Roundwood (C)	Coniferous	Wood in the rough, all industrial roundwood, sawlogs, round and split
Medium Density Fiberboard	Coniferous- Mixed	Panels produced from binding wood fibers with wax and resin
Particle Board	Coniferous- Mixed	Panel manufactured from pressed wood pieces or fiber and resin
Sawnwood (NC)	Non-Coniferous	Wood produced from roundwood that has been sawn lengthways, > 6mm
Ind. Roundwood (NC) Tropical	Non-Coniferous	Wood in the rough, all industrial roundwood, sawlogs, round and split
Ind. Roundwood (NC) Other	Non-Coniferous	Wood in the rough, all industrial roundwood, sawlogs, round and split
Plywood	Non-Conif-Mixed	Panel consisting of veneer sheets bonded together, generally at right angles
Veneer Sheets	Non-Conif-Mixed	Thin sheets of wood of uniform thickness, not exceeding 6 mm

Consumer Country Trade Flows

Flooring Import Trends

Following implementation of the Japanese Public Procurement Policy in 2006, the Japanese flooring market has been quite steady. Despite a decline in the market from 2008 to 2010 the makeup of Japan's source countries for flooring have been remarkably stable (**Figure 2**). From 2007 to 2013, Chinese manufacturers have maintained a market share of between 42% and 49% of the market while Indonesian, European, Vietnamese, Malaysian and Canadians have shown only marginal changes in their minority shares of the flooring market.

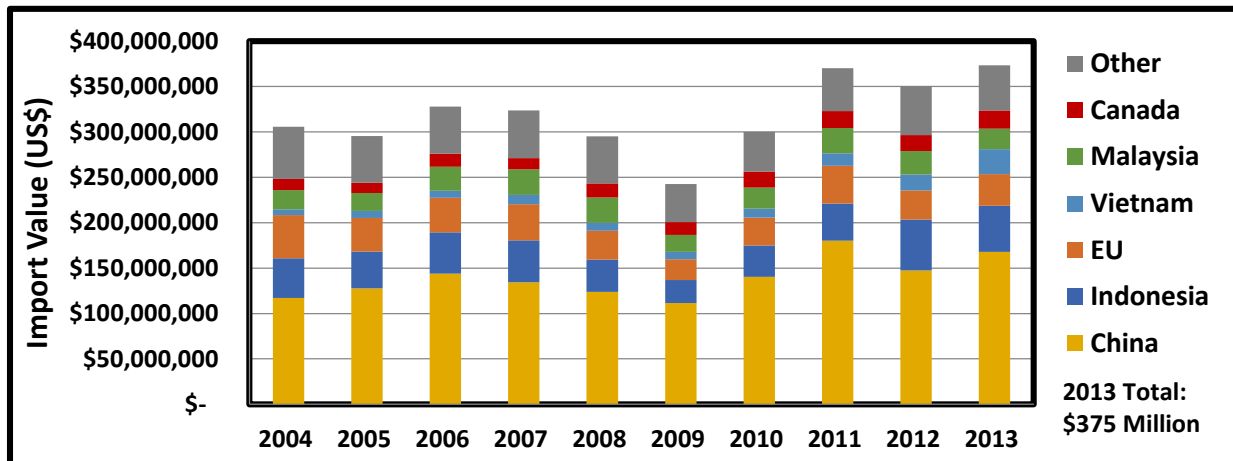


Figure 2. Japanese flooring imports by country 2004-2013.

The U.S. flooring market has not shown the same stability as that of Japan (**Figure 3**). Following passage of the U.S. Lacey Act in 2008 and the economic crisis there have been dramatic shifts in source countries for U.S. flooring imports. From 2007 to 2009, China and Brazil controlled nearly identical 25% shares of the U.S. flooring market, however the Brazilians have rapidly expanded into the U.S. flooring market with a 30% market share while Chinese market share declined to 20% by 2013 (**Figure 4**). It is worth noting that the U.S. flooring market declined significantly following the economic crisis and current imports of \$1.2 billion in 2013 are only 65% of the high of \$1.85 billion recorded in 2006.

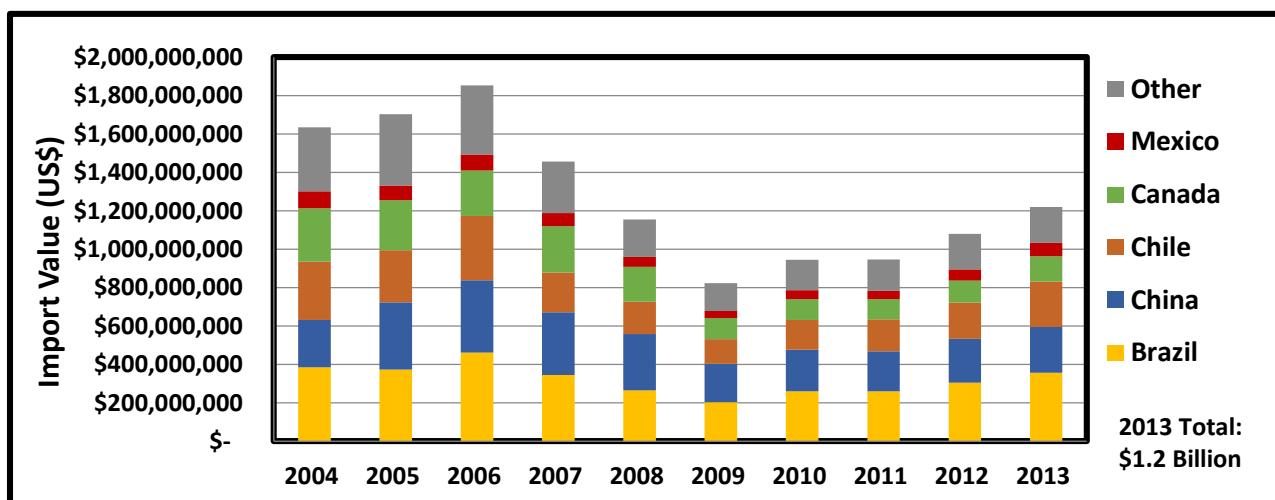


Figure 3. United States flooring imports by country 2004-2013.

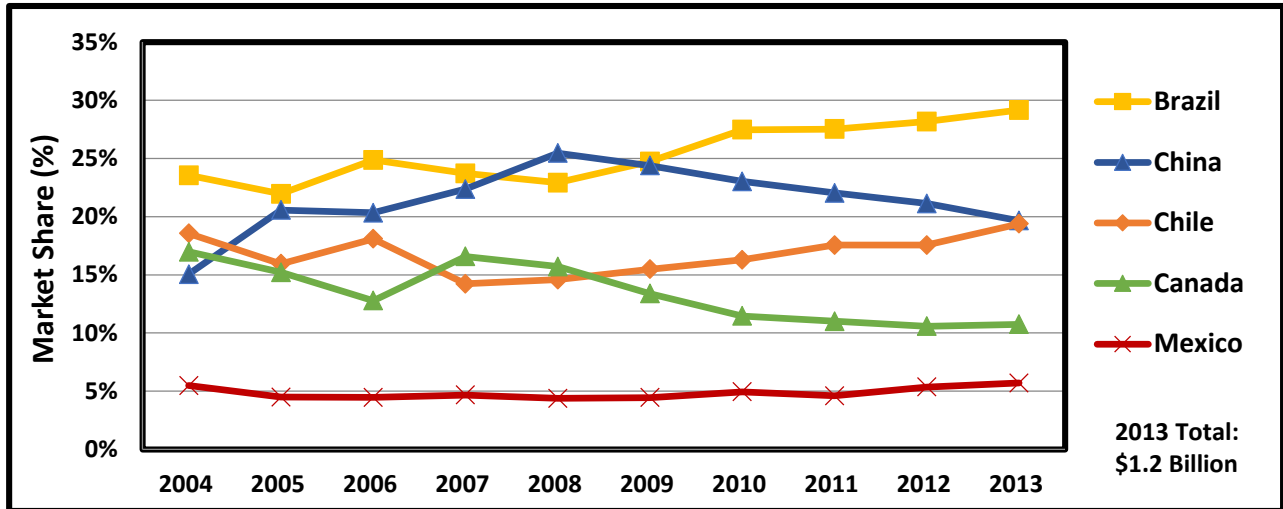


Figure 4. United States flooring imports: Percent market share by country.

Similar to the U.S. market, European Union flooring imports showed significant declines following the economic crisis, however the EU market showed a further reduction in imports in 2012 and 2013 (**Figure 5**). While the rest of the market has stayed relatively constant, Chinese manufacturers have experienced a huge increase in their share of the European furniture market in spite of contraction in this market (**Figure 6**). While in 2004, Indonesia was the largest flooring source for the EU, Chinese manufacturers have steadily increased their market share over the last decade, eating into Indonesian and Brazilian sales. Sales to the EU of Chinese flooring have increased 137% since 2004 and the Chinese have reached a dominant market position, supplying 46% of the European flooring market.

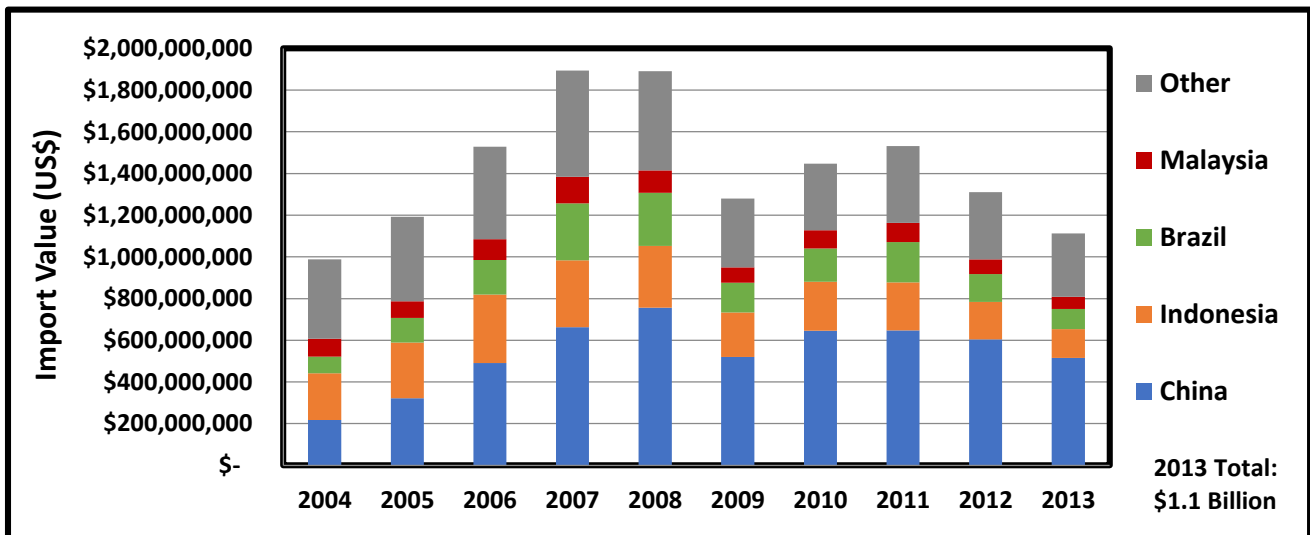


Figure 5. European Union flooring imports by country 2004-2013.

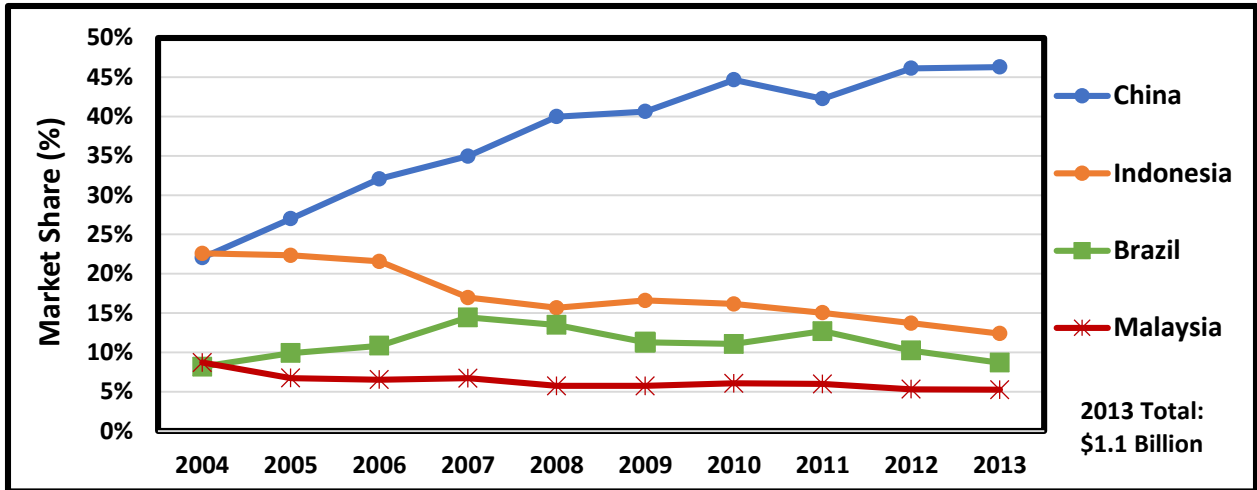


Figure 6. European Union flooring imports: Percent market share by country.

Unlike the U.S. and European markets, the Australian flooring market only experienced a minimal decline following the 2008 economic crisis. Market demand has increased steadily over the last decade, with growth of 124% since 2004 (Figure 7). The most significant change in market composition comes from Indonesia, which has reinforced its dominant position in the market over the last ten years, reaching a market share of 41% in 2013.

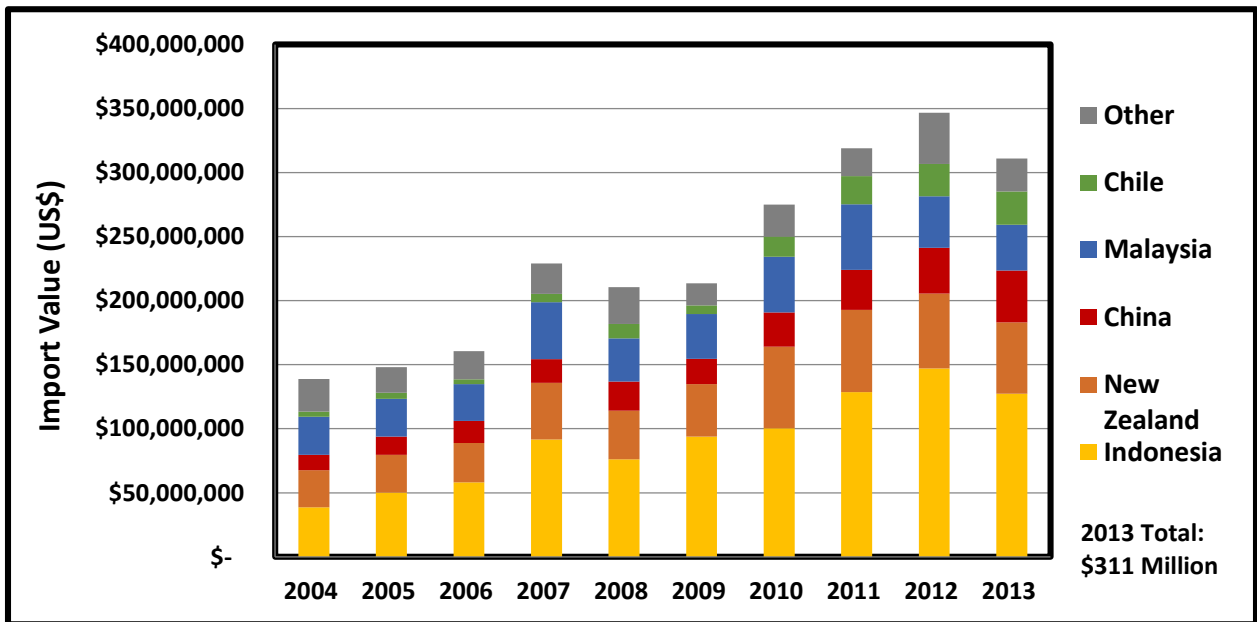


Figure 7. Australian flooring imports by country 2004-2013.

Furniture Import Trends

Japanese furniture imports have increased steadily over the last decade and were surprisingly resilient throughout the economic crisis, with only a 4% decline in 2009 followed by a rapid recovery (Figure 8). From 2004 to 2013 the Japanese furniture market expanded 36% and the market shares of source countries have remained relatively constant. Chinese furniture manufacturers currently control a dominant market position, supplying 45% of Japanese imports. In contrast, the Vietnamese have increased their market share steadily over the last decade moving from 11% of Japanese imports in 2004 to 20% in 2013 (Figure 9).

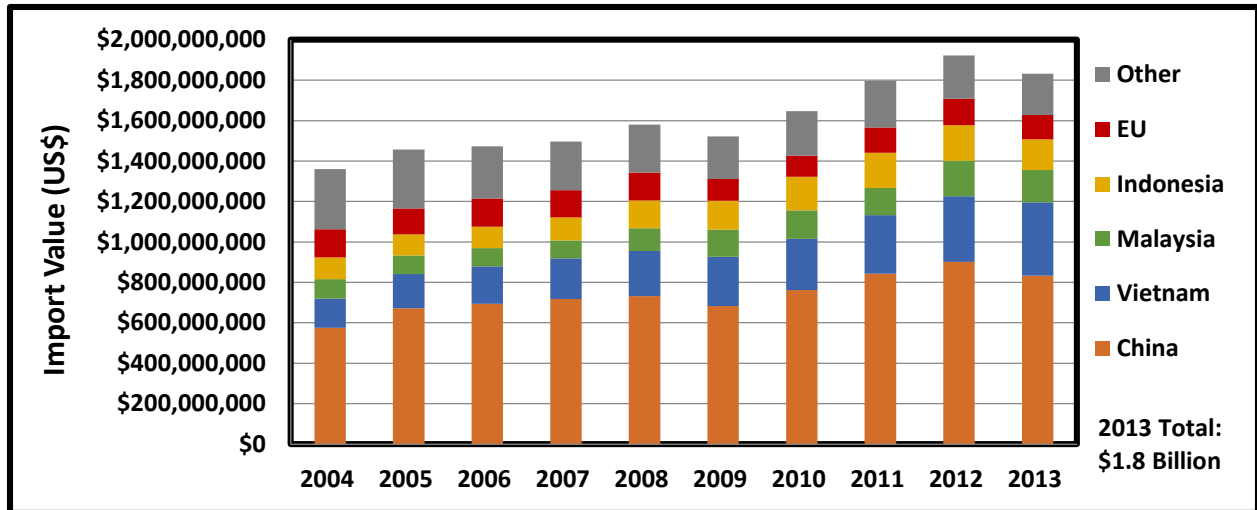


Figure 8. Japanese furniture imports by country 2004-2013.

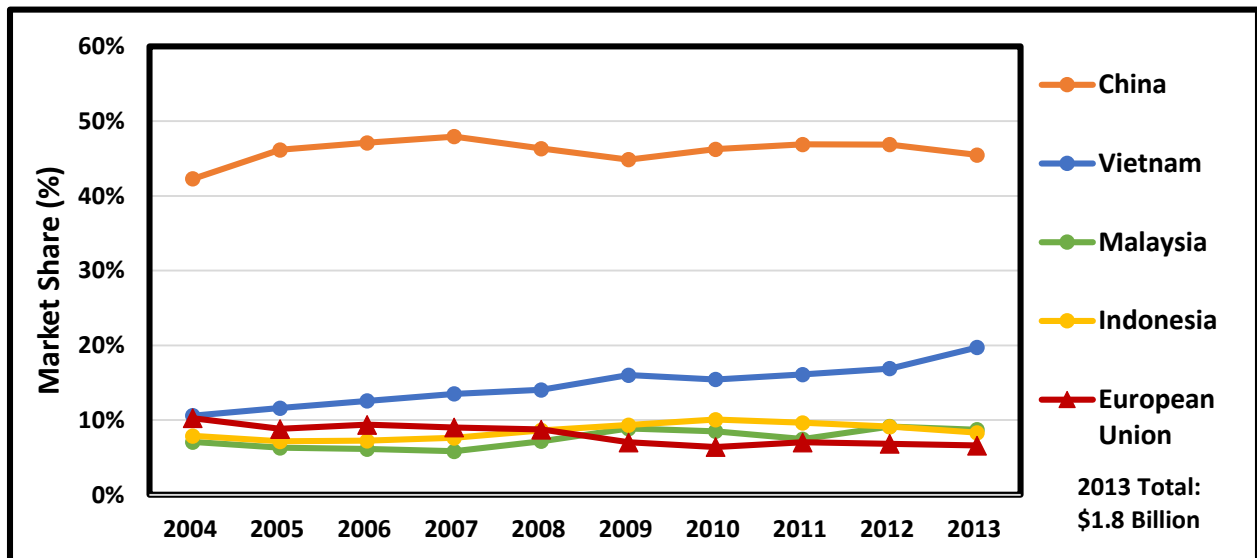


Figure 9. Japanese furniture imports: Percent market share by country.

As the largest importer of wooden furniture globally, shifts in the U.S. furniture market have a significant effect on the demand for forest products globally. Following the economic crisis, the U.S. furniture market shrank considerably and by 2013 imports had only returned to 84% of peak levels in 2006 (**Figure 10**). Over the last decade Chinese manufacturers have maintained a stable and dominant position in the U.S. market, supplying 41% of U.S. furniture imports in 2013. It is particularly noteworthy that over the same time period the Vietnamese market share has increased dramatically, going from providing \$315 million worth of furniture in 2004 to supplying nearly \$2 billion in 2013, an increase of 516% (**Figure 11**).

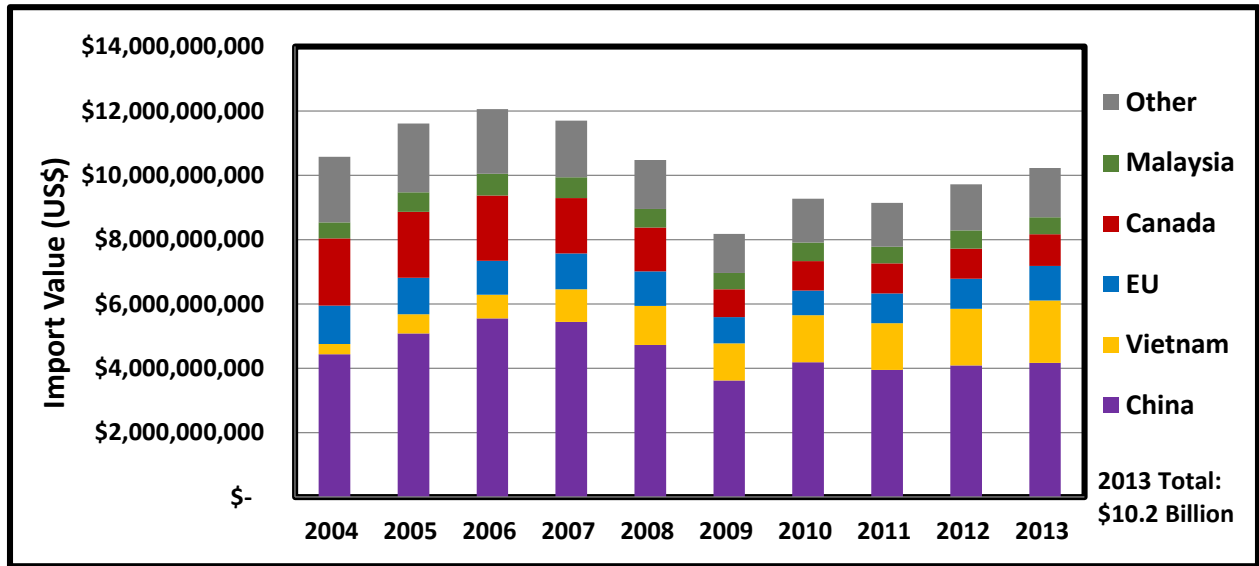


Figure 10. United States furniture imports by country 2004-2013.

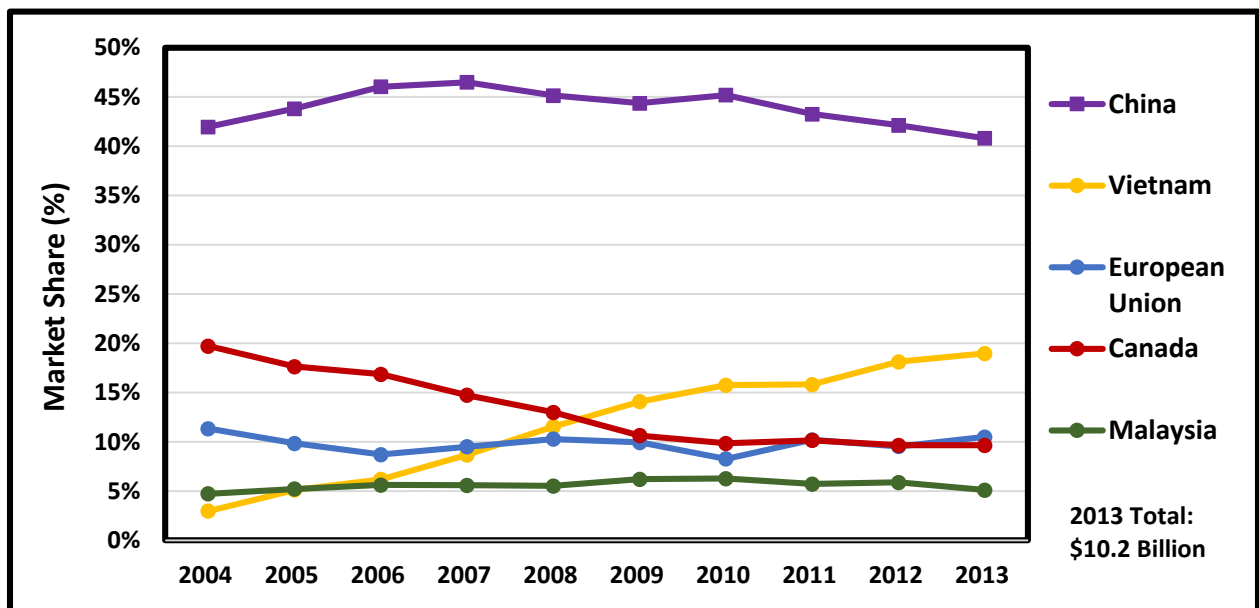


Figure 11. United States furniture imports: Percent market share by country.

While furniture imports by individual EU member states total \$16.2 billion, only \$4.3 billion of those imports are from external sources, with \$11.9 billion in furniture flows occurring internally between EU member states. Similar to the flooring market, European imports of furniture from outside of the EU declined significantly following the economic crisis in 2008 and experienced a second decline from 2010 to 2013 (**Figure 12**). China has significantly increased its share of the EU’s externally sourced furniture market over the last decade, increasing 117% since 2004 and reaching a 50% market share by 2013 with \$2.1 billion in sales (**Figure 13**). Vietnam has maintained a relatively constant share of the European market over the last decade, increasing from 11% to 14% of external furniture imports in 2013.

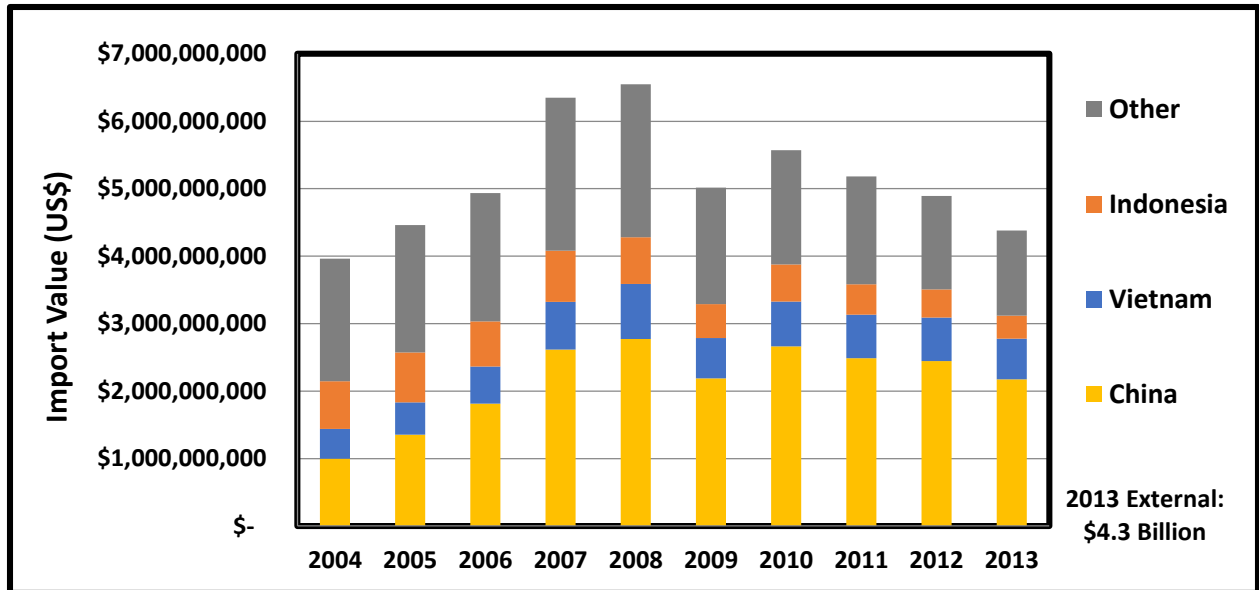


Figure 12. EU furniture imports from external sources by country 2004-2013.

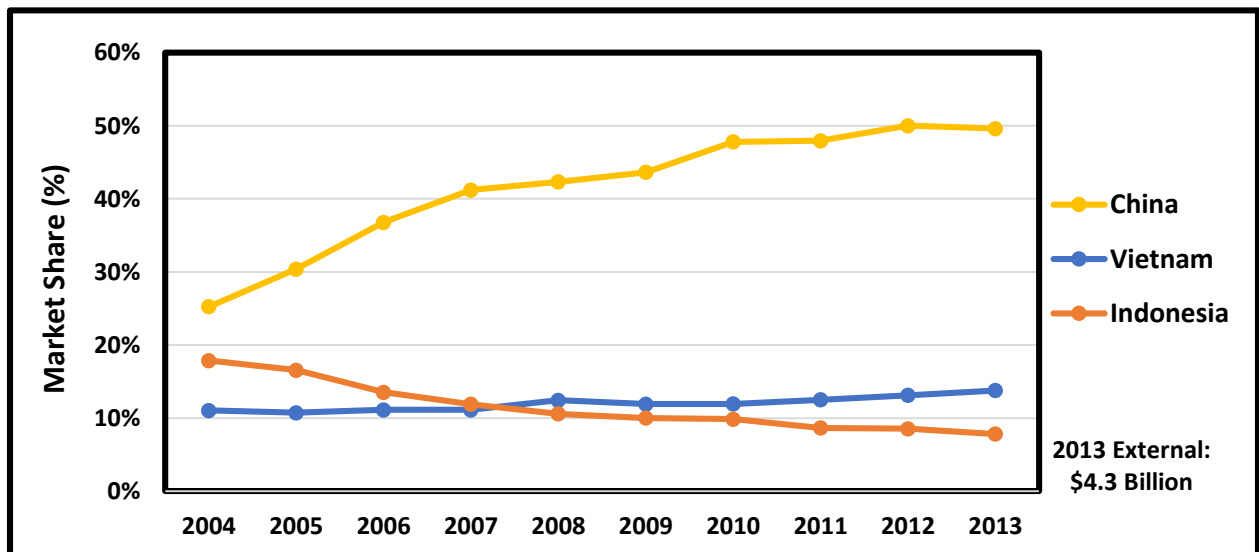


Figure 13. EU furniture imports from external sources: Percent market share by country.

It is worth noting that the European market is largely supplied internally and while China is the largest external supplier, it is only the third largest supplier overall, with Germany and Poland dominating the European furniture market (**Figure 14**). Thus, while the EU is a major consumer of furniture products overall, the U.S. has a significantly larger influence on global markets, purchasing \$4.2 billion worth of furniture from the Chinese market and nearly \$2 billion from Vietnamese manufacturers, while the European market only imports \$2.1 billion and \$603 million respectively from China and Vietnam.

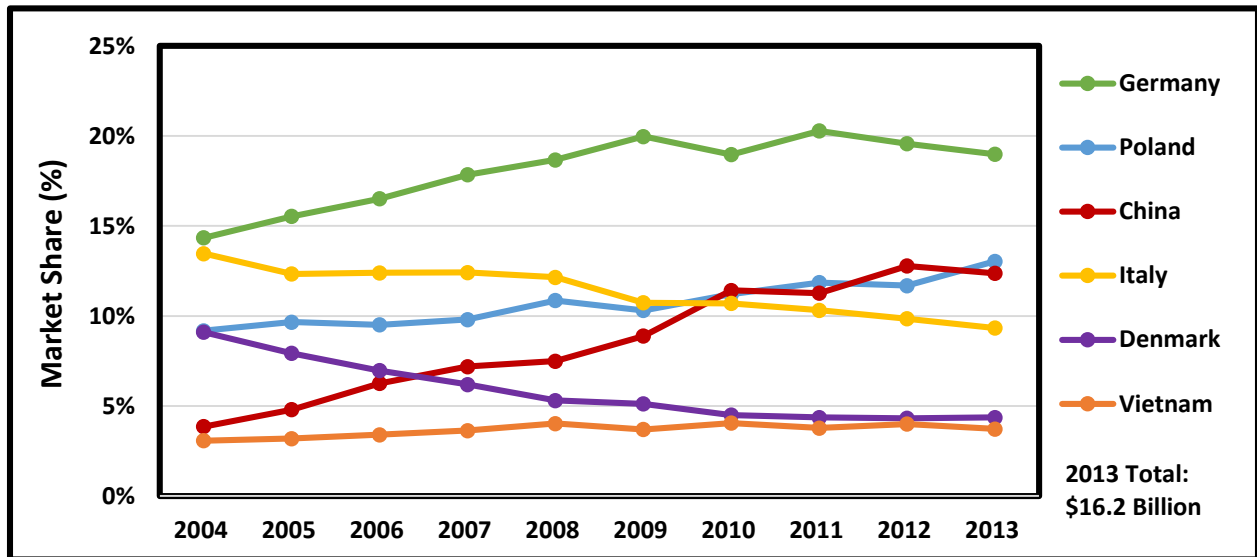


Figure 14: EU furniture imports from internal external sources: Percent Market Share.

Similar to the flooring market, the Australian furniture market was not significantly impacted by the global economic crisis. Market demand for furniture has grown steadily over the last decade increasing from \$421 million in 2004 to \$911 million in 2013 (**Figure 15**). The most notable change in the market has been from Chinese suppliers, who have increased their share of the market from 35% in 2004 to a dominant 56% in 2013 (**Figure 16**).

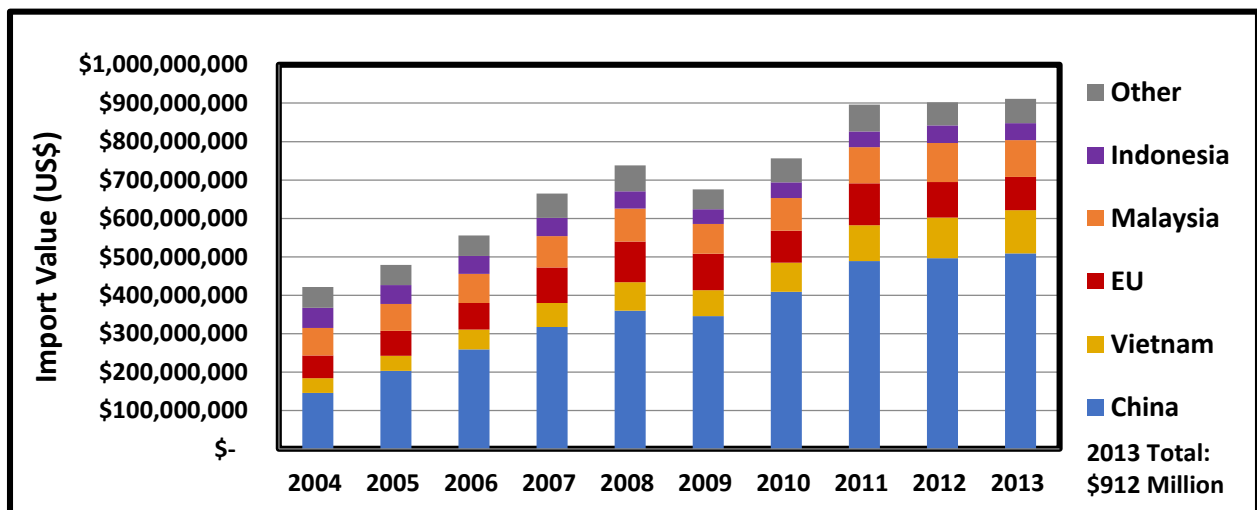


Figure 15. Australian furniture imports by country 2004-2013.

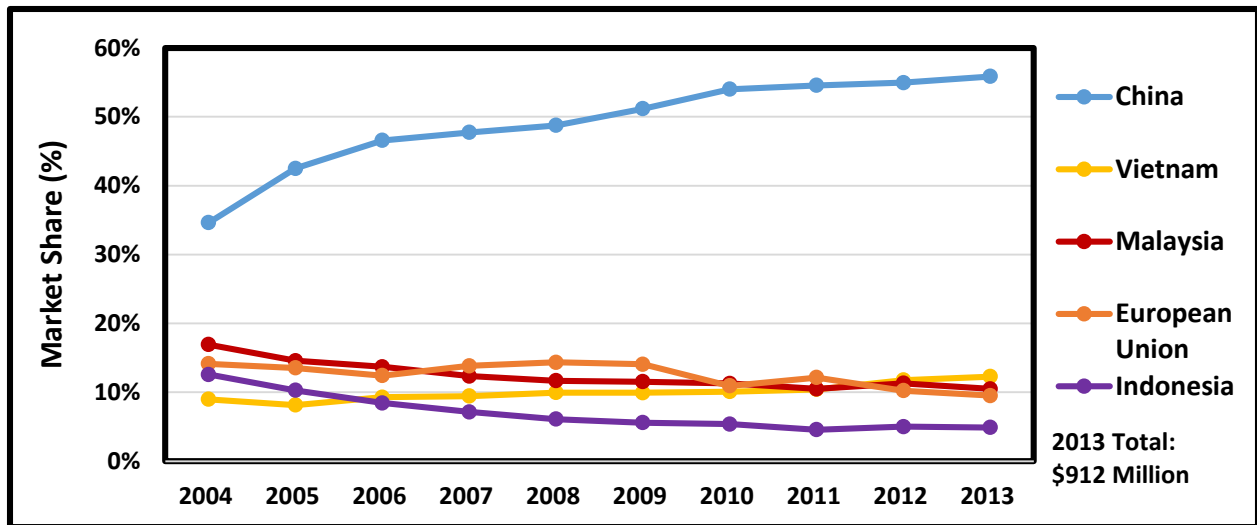


Figure 16. Australian furniture imports: Percent market share by country.

Processing Country Trade Flows

Chinese Raw Material Imports

Over the last decade, Chinese imports of wood raw materials have increased considerably, growing from \$6.3 billion in 2004 to \$18.1 billion in 2013, an increase of 188% (Figure 17). The Chinese market appears to have largely avoided the effects of the economic crisis, expanding considerably after 2009. Of particular note is the rapid expansion of Chinese imports of coniferous wood raw materials, particularly industrial roundwood and sawnwood. Figure 17 includes labels which designate products which are predominantly coniferous (C) or non-coniferous (NC). Chinese imports of coniferous sawnwood increased from \$434 million in 2004 to a stunning \$3.82 billion in 2013, an increase of 780%, while coniferous industrial roundwood imports increased from \$1.12 billion in 2004 to \$5.11 billion in 2013, an increase of 328%. Over the same period imports of non-coniferous and tropical wood products have largely stayed level or shown major declines, such as with non-coniferous roundwood and plywood.

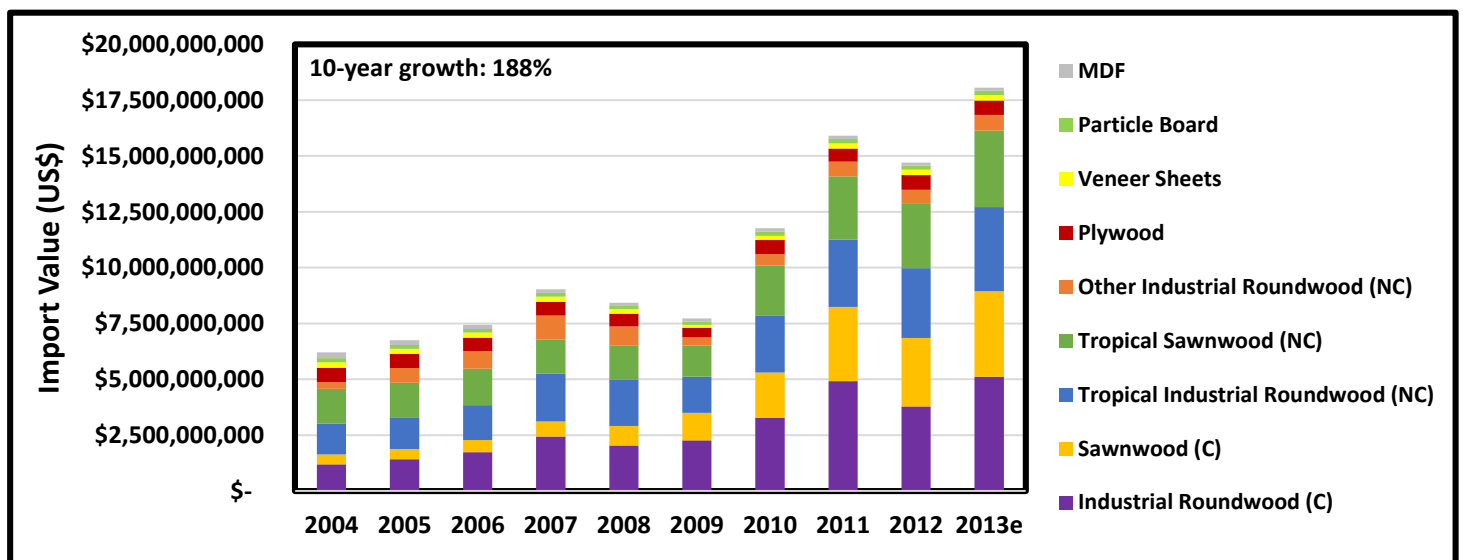


Figure 17. Chinese raw material imports by product type.

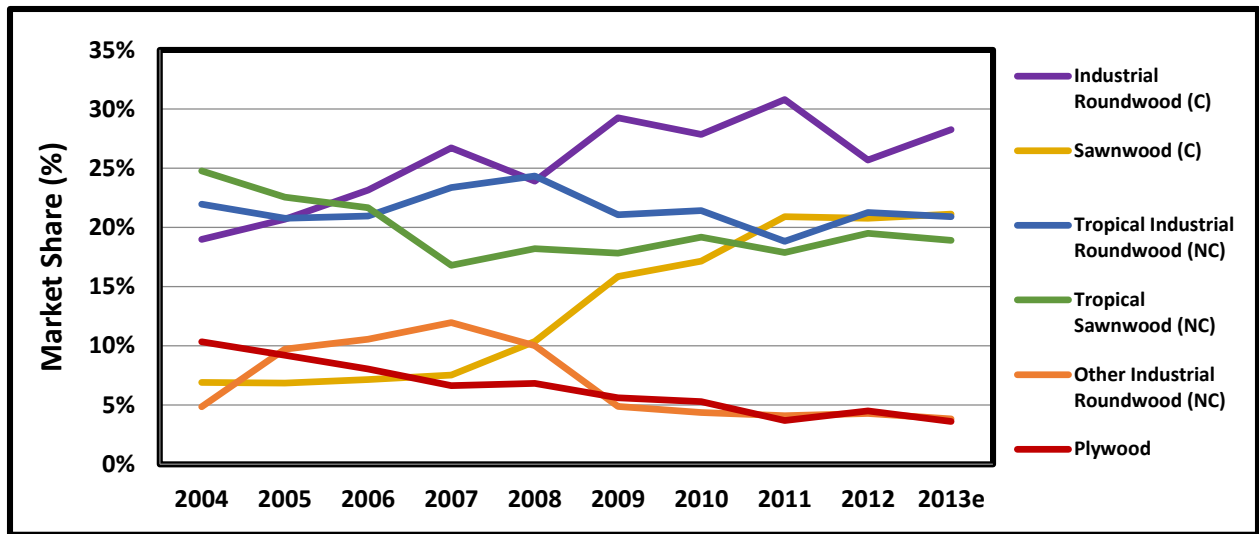


Figure 18. Chinese raw material imports: Percent market share by product type.

While the Chinese market has significantly increased imports of coniferous wood raw materials since 2010, an evaluation of source countries reveals some interesting trends. Russia has maintained a strong position in the Chinese softwood market over the last decade with relatively stable sales to China since 2008 (Figure 19). However, while the Russians may have maintained their total level of exports, with the rapid growth of the Chinese market their relative share of the market has declined substantially since 2007, falling from 62% in 2007 to 27% in 2012 (Figure 20). At the same time as the Russians lost their dominant position, a number of formerly minor players have risen in the market. Canada, New Zealand and the United States barely had a foothold in the Chinese market before 2007, at which time all three countries held less than a 5% market share. However, by 2011 all three of these source countries had recorded over one billion dollars in sales to the Chinese market, with Canada set to overtake Russia’s dominant position within a few years.

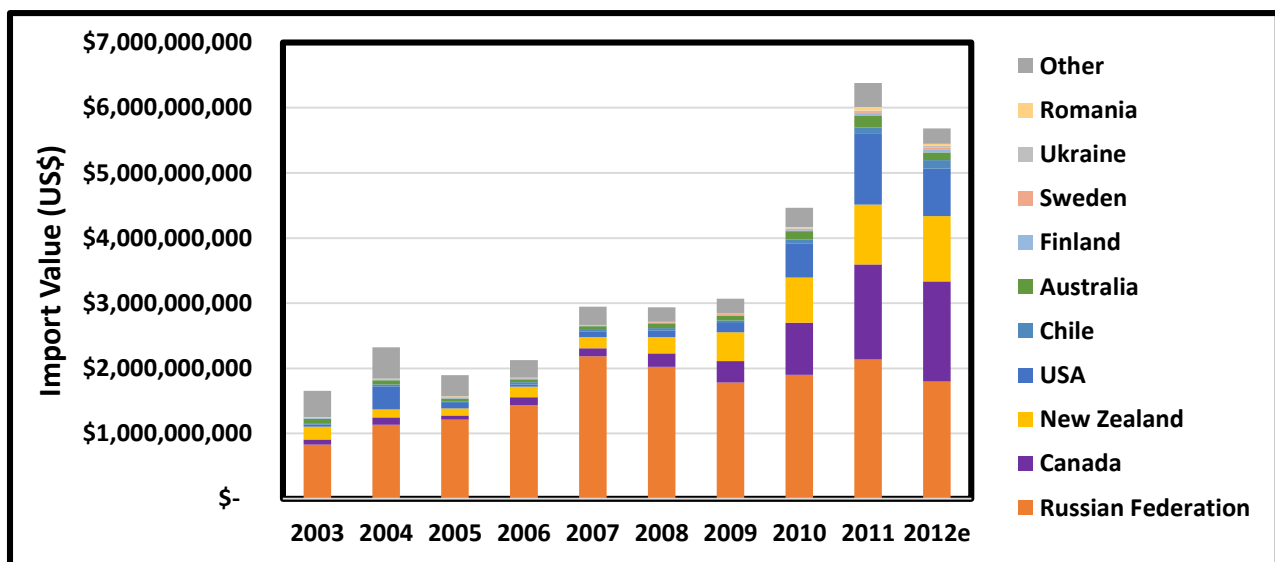


Figure 19. Chinese imports of coniferous raw materials by country.

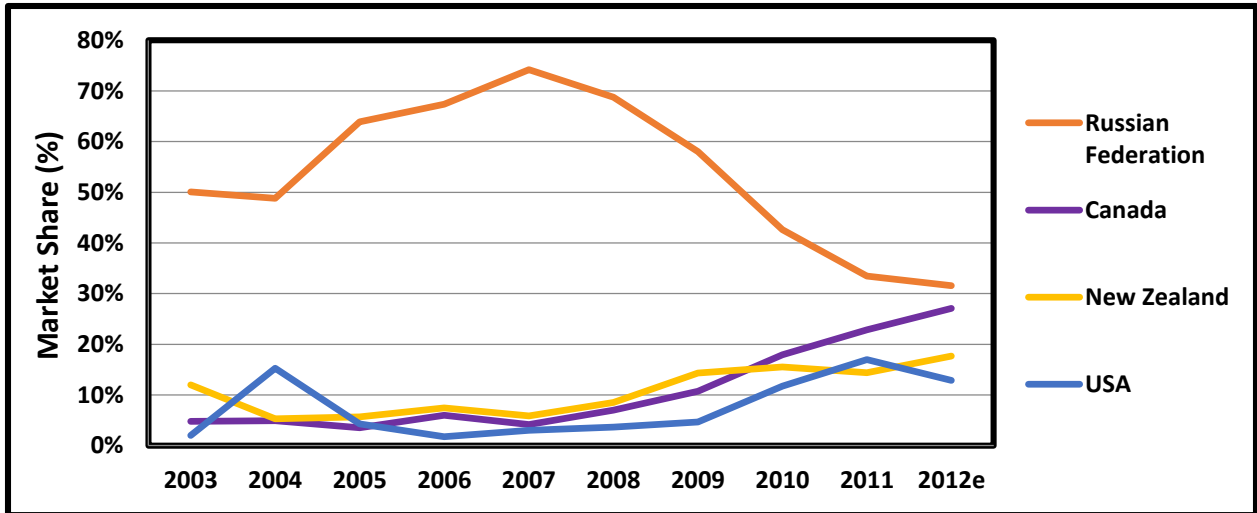


Figure 20. Chinese imports of coniferous raw materials: percent market share by country.

Whereas Chinese imports of coniferous wood products are dominated by a small number of countries, the opposite is true for Chinese non-coniferous imports. Imports of hardwoods are largely fragmented, and source countries have consistently been unable to garner a dominant market share. The largest share of the market is that of the United States with only an 11% share of the market (Figure 21). Nearly 41% of China’s imports in 2012 were from countries which supply less than 1% of total imports. The non-coniferous wood market is notably unstable, with major shifts in market share from year to year across countries. The market for non-coniferous wood products was significantly impacted by the financial crisis, however it has rebounded and 2012 import levels exceeded those for coniferous products.

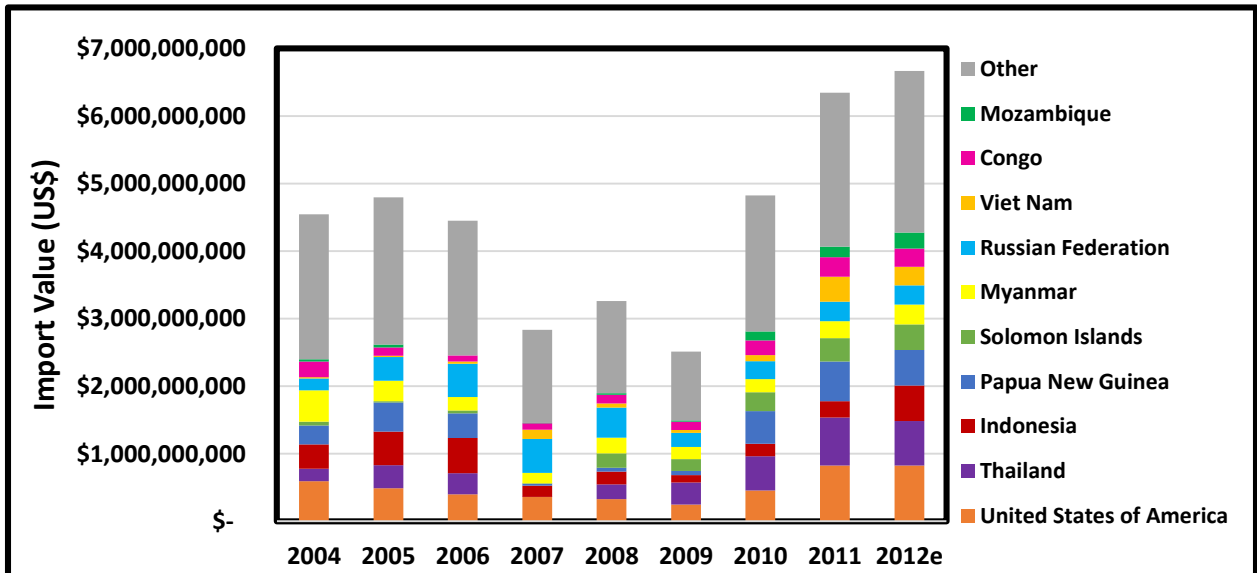


Figure 21. Chinese Imports of Non-Coniferous Raw Materials by Country.

Vietnamese Raw Material Imports

Vietnamese imports in the last decade have risen dramatically, particularly in the years after 2008, with a 10-year increase of 570% (**Figure 22**). The breakdown of raw materials by market share reveals a sharp reduction in coniferous materials with a concurrent increase in imports of non-coniferous materials. While in 2004, non-coniferous tropical industrial roundwood and plywood made up only 1% and 2% of imports respectively, by 2013 these product groups made up a sizeable portion of import totals, with tropical roundwood contributing to 25% of imports and plywood to 15%. At the same time coniferous sawnwood has dropped from 21% of the market to 7% (**Figure 23**). These shifts have resulted in the three largest import product categories being tropical hardwoods (industrial roundwood and sawnwood) or have a major tropical component (plywood), while coniferous products now make up only a small share of the market.

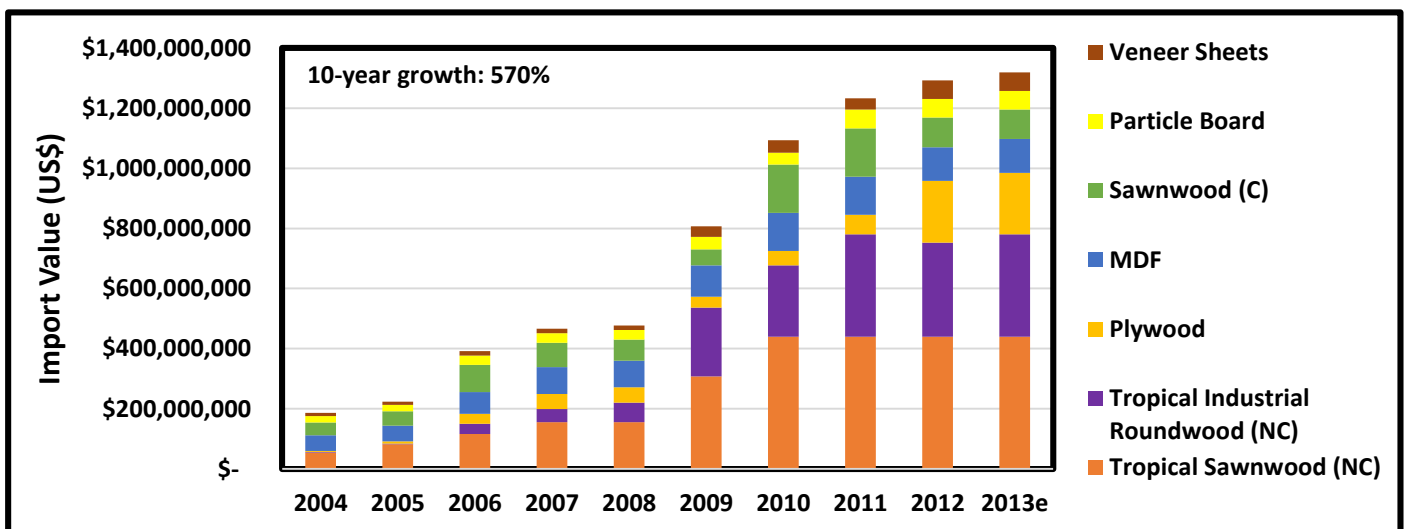


Figure 22. Vietnamese raw material imports by product type.

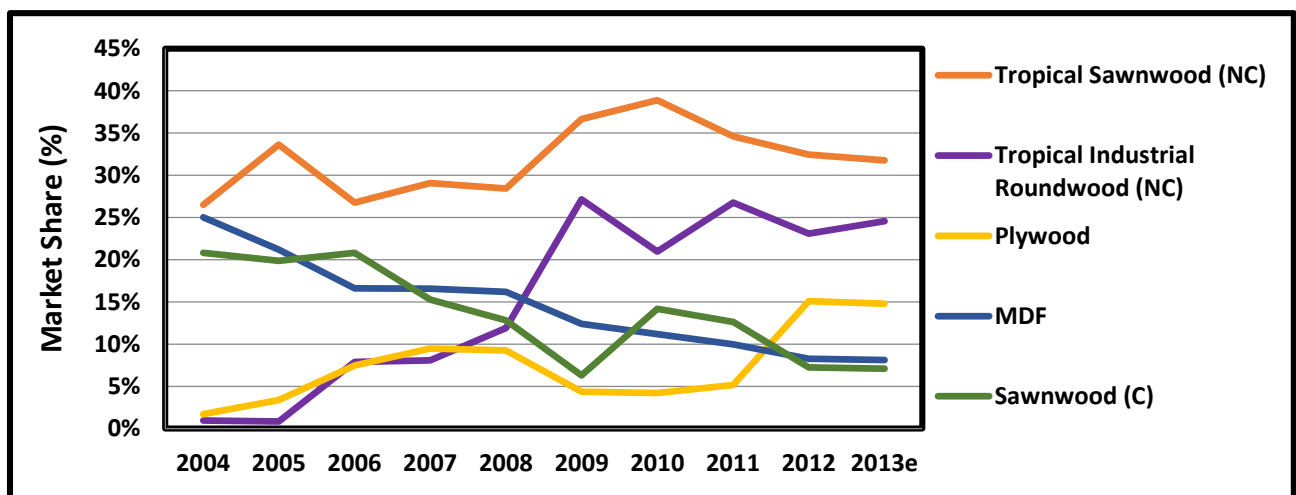


Figure 23. Vietnamese raw material imports: percent market share by product type.

While the share of coniferous raw materials in total imports has dropped in the last decade, there has still been a dramatic increase in coniferous imports over the last ten years, increasing from \$53 million in 2003 to \$273 million in 2012 (Figure 24). While there has been a dramatic increase in demand, the composition of source countries has remained relatively constant, with only a few shifts. Thailand and New Zealand have retained their dominant position as suppliers of coniferous materials to Vietnam, while Malaysia has lost its position as Vietnam’s largest supplier and now only represents a 10% market share.

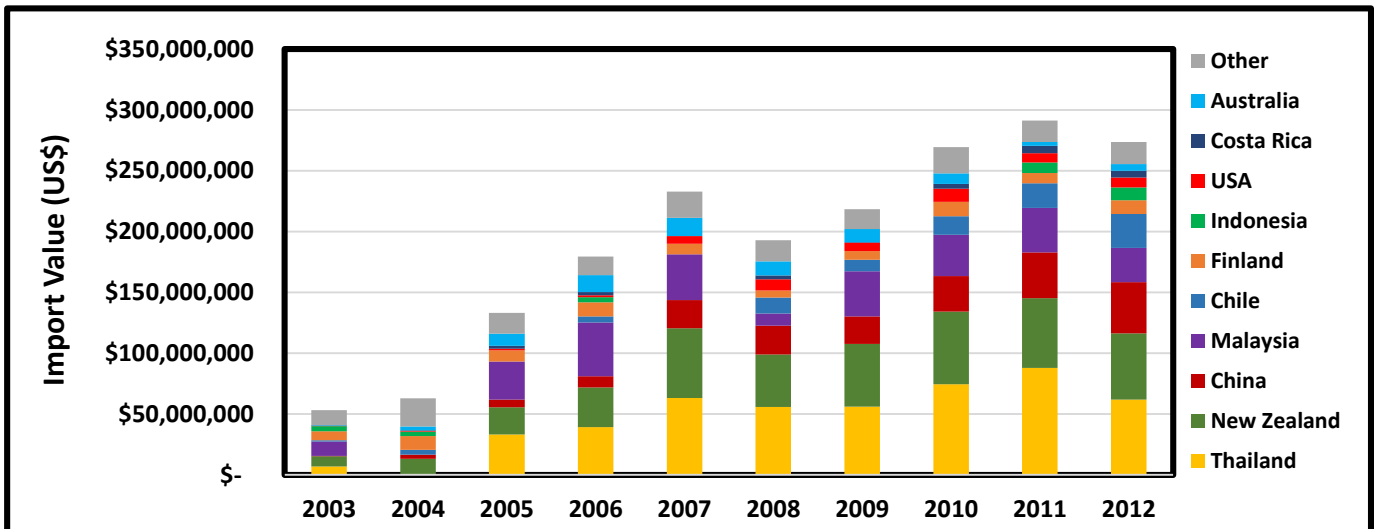


Figure 24. Vietnamese Imports of Coniferous Raw Materials by Country.

Similar to coniferous imports, Vietnamese imports of non-coniferous raw materials have shown significant growth, increasing from \$48 million in 2003 to \$379 million in 2012 (Figure 25). The United States has maintained a dominant position among source countries over the last decade, supplying 35% of Vietnam’s non-coniferous products in 2012. However, China has shown marked growth over the same time period increasing from 3% in 2003 to 30% in 2012.

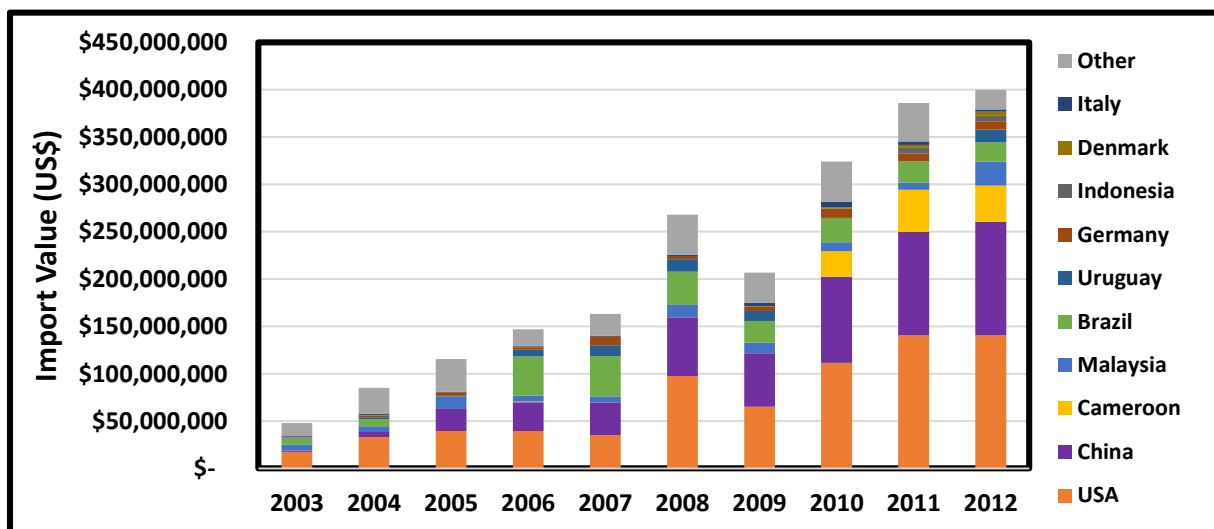


Figure 25. Vietnamese Imports of Non-Coniferous Raw Materials by Country.

Discussion

Considering major changes to the furniture and flooring markets, there have been a mixture of trends over the last ten years among major consumer markets. Japanese and Australian furniture and flooring imports have both remained relatively stable over the last decade, with only minor impacts following the economic crisis and steady growth in the successive years. The mix of supply countries has not shown major changes for either country, although the Japanese market has seen a significant increase in furniture imports from Vietnam while Chinese furniture imports have strengthened their position in the Australian market.

Unlike Japan and Australia, European demand for furniture and flooring were both severely impacted by the 2008 economic crisis and experienced a second drop in demand in 2012. While overall demand declined, Chinese manufacturers have achieved dramatic gains in market share in Europe, supplying nearly half of Europe's imports of furniture and flooring from external sources. Even considering the dominant role that EU member states play in wood products manufacturing, the Chinese have shown marked increases, rising from the 5th largest supplier of furniture in 2004 to the 3rd largest in 2013 and closely competing with Poland for the number two spot.

Relative to other major consumer countries, the U.S. market displayed dramatic shifts after 2008. While the European marketplace has shown major increases in Chinese market share in furniture and flooring since 2008, this change was relatively gradual and followed a pattern of growth which was evident as early as 2004. In the U.S. on the other hand, a restructuring began to occur in 2008. In the flooring market, Chinese manufacturers, which had been experiencing steady growth showed a major pullback in market share in 2008, with a transition towards U.S. imports from Brazil. While the Chinese still hold a dominant position in the U.S. furniture market, supplying 41% of imports, this is down from a high of 47% in 2007. This market share has largely gone to Vietnam, which went from the fifth largest U.S. source of furniture in 2004 to the second largest in 2008. Together these trends suggest a pullback by Chinese manufacturers away from the U.S. market and a shift towards the European market.

This shift away from the U.S. market can be explained by a number of factors working in conjunction. The economic crisis of 2008 and 2009 have continued to depress U.S. demand for wood products in spite of some rebounds over the last six years, causing suppliers to seek out other markets for their products. The U.S. Lacey Act, which was implemented in 2008 may have resulted in some restructuring of the market, however the fact that the regulation's enforcement coincided with the recession makes it challenging to parse out which factor played a leading role in these market shifts. While we may not be able to ascertain whether recession or regulation was the driving force behind shifts away from the U.S. market, it is clear that the dramatic growth of the Chinese market, a market which is expected to be the fastest growing consumer of wood products for years to come (Sun and Canby 2011), has counteracted the drop in demand for wood products from major consumer markets. The booming Chinese domestic market and its impressive demand for wood products has led Chinese manufacturers and nearby producer and processing markets to focus much more strongly on the lucrative Chinese domestic market.

The dramatic increase in U.S. imports of Vietnamese furniture may be related to the 2001 enactment of the U.S.-Vietnam Bilateral Trade Agreement which normalized trade between the two countries (U.S. Embassy 2013). Following the Vietnam War, which ended in 1975, the U.S. and

Vietnam maintained no economic relations until 1994 when President Bill Clinton lifted the U.S. trade embargo on Vietnam. Under the 2001 Bilateral Trade Agreement, both Vietnam and the United States extended each other 'most-favored nation' trade status, giving Vietnamese goods and companies access to the U.S. market. One of the biggest impacts this had was on tariff rates, which dropped from an average of 40 percent to an average of 3 percent, which helps to explain the more than five hundred percent growth in U.S. imports of furniture from Vietnam over the last decade.

In assessing imports of raw materials to major processing countries, it is clear that the distinguishing characteristic of the Chinese market is its dramatic growth, particularly following the 2008 economic crisis. A 2011 paper by Sun and Canby reports that the growth of the Chinese domestic wood market is driven by a number of factors including overall economic growth and the expansion of the middle class which in turn has increased demand for wood products in construction and furnishings. In addition, the 2008 Sichuan earthquake demonstrated the durability of wood based building which aided in increasing domestic demand for wood in construction (Sun and Canby 2011). On the government side, there has been significant investment in improving the Chinese distribution network for wood products as well as promotion of domestic demand-driven economic development (Sun and Canby 2011). As a result of these factors, and increased demand for Chinese products from abroad, Chinese imports of both coniferous and non-coniferous wood products have experienced huge increases, with growth of 188% over the last decade. However, while both product groups have grown, coniferous products have grown much faster and now make up considerably more of Chinese imports relative to non-coniferous imports.

While domestic demand has grown, the makeup of major suppliers has changed significantly, particularly with Chinese imports of coniferous materials from Russia. The fall in Russian market share coincides with the introduction of log export taxes. In 2007 and 2008, the Russian government adopted a series of export taxes on roundwood in order to promote Russian wood processing. The Russian government adopted a percentage based export tariff on roundwood which increased incrementally each year, starting at 6.5% in 2007 but increasing to 25% by 2008 (Simeone 2013). In response many wood processors who in the past had relied heavily on imports of Russian roundwood developed other suppliers in response to the higher costs, resulting in a decline in Russian dominance of Chinese conifer imports (Sun and Canby 2011). The trend analysis shows that wood processors have shifted towards Canada, New Zealand and the U.S., which had previously been smaller players in the market. Therefore, while the reason behind this shift was not directly related to the implementation of timber legality regulations, there has been a major shift towards imports from more regulated markets due to cost pressures from the Russian market. Unlike Chinese imports of coniferous products, the makeup of the non-coniferous market has largely remained unchanged in China, with the U.S. maintaining a dominant position in the market.

Not only has the Vietnamese market for wood products matched Chinese growth in recent years, it has surpassed it with a ten-year growth rate of 570%. While the Chinese market has seen a shift towards coniferous products, Vietnamese imports have shifted towards non-coniferous products such as tropical industrial roundwood, tropical sawnwood and plywood. While the makeup of Vietnamese imports of coniferous products has been stable over the last decade, there have been major changes in non-coniferous imports. Much like the Chinese market, the U.S. holds a dominant position in the Vietnamese hardwood market, although there has been a move towards sourcing of tropical hardwood products from China. The Chinese market is not a major producer of tropical timber,

therefore this increase in supply is most likely due to growth in Chinese firms which serve as an intermediary and re-export or minimally process raw timber before selling it into the Vietnamese market.

The results of this analysis may overlook some of Vietnam's largest sources of illegally harvested wood products, Cambodia and Laos, which both have long standing log and sawn wood export bans in place (The World Bank 2010) as well as Myanmar which imposed a log export ban in 2014 (Song 2014). Several reports have shown that large amounts of timber are still imported from Cambodia and Laos illegally by Vietnamese firms due to poor governance, but this volume is not reported in official statistics (EIA and Telepak 2008; EIA 2011). As a result, imports from countries with export bans are not included in this analysis so we cannot assess their relative share of Vietnamese imports. However, the increase in Vietnamese imports of tropical wood products from China, a country which does not produce a large volume of tropical wood raises major concerns. This development suggests that illegally exported products from Southeast Asia are potentially being diverted through Chinese intermediaries so as to disguise their illegal origin, further obscuring trends in the use of suspicious wood products. The steady increase of Chinese share of Vietnamese imports from 3% in 2003 to 30% in 2012 suggests a systematic shift which may be due to concerted efforts to evade timber export restrictions in the region by laundering illegal wood products.

Research Objectives and Questions

As timber legality regulations and chain-of-custody certifications are relatively new mechanisms, assessments of the impact of these policies have thus far been limited in focus. To date, research on illegal logging has primarily made use of economic models to estimate the market and economic effects of timber legality regulations at the global scale. A few researchers have adopted a social science approach to evaluate the impacts of regulations based on surveys of experts and government officials. However, to date there has been little assessment of the impacts of these regulations at the national level or by sectors within the wood products industry, and emerging markets for wood products have largely been overlooked.

As discussed earlier in the literature review and trade flow analysis, evaluations of the illegal logging supply chain have identified a large pool of 'suspicious producer countries,' where greater than 15% of production and exports are thought to be comprised of illegally harvested wood products (see **Table 1**). Due to the number of countries in this 'suspicious producers' group and the difficulties inherent in measuring companies involved in illegal logging on the ground, it is not feasible to develop a representative sample of the impacts of timber legality regulations on producer countries in the wood products supply chain. However, there are a relatively small number of "suspicious processing countries," which are major importers of illegally harvested wood while additionally being manufacturing centers that re-export large quantities of wood products. This group is made up of China, India, Japan, Taiwan and Vietnam (Bridegam and Eastin 2014). This limited set of countries serves as a chokepoint in the illegal timber supply-chain, and as a result targeting this subset of countries allows for a more focused assessment of the impacts of policies on wood products manufacturers and traders and in turn the effects these regulations may have further down the supply chain.

Assessing processing countries will allow for a broader view of the market situation while avoiding the costs and challenges associated with data collection across producer countries which are more geographically dispersed and may be less inclined to discuss issues of timber legality. Specifically, this study will focus on China and Vietnam, and targets individual furniture and flooring manufacturers and wood products traders as a way to evaluate the impacts of policy instruments on business practices in these processing countries. China is the largest furniture manufacturer and exporter in the world, the largest furniture supplier to the United States as well as the largest external supplier of furniture to the European Union (GTIS 2015a). Vietnam is an emerging market with a large and rapidly growing wood furniture manufacturing sector whose exports are strongly directed towards the United States.

In recent years, numerous reports have been published which detail that a substantial proportion of the raw materials used by Chinese and Vietnamese manufacturers are from illegal sources (Seneca Creek Associates 2004; EIA and Telepak 2008; EIA 2011, 2015b). This has been met with a backlash from major consumer countries and there has been increasing pressure by China and Vietnam's trading partners for industry reform. Due to this political pressure, the strong connection between these countries and the U.S. and European markets, as well as China and Vietnam's geographic proximity to Japan and Australia, it is expected that China and Vietnam will be directly impacted by recently adopted timber legality policies.

This analysis aims to provide evidence to clarify the effects of timber legality regulations on the Chinese and Vietnamese wood products industry, with a specific focus on the U.S. Lacey Act and the EU Timber Regulation. Of particular interest are managers' attitudes and perceptions regarding timber legality regulations, the impacts these may have on sourcing and sales decisions and the choice to obtain chain-of-custody certification and how demographic characteristics influence firm behavior. The overarching goal of this research is to identify how Chinese and Vietnamese firms have changed their behavior in response to timber legality regulations, and whether there are fundamental differences in the drivers of behavior between firms in the two countries. Of particular interest is the issue of regulatory leakage and this research will consider whether firms have made a conscious choice to shift away from regulated markets.

To address the limited understanding of timber legality policy impacts on wood processing countries, this study will focus specifically on the Chinese and Vietnamese furniture and flooring industries and seek to evaluate the following research questions:

- How do demographic characteristics, awareness and perceptions regarding timber legality regulations differ between Chinese and Vietnamese wood processing firms?
- How has awareness of the U.S. Lacey Act and EU Timber Regulation impacted firms' usage of chain-of-custody certification?
- Have timber regulations led firms to shift away from regulated markets and how is this behavior affected by demographic characteristics, sourcing and sales decisions?
- What natural groupings exist with regard to firms' awareness and perceptions towards timber legality regulations? Are these patterns of perceptions and awareness significantly impacted by firms' demographic characteristics?

Methodology

Survey Instrument

In order to better understand the impact of timber legality regulations on business practices in Vietnam and China, researchers from the Center for International Trade in Forest Products (CINTRAFOR) at the University of Washington administered surveys in 2013 and 2014 at home and furniture trade shows in Ho Chi Minh City, Shanghai and Guangzhou. The sample population for this study was comprised of individual companies based in Vietnam and China which are involved in the manufacture of wood furniture and flooring products as well as firms which import and export wood products.

The survey instrument was developed based on the results of background research and informal interviews with government officials and industry managers in China and Vietnam. Survey questions were developed by representatives from industry groups and academia and included questions on firms' awareness of the four major timber legality regulations, how these regulations influence where firms source and sell materials, their perception of regulations as well as their use of chain-of-custody certification. The survey also included demographic questions which collected information on the type of products the firm produced, their annual sales revenue, number of employees and geographic location. These questions were designed to assess the impact of recently implemented trade regulations on the perceptions and business practices of industry managers and identify differential impacts across demographic variations. The English, Chinese and Vietnamese versions of the survey can be found in **Appendix A, B and C**.

The survey was translated into Chinese and Vietnamese and was administered by graduate students and faculty from the University of Washington at a series of trade shows with local university students acting as facilitators. Surveys were administered in China across three tradeshows which were held between March 2013 and March 2014. The Chinese surveys were administered at two shows in Shanghai: the DOMOTEX Asia/ CHINAFLOOR Show and the Furniture Manufacturing & Supply China Show, as well as at the China International Furniture Fair which was held in Guangzhou. Surveys were administered at two tradeshows in Vietnam between September 2013 and March 2014 at the VietnamWood: Woodworking Industry Fair and the Vietnam International Furniture & Home Accessories Fair, both of which were held in Ho Chi Minh City, Vietnam. During the trade shows a display booth was stationed on the show floor with survey administrators selecting company representatives to complete a paper based survey. Due to the wide variety of companies present across the five trade shows, screening questions were asked before administering the survey to ensure that only industry managers involved in the production and trade of wood products were invited to participate and that no companies were sampled more than once.

Data Structure

The resulting data from the survey was comprised of a series of categorical variables, binary variables, discrete variables and percent data, which are outlined in **Table 5**.

The variables included a number of demographic questions which included categorical questions relating to firms' business type and annual sales revenue as well as discrete data on the number of full time workers employed by each firm.

Companies were asked a series of questions relating to their supply chain which included questions regarding the percent of their products containing tropical hardwoods, what percent of products had Chain-of-Custody (CoC) certification and a follow-up categorical question to determine which CoC certifications their firm had obtained. Firms were asked to disclose what percent of their sales revenue was derived from their domestic market and the percent derived from direct or indirect exports. The data set includes a series of categorical questions asking firms to disclose how sourcing and sales have changed over the last five years. This series of questions included a list of the top eight source and sales countries for China and Vietnam and was developed using the Global Trade Atlas data (GTIS 2015a).

Firms were asked a series of eight Agree/Disagree questions designed to gauge their attitudes and perceptions towards timber legality regulations in general. This was followed by a series of five Agree/Disagree questions specific to the U.S. Lacey Act. Finally, firms were asked to indicate their level of familiarity with the four main timber legality regulations to determine their degree of awareness of the U.S. Lacey Act, EUTR, Japanese Goho-Wood and Australian ILPA.

Table 5. Data structure detailing questions and variable types.

DEMOGRAPHIC QUESTIONS	
Main Business Type (Furniture, Flooring, Import/Export)	Categ.
Annual Sales Revenue	Categ.
Number of Full Time Workers	Discrete
SUPPLY CHAIN QUESTIONS	
Products with: Tropical Hardwoods, CoC Certification	Percent
Firm Has Obtained FSC, PEFC Certification	Binary
Percent Sales Revenue Derived From:	
• Domestic Market, Indirect Exports, Direct Exports	Percent
Sales to _____ incr, decr, same, don't sell? (Top 8 Mkts)	Categ.
Source from _____ incr, decr, same, don't sell? (Top 8 Mkts)	Categ.
PERCEPTIONS/ATTITUDES QUESTIONS	
<i>Questions regarding timber legality regulations:</i>	
• Legality regs. are effective at reducing illegal timber	Agree/Dis.
• I intend to increase exports to countries without regs.	Agree/Dis.
• Timber legality regs. cause timber prices to increase	Agree/Dis.
• Timber legality regs. increase the cost of exporting	Agree/Dis.
• I intend to decrease exports to countries with regs.	Agree/Dis.
• I will increase use of cert. wood to comply with regs.	Agree/Dis.
• Timber legality regulations are a trade barrier	Agree/Dis.
• I intend to sell more products domestically due to regs.	Agree/Dis.
<i>Questions specific to US Lacey Act:</i>	
• I acquired certification to comply with the Lacey Act	Agree/Dis.
• I will source more from US to comply with Lacey Act	Agree/Dis.
• I will reduce exports to the US due to the Lacey Act	Agree/Dis.
• The Lacey Act made me careful about sourcing timber	Agree/Dis.
• It is easy to comply with the Lacey Act	Agree/Dis.
AWARENESS QUESTIONS	
<i>Familiarity with the following timber legality regs:</i>	
• US Lacey Act	Categ.
• EU Timber Regulation	Categ.
• Japanese Public Procurement Policy (Goho-Wood)	Categ.
• Australian Illegal Logging Prohibition Act	Categ.

Survey Responses

Survey administration resulted in a total of 396 firms being sampled overall; with 262 individual firms sampled at Chinese trade shows and 134 firms sampled at Vietnamese trade shows. The number of surveys collected from each of the trade shows is outlined in **Table 6**.

Table 6. Trade show dates, locations and number of firms sampled.

Trade Show	Location	Date	Responses
Domotex Asia/ ChinaFloor Show	Shanghai, China	Mar. 2013	105
Furniture Manufacturing & Supply Show	Shanghai, China	Sept. 2013	120
China International Furniture Fair	Guangzhou, China	Mar. 2014	37
VietnamWood Woodworking Industry Fair	Ho Chi Minh, Vietnam	Sept. 2013	53
Vietnam International Furniture & Home Accessories Fair	Ho Chi Minh, Vietnam	Mar. 2014	81

The research administration used a convenience sampling method for conducting the survey as this was a cost effective way to sample the available target population (Fowler 2009). The advantage of convenience sampling was that it allowed researchers to avoid the travel costs associated with visiting individual companies in China and Vietnam. Additionally, it was not practical to mail out questionnaires to randomly selected wood products manufacturers as this was expected to have a high cost and low response rate. It was also not feasible to obtain electronic contact information for Chinese and Vietnamese firms or effectively screen for our target population with an online survey (Dillman 2000). The disadvantage of the convenience sampling methodology is that it can result in selection biases, or the biased estimation of the effect of a treatment, so the choice of survey venues is critical for this sampling method (Heckman 1979).

In order to counteract sampling bias, the trade shows in this study were carefully selected to develop a broad overview of the Chinese and Vietnamese wood products industry, covering multiple industry types while at the same time evaluating as large a potential pool of firms as possible. The 2013 Domotex Asia/ChinaFloor Show in Shanghai was largely comprised of flooring manufacturers, hosted 40,000 visitors and 1,100 exhibitors and is the largest international flooring trade exhibition in the Asia-Pacific region (VNU Exhibitions Asia 2013). The 2013 Furniture Manufacturing & Supply China Show was aimed at furniture manufacturers and with 33,834 visitors and 790 exhibitors is the 3rd largest furniture show in the world (SWEECC 2013). The 2014 China International Furniture Fair which was held in Guangzhou is the world's largest office furniture trade fair and hosted 149,000 visitors and 3,600 exhibitors (CIFF 2014). Together these tradeshow give a broad representation of Chinese flooring and furniture manufacturers.

The 2013 VietnamWood Woodworking Industry Fair hosted 10,062 visitors and 260 exhibitors and is the largest wood manufacturing fair in Vietnam (VietnamWood 2013). The Vietnam International Furniture & Home Accessories Fair hosted 142 exhibitors and 7,900 visitors and is the second largest furniture show in Vietnam (VIFA-Expo 2014). The Vietnamese trade shows gave an adequate representation of furniture manufacturers, however the representation of other wood products industries in Vietnam is lacking. Altogether, the tradeshow included in this study produced a heterogeneous mix of respondents and provided a diverse representation of the Chinese and Vietnamese wood products industries.

Data Analyses

Descriptive Analysis

After coding the surveys into SPSS the results were cleaned to remove outliers and miscoded data. An evaluation was performed using descriptive statistics which included an assessment of response frequencies, percentages and means. This analysis initially focused on describing the demographic characteristics of Chinese and Vietnamese firms in order to identify similarities and differences between firms in the two sample groups.

Next, the analysis examined firms' responses to questions regarding use of chain-of-custody certification, the proportion that domestic sales, direct exports and indirect exports make up of total sales revenue, how markets for sales and sourcing have changed over the last five years, perceptions towards timber legality regulations and awareness of these policies. This analysis first used descriptive statistics to identify broad trends and relationships with firm demographic characteristics, and then further analysis uses contingency tables to address the relationships between these variables. For these analyses several statistical analyses were employed to evaluate differences in responses across firm characteristics. Chi-square tests were used to compare the counts of two variables, testing the null hypothesis that the two variables are independent. A significant finding on this test means that we can reject the null and support the hypothesis that there is a significant relationship between the two variables. Z-tests were used to compare whether the difference between proportions of responses was significant, testing the null hypothesis that the proportions are equal. If this test results in a z-score that is significant, we can reject the null and support the assertion that the proportion of responses is significantly different.

In order to examine mean scores, t-tests of independent samples were used to evaluate differences between sets of two means, testing the null hypothesis that the two means are equal. A significant t-value allows us to reject the null hypothesis and accept the alternative hypothesis that the means are significantly different. Finally, a one-way ANOVA was employed to evaluate differences in mean scores across three or more categories, with the null hypothesis that all population means are equal. If a significant F-statistic is found, we can support the alternative that the population means are unequal. However, a significant result on the one-way ANOVA test does not identify which of the means are different. In order to isolate where the differences are, a series of pairwise t-tests were performed to distinguish which of the means are significantly different. A Bonferroni adjustment was employed to avoid the potential problem of alpha inflation where, as more tests are conducted, the likelihood of a finding of significance due to chance increases. While the Bonferroni adjustment calculates a new pairwise alpha to maintain an overall alpha of 0.05, this technique tends to

overcorrect for Type I errors and actually reduces power (Zar 2010). Therefore, this evaluation of the difference in means across categories should be considered to be a conservative estimate. Results with a significance level of 0.05 were further analyzed and represented graphically.

Regression Analyses

Data were further evaluated to identify relationships between use of FSC and PEFC chain-of-custody certification and a number of independent variables. The binary variables ‘Obtained FSC’ and ‘Obtained PEFC’ chain-of-custody certification were selected as dependent variables and independent variables included the country the firm is located, awareness of each of the four major timber legality policies, percent of firms’ products containing tropical hardwoods, company sales revenue, and interaction between these variables and firm location. In order to predict the values of the two binary dependent variables, multiple logistic regressions were used to analyze the data. In developing the model, differential behavior by country was controlled for using interaction terms. A sequential predictor entry method was used to control for the effects of country as well as to evaluate interaction effects. The results of this analysis were evaluated to identify zero-order correlations as well as the extent to which each block accounts for variance in the dependent variables.

Based on the results of descriptive analyses, significant relationships were observed between the survey’s perception variables. In order to explore firms’ perceptions further, and to eliminate multi-collinearities among the perception variables, a principal components analysis (PCA) was performed to reduce the dimensions of the data and highlight differences between Chinese and Vietnamese perspectives. This ‘Factor Analysis’ serves to identify underlying sources of variance and can be used with further analyses to identify relationships with independent variables to further theoretical evaluation of patterns in the data (Lattin 2003). A bivariate correlation was used to analyze which perception variables were significantly correlated and a factor analysis based on eight of the nine perception variables was performed. A Varimax rotation was used to facilitate interpretation by maximizing the sum of the variances of the square loadings between the variables and factors (Abdi 2003). The factor analysis resulted in three or four strong groupings and based on the percent of variance explained, assessment of a scree plot and evaluation of relative interpretability of the factors, the three factor solution was selected. For each of the three factors identified, firms were assigned composite scores based on their responses to the eight perceptual questions. A comparison of factor scores across countries identified a significant country effect for the “Intend to Shift” factor which was selected for further investigation to identify the drivers of regulatory leakage.

A linear regression using stepwise forward selection was conducted to estimate firms’ ‘Intend to Shift’ factor scores. The linear regression was conducted with the ‘Intend to Shift’ factor as the dependent variable and prediction was based on a number of independent variables. As significantly different average ‘Intend to Shift’ scores were observed for Chinese and Vietnamese firms, the decision was made to evaluate each country separately so as to avoid obscuring any patterns present in the data. The independent variables chosen for the regression model were selected based on comparisons of mean factor scores against demographic, sales and sourcing variables using independent samples t-tests and one-way ANOVAs. Based on the results of the initial screening, those predictors which showed significant differences in mean factor scores were included in the regression model. A forward stepwise selection method was employed which iteratively adds variables to the

model, keeping those variables which are shown to improve the model based on comparison criteria including the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC). AIC and BIC are measures of the relative quality of statistical models which estimate the efficiency of each proposed model relative to other models, and the model with the lowest score is preferred. Both measures evaluate the trade-off between goodness of fit and the complexity of the model, however BIC penalizes the number of parameters in the model more strongly. This technique attempts to minimize the number of selection criteria in order to select the most parsimonious model. The variables highlighted by the stepwise regression were further assessed to draw inferences and conclusions.

Multivariate Analyses

Multivariate analysis of the data set was performed using R Statistical Software (R Core Team 2015). As the first objective of this study was to determine the groupings of firms with regards to their attitudes and perceptions, an agglomerative hierarchical cluster analysis was run on firms' perceptions towards timber legality regulations using the Ward's minimum variance method (McCune and Grace 2002). Ward's method is aimed towards developing compact clusters by combining groups whose merger leads to the smallest within-cluster sum of squares (Lattin 2003). The analysis is based on a squared Euclidean distance matrix containing the subset of questions related to perceptions. Using a squared Euclidean distance increases the importance of large distances while weakening the importance of objects which are closer together. Used with Ward's method, this space-conserving strategy minimizes total within-cluster variance and creates clusters of small size. The number of clusters selected was determined through a combination of scree plot and index-based assessment (Milligan and Cooper 1985). The results of the hierarchical cluster analysis were then compared against the perception and demographic variables in order to characterize the make-up of each cluster and describe their relative positions regarding timber legality regulations.

Nonmetric Multidimensional Scaling (NMDS) was used to assess the impact of demographic variables on firms' perceptions (Legendre and Legendre 1998). The mixed nature of the study's variables as well as the large amount of missing data present in the dataset was a significant factor in the determination to use this method. NMDS is a flexible method which can be used with any distance matrix and avoids the assumption of linear relationships among variables. This method supports the use of Gower's similarity coefficient which allows for the use of objects which contain missing information. An additional benefit of using NMDS is that this method uses the rank order of distances, rather than the distances themselves and as such the assumption of linearity is relaxed, which is ideal with mixed variables (Digby and Kempton 1987). NMDS is accomplished by iteratively repositioning the objects in a multidimensional ordination space until they represent, as closely as possible the ranked dissimilarity relations between objects depicted in the distance matrix. The algorithm attempts to minimize stress, which is a measure of the degree to which the ranked ordination differs from multivariate space distances. If stress is high, the algorithm repositions points in ordination space in the direction of decreasing stress and repeats until the stress is below a certain threshold. Generally, stress under 0.05 is an excellent representation of reduced dimensions, however any stress less than 0.3 is considered acceptable (Lattin 2003).

Based on the results of the NMDS, vectors were computed based on a linear regression between perception and awareness variables and NMDS scores. These vectors were then overlaid over a plot of NMDS points representing each firm, allowing for visual interpretation of the differences between firms as well as the major drivers of perceptions towards timber legality regulations. Confidence ellipses were plotted in order to aid interpretation. These ellipses represent 95% confidence intervals around the centroids of specific categories of responses and can be used to visually depict firm location, size and business type across ordination space.

Finally, an analysis of similarity (ANOSIM) was carried out in order to evaluate whether there exist statistically significant differences between specific demographic groups. ANOSIM is a procedure for testing the hypothesis of no difference between two or more groups of objects. The method compares the ranks of distances within one group against ranks of distances within another group, comparing means of these two ranks. The resulting R test statistic measures whether separation of community structure is found ($R=1$) or whether no separation occurs ($R=0$). R values greater than 0.75 are considered well separated, above 0.5 are considered separated but overlapping and R less than 0.25 are considered barely separable (Clarke and Gorley 2005). This method is a non-parametric technique which can be used with any distance measure and, as it is based on rank similarity, it is commonly used in combination with NMDS (Clarke 1993). ANOSIM was conducted using a Gower's dissimilarity matrix and was calculated to determine whether there exists a significant difference between Chinese and Vietnamese firms using a one-way ANOSIM, between firms across six sales revenue categories using pairwise ANOSIMs, as well as between the results of the cluster analysis using pairwise ANOSIMs. The results of the ANOSIM were then compared with the NMDS ordinations and perception and awareness vectors, allowing for visual interpretation of the drivers of group dissimilarity.

Results and Discussion

After coding the data into SPSS 19 the results were initially evaluated using descriptive statistics including an assessment of response frequencies, percentages and means. This analysis initially focuses on describing the demographic characteristics of Chinese and Vietnamese firms in order to identify similarities and differences between firms in the two sample groups.

Next, this analysis examines firms' responses to questions regarding use of CoC certification, the proportion that domestic sales, direct exports and indirect exports make up of total sales revenue, how markets and sourcing have changed over the last five years, managers perceptions towards timber legality regulations and their awareness of policy. This analysis first uses descriptive statistics to identify broad trends and relationships with firm demographic characteristics, and then further analysis uses contingency tables to address the relationships between these variables. For these analyses Chi-square tests were used to check the independence of counts between compared variables, Z-tests were used to compare column proportions and one-way ANOVA were employed to evaluate differences in mean scores. Results with a significance level of 0.05 were further analyzed and represented graphically.

Geographic Distribution

Administration of the survey resulted in a total of 396 firms sampled overall; with 262 individual firms sampled at Chinese trade shows and 134 firms sampled at Vietnamese trade shows.

The results of the Chinese surveys are depicted in Figure 26 and clearly show that respondent firms tended to be located in coastal provinces. In part because two of the three trade shows were located in Shanghai, a large proportion of respondents were located in the central China region which is also a major hub for wood products manufacturing. Chinese wood products manufacturers are predominantly located in east and coastal regions of China. The survey responses provide adequate coverage of these major manufacturing regions and offer an adequate representation of the Chinese wood products market as a whole.

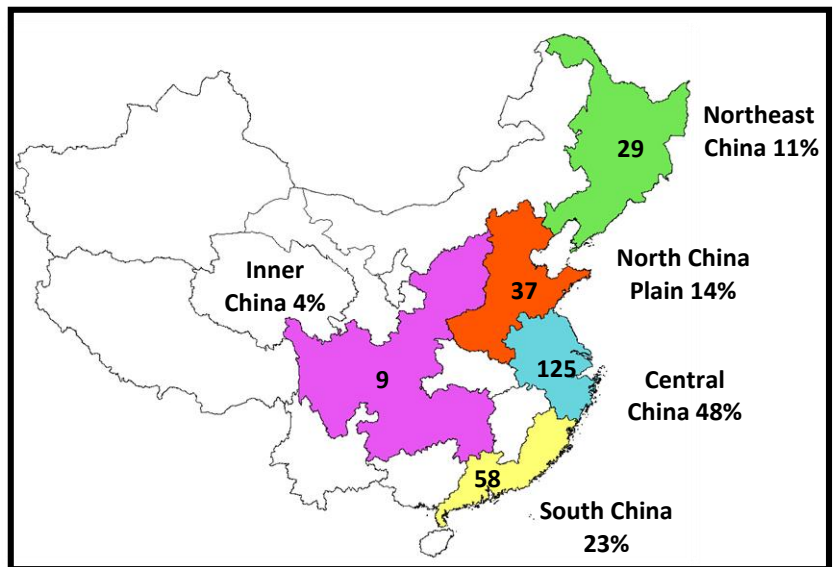


Figure 26. Response rate of Chinese firms by region.

Responses from Vietnamese firms were primarily focused in the southeast region of Vietnam, which includes Ho Chi Minh City, where both surveys were administered **Figure 27**. Wood manufacturing in Vietnam is largely centered on three regional hubs, including the Red River Delta, the South Central Coast and the Southeast provinces (Schaumburg-Müller and Chuong 2010). While this survey gave an adequate representation of firms from the area around Ho Chi Minh City including Binh Duong and Dong Nai, it would be better to get more coverage of manufacturers from the Binh Dinh province on the south central coast as well as from the Bac Ninh and Hanoi provinces from the Red River Delta region as these regions are major centers for wood manufacturing and may provide different results.

Respondent Demographics

In assessing firms' responses to questions regarding their company's characteristics it becomes clear that the firms sampled in China and Vietnam are distinctly different. The Chinese companies showed a much wider distribution of business types than their Vietnamese counterparts, with a large proportion of furniture, flooring and exporting firms represented in the sample (see **Figure 28**). On the other hand, 60% of the sampled Vietnamese companies reported that they were furniture manufacturers and only 30% reported they were either importers or exporters.

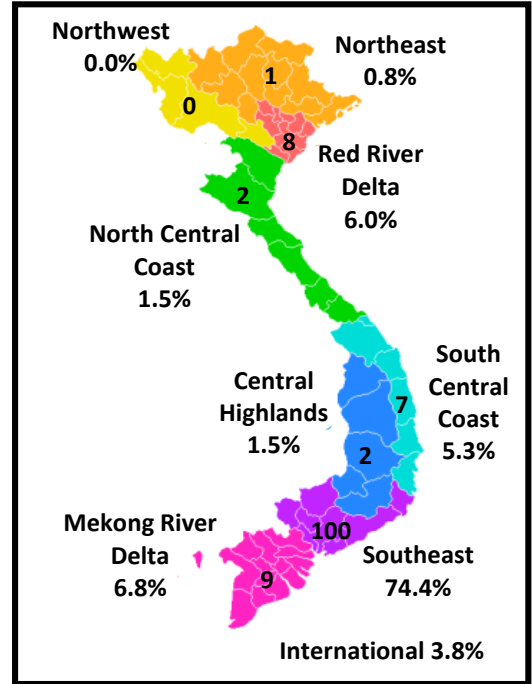


Figure 27. Response rate of Vietnamese firms by region.

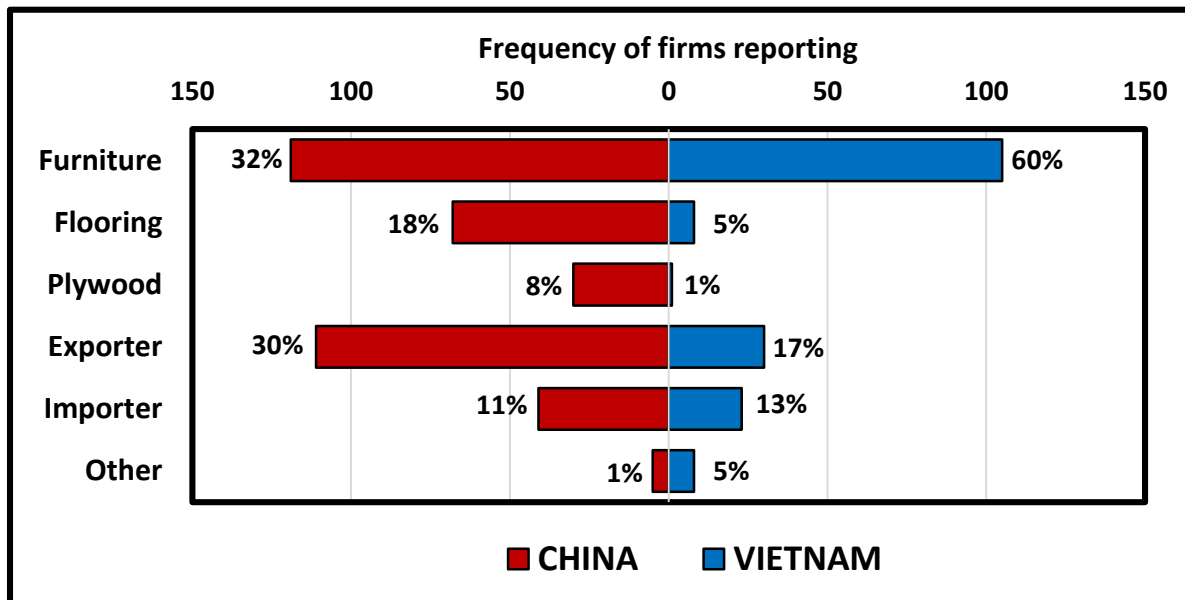


Figure 28. Reported business types of Chinese and Vietnamese firms.

One of the main differences between the Chinese and Vietnamese furniture industry is related to the Vietnamese industry's focus on wooden outdoor furniture (Schaumburg-Müller and Chuong 2010). Thus, the survey in Vietnam was adjusted to gather additional information regarding furniture firms' production of both indoor and outdoor furniture. As **Figure 29** shows, the majority of firms produce wooden indoor furniture, although outdoor furniture still makes up a large subset of the responses gathered from Vietnamese furniture manufacturers.

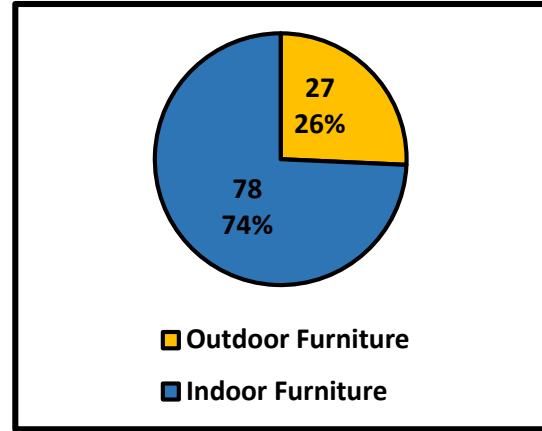


Figure 29. Response rates of Vietnamese furniture subcategories.

Chinese responses demonstrated a higher percentage of firms reporting that they have two or more business types (**Figure 30**), such as firms which are both furniture manufacturers and exporters. This suggests a greater level of vertical integration along the supply chain and may serve as an indicator of firms' level of sophistication. The Vietnamese respondents had a larger proportion reporting one business type, suggesting that a large number of Vietnamese firms are solely furniture manufacturers and work with an intermediary to export their products to international markets.

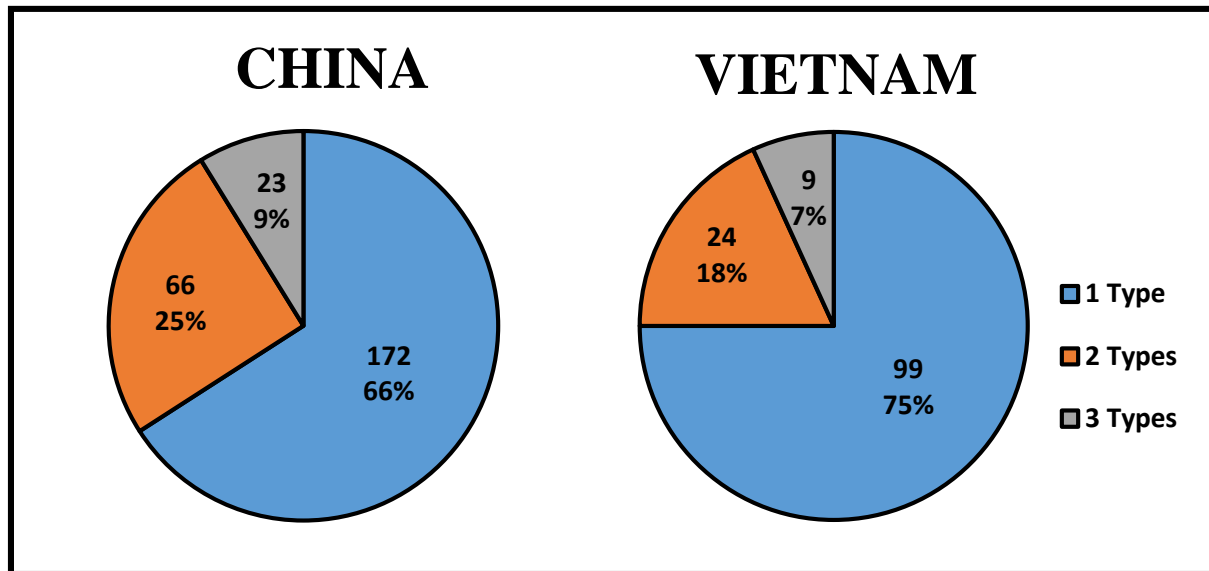


Figure 30. Number of main business types reported by Chinese and Vietnamese firms.

Another distinct difference between the Chinese and Vietnamese respondents relates to the size of the firms surveyed. Firm size was evaluated based on reported annual sales revenue. The majority of Vietnamese firms reported sales revenues of less than \$6.5 million, with 40% of firms falling into the smallest category with sales less than \$1.5 million annually (**Figure 31**). Responses by Chinese firms were much more uniform, with relatively even representation across the six sales revenue categories. It is worth noting that relative to the firms in Vietnam, the Chinese firms had a much higher proportion of firms in the largest sales revenue categories.

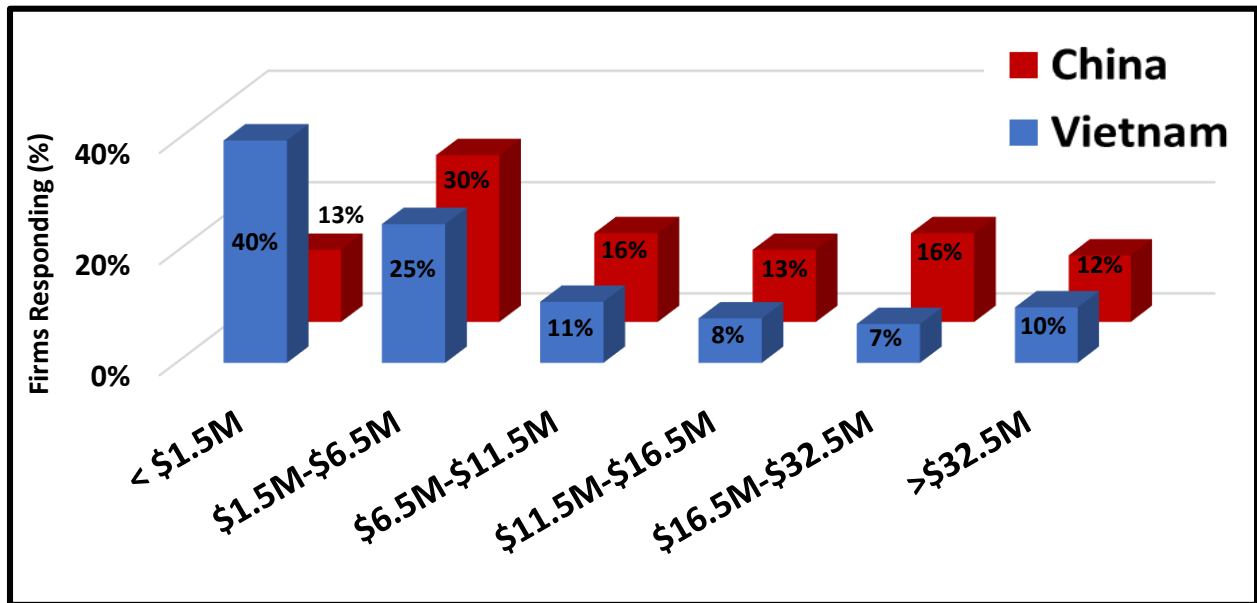


Figure 31. Annual sales revenue reported by Chinese and Vietnamese firms.

A second indicator of firm size was included in the survey, with firms asked the number of full time workers their company employs (Figure 32). On average Chinese firms employed a higher number of employees, with 508 workers on average, while Vietnamese firms employed an average of 345 workers. The Chinese firms showed a distinct relationship between sales revenue and number of employees, with larger firms reporting a higher number of workers. While this pattern was present in the Vietnamese data, the relationship was not as strong. Therefore, further analyses will make greater use of firms' reported annual sales revenue as an indicator of firm size.

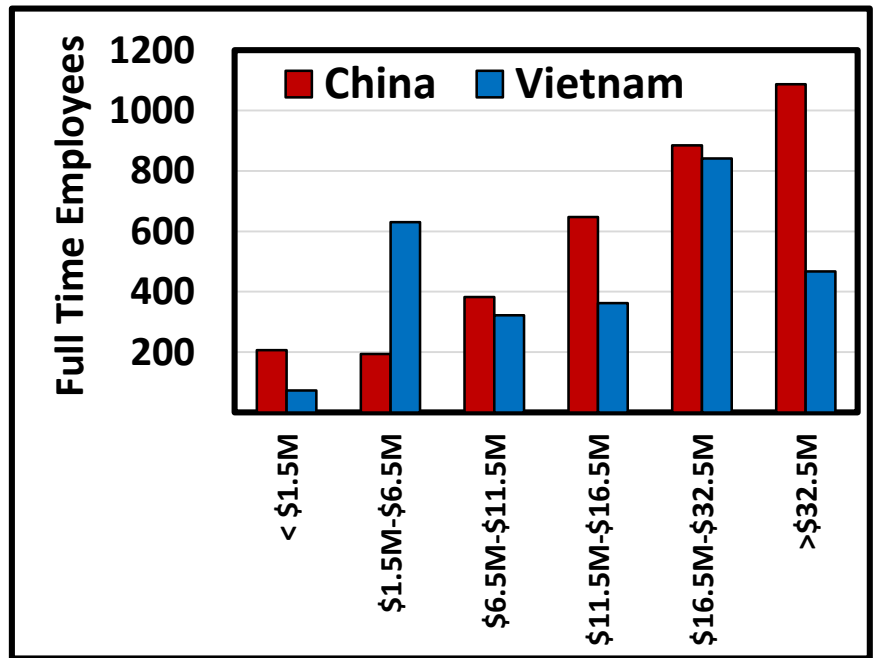


Figure 32. Number of full time workers employed.

Descriptive Analyses of Survey Responses

Chain-of-Custody Certification

The results from the survey show that overall use of CoC certification is higher in China. Although usage of PEFC CoC certification is low across both Chinese and Vietnamese firms, there is a significant difference in usage of FSC CoC certification (**Figure 33**). A significantly higher proportion of Chinese firms responded that they use FSC compared to their Vietnamese counterparts ($\chi^2 = 34.5, d.f. = 1, p < 0.001$).

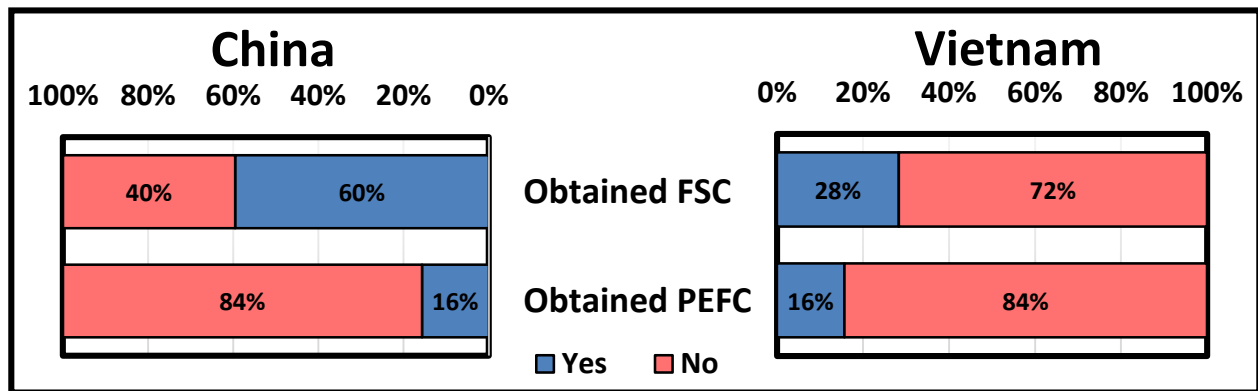


Figure 33. Percent of firms reporting FSC and PEFC usage.

Comparing chain-of-custody certification usage against firms' sales revenue, it becomes clear that there is a strong relationship between usage and company size, with a larger proportion of firms with high revenue reporting they use certified wood (**Figure 34**). Although both Chinese and Vietnamese responses show a trend where smaller firms use less certified wood and larger firms use more, this is only significant for Vietnamese firms. Based on the results of an independent samples t-test, large Vietnamese firms with sales revenue greater than \$32.5 million showed a significantly higher usage of FSC than small firms with revenue less than \$6.5 million and medium sized firms with revenues ranging from \$11.5 to \$16.5 million ($p = .015$). Considering use of PEFC certification, large companies with sales revenue between \$16.5 and \$32.5 million showed a significantly higher use of PEFC CoC certification than those small and medium sized firms with sales revenue less than \$11.5 million ($p = .008$).

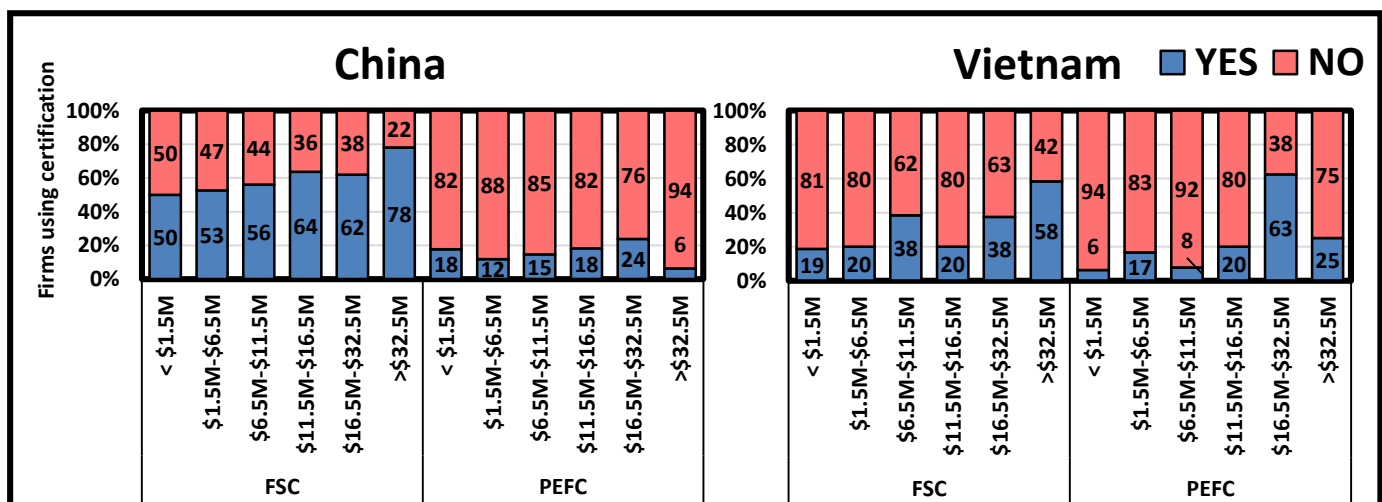


Figure 34. Firms' reported use of FSC and PEFC by annual sales revenue.

When evaluating chain-of-custody certification usage against main business type (see **Figure 35**) Chinese furniture firms showed significantly lower usage rates of CoC certification than other business types ($p = 0.040$). Plywood firms also showed a similarly low proportion of CoC certification use, however due to the smaller sample of firms in this category this did not reach the level of significance. The Chinese market is noteworthy because use of CoC certification is significantly higher for exporters ($p < .001$) and importers ($p = .028$). In Vietnam, firms have lower CoC usage rates than their Chinese counterparts across all business types. Vietnamese furniture firms have the lowest CoC certification usage rate of any business type, however the difference in proportion between furniture firms and other business types does not reach the level of significance.

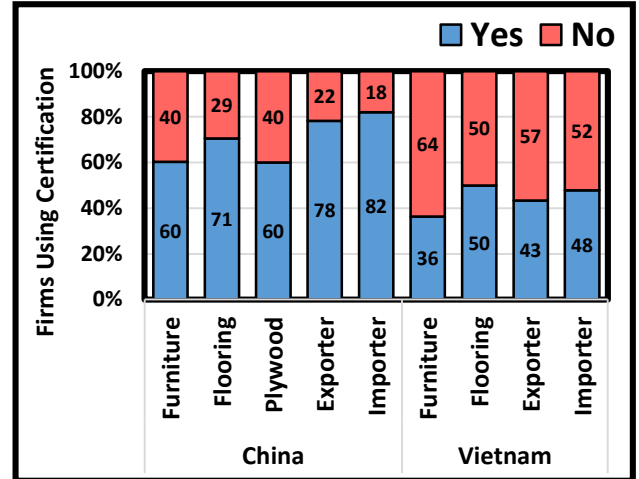


Figure 35. Firms' use of CoC Certification by business type.

Subdividing Vietnamese furniture manufacturers into indoor and outdoor furniture reveals that outdoor furniture manufacturers use a significantly higher proportion of FSC certified wood than other furniture companies ($p = .038$) (**Figure 36**). However, the subset of indoor furniture manufacturers shows a significantly lower usage rate when compared with other furniture companies ($p = .042$). This may reflect outdoor furniture manufacturers focus on export markets, particularly with garden furniture, as well as an increased use of certified wood in response to a recent exposé which uncovered widespread use of illegal wood in the Vietnamese outdoor furniture industry and a subsequent backlash by major consumer markets (EIA and Telepak 2008).

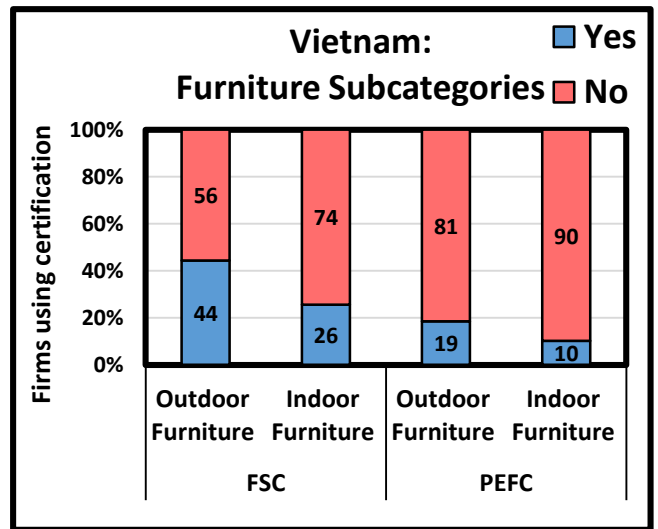


Figure 36. Vietnamese firms' reported use of FSC and PEFC across furniture subcategories.

Chain-of-Custody Usage Rate

As a follow up question to whether firms had obtained chain-of-custody certification, firms were asked to report the percentage of their wood products and raw materials which had chain-of-custody certification. Responses across countries were very similar, with Chinese firms reporting an average of 52% of products had CoC certification while Vietnamese firms reported that 56% were certified. Usage rates were not significantly different across firms' annual revenue. Flooring firms in both countries showed higher than average usage of CoC certification, with Chinese flooring firms reporting an average of 55% and Vietnamese flooring firms reporting 64% of materials had chain-of-custody certification.

Tropical Hardwoods Usage Rate

Chinese and Vietnamese firms reported significantly different average rates of tropical hardwoods in their wood raw materials and wood products exports ($t=-3.99$, $d.f. = 361$, $p<.001$), with Chinese firms reporting that 33% of wood products were from tropical hardwoods, while Vietnamese firms reported that 49% were of tropical origin. An interesting pattern emerges when comparing use of tropical hardwood and annual sales revenue (**Figure 37**). Chinese firms show a steady and significant increase in use of tropical hardwoods as annual revenue increases, with tropical hardwoods only in 22% of products for the smallest firms and largest firms using almost twice as much ($F(5,238)=2.45$, $p=.035$). Vietnamese firms on the other hand showed the highest rates in smaller firms with annual revenues less than \$6.5 million which used significantly more tropical hardwoods than their larger colleagues ($F(5,99)=3.16$, $p=.011$).

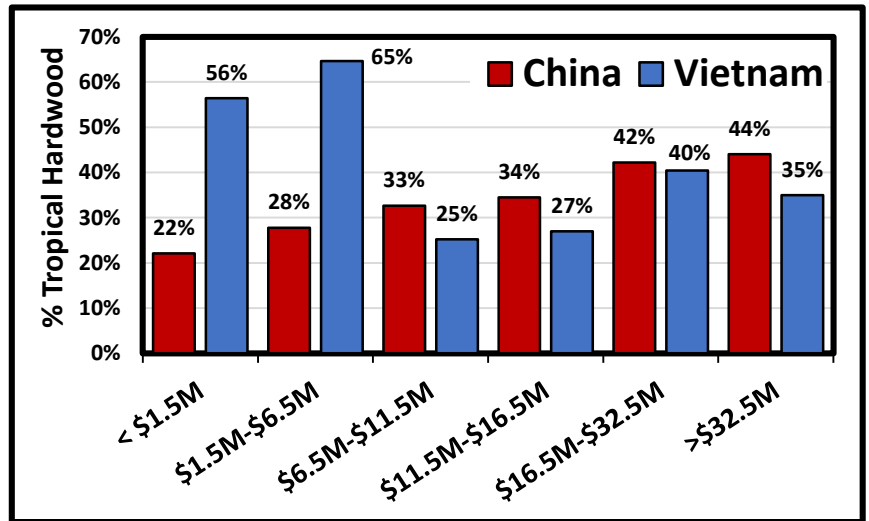


Figure 37. Percentage of tropical hardwood usage by annual sales revenue.

A comparison of tropical hardwood usage across business types shows that across all types of companies, Vietnamese firms use a higher percent of these tropical products (**Figure 38**). Chinese firms show the highest rate of tropical products usage by flooring manufacturers, and the lowest rates of usage are among furniture manufacturers. Only a very small sample of Vietnamese firms produced plywood and none responded to this question.

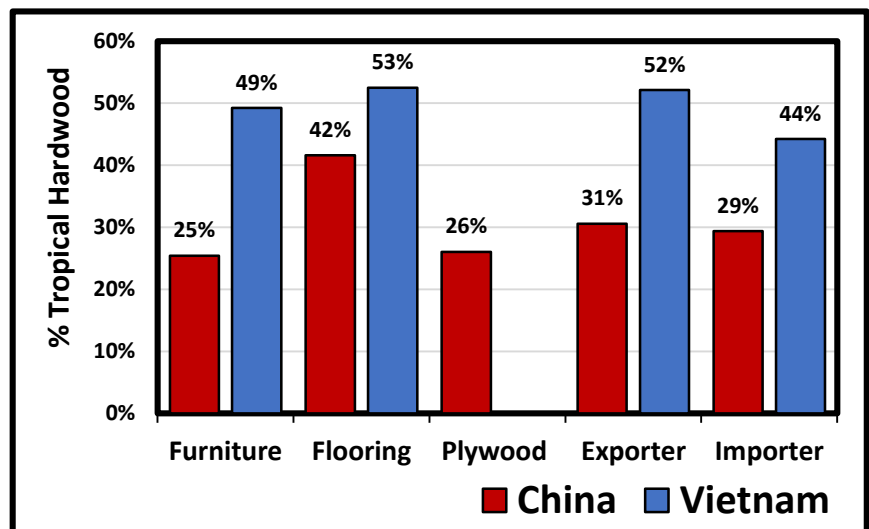


Figure 38. Percentage of tropical hardwood use by business type.

Channels of Distribution

Firms were asked a series of questions related to the methods of exporting and channels of distribution they use, which addressed the percentage of firms' sales derived from the domestic market, direct exports and indirect exports (**Figure 39**). Among Chinese and Vietnamese firms there was no significant difference in the average percent of sales directed towards the domestic market. However, there were major differences between China and Vietnam in the proportion of sales channeled through direct and indirect exports. An independent samples t-test found that Chinese firms showed a significantly higher proportion of direct exports than their Vietnamese counterparts ($t=2.401, d.f.=377, p=.017$). Meanwhile, Vietnamese firms exhibited a significantly higher percent of sales from indirect exports with 16%, as compared to an average of 8% with Chinese firms ($t=-3.194, d.f.=376, p=.002$). This suggests that while Chinese firms may be more vertically integrated and directly export to international markets, a higher proportion of Vietnamese firms make sales to international buyers indirectly through traders which act as intermediaries in the supply chain.

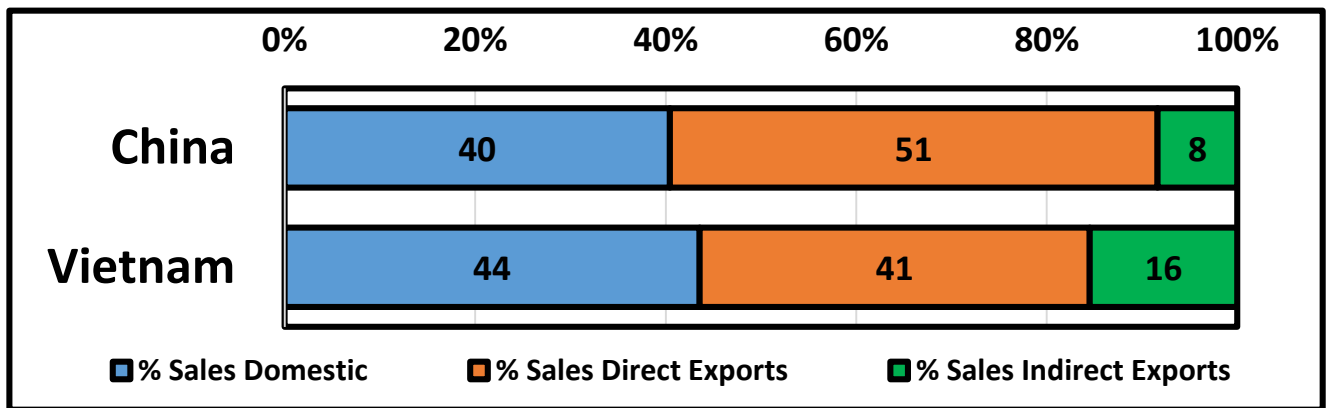


Figure 39. Average percent of sales derived from different channels of distribution.

Looking at channels of distribution and company size, firms were divided into two size categories to add clarity to the results, with smaller firms defined as those with annual sales revenue less than \$11.5 million and larger firms with revenue greater than \$11.5 million. Chinese firms show a distinctly uniform pattern of domestic sales and export modes with no significant differences across company size (**Figure 40**). However, the results from Vietnam are dramatically different showing a distinct divide between smaller and larger firms. Smaller companies show a significantly higher proportion of domestic sales than firms with larger sales revenue ($t=2.877, d.f.=110, p=.005$). Indirect sales remain relatively constant across firm size, however there are significant increases in the proportion of direct exports as firm size increases ($t=-3.647, d.f.=110, p<.001$).

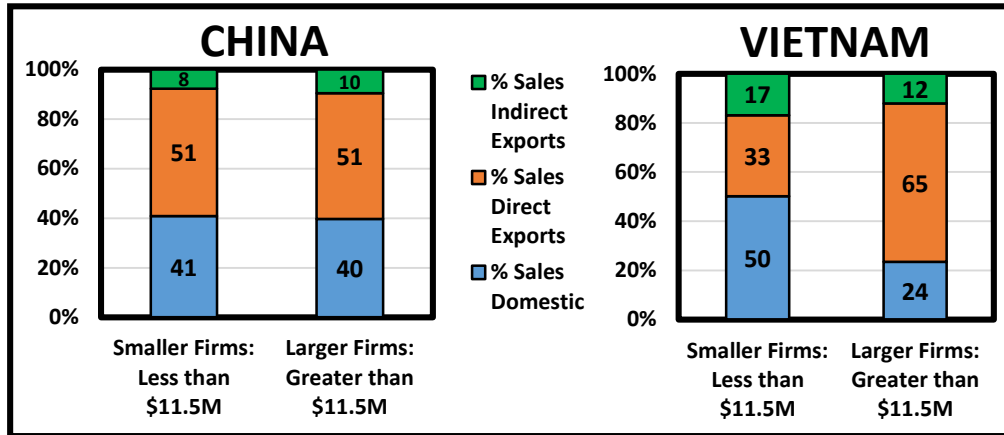


Figure 40. Percent of sales derived from different channels by annual sales revenue.

Breaking out channels of distribution across firms' main business type give a series of results which are logical and support the validity of the survey responses. The results show that Chinese importers display a high degree of domestic focus as compared to other firms ($t = -2.515, d.f. = 257, p = .013$) (Figure 41). Plywood and furniture firms also show a relatively high proportion of domestic sales but this does not reach the level of significance. Chinese flooring firms and exporters show a focus on direct exports while levels of indirect sales are relatively constant across business types. In Vietnam, importers show the highest level of domestic sales ($t = -2.728, d.f. = 118, p = .007$) as well as the lowest level of direct exports ($t = 2.650, d.f. = 118, p = .009$). Exporters show the lowest levels of domestic sales ($t = 3.457, d.f. = 118, p < .001$) and direct exports from this category are significantly higher than other business types ($t = -2.633, d.f. = 118, p = .010$). The results from Vietnam make sense logically, however what is interesting is the relative variability of Vietnamese responses which is not present among Chinese firms. The relative differences in channels of distribution across Vietnamese firm categories may be indicative of the lack of integration in Vietnamese firms, which indicates that Vietnamese exporters and importers tend to be more specialized which is expressed through larger variation in use of distribution channels.

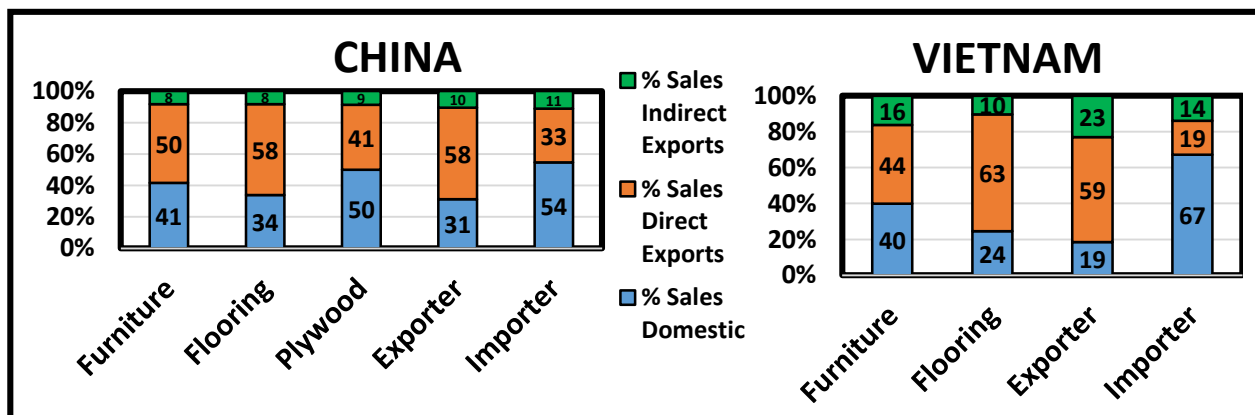


Figure 41. Percent of sales derived from different markets by business type.

Awareness of Timber Legality Regulations

The study included a series of questions related to firms' level of familiarity with timber legality policies. There was very low awareness of the Japanese 'Goho-wood' and Australian Illegal Logging Prohibition Act across both Chinese and Vietnamese firms (**Figure 42**). With regard to the U.S. Lacey Act and EU TR, a much larger proportion of Chinese firms were moderately or very familiar with the policies, as compared to Vietnamese firms which were significantly more likely to have not heard of the U.S. Lacey Act or EU TR ($p < .001$). While only a small subset of Chinese firms responded that they were 'very familiar' with the U.S. Lacey Act or EU TR, Chinese firms did show a significantly higher proportion of firms which had moderate levels of understanding of these regulations relative to their Vietnamese counterparts ($p < .001$). Looking at the Vietnamese responses, it is interesting that among the four policies, Vietnamese firms were the most aware of the EUTR, reporting higher rates of 'very familiar' and 'somewhat familiar' than with the other policies. This may be related to Vietnam's ongoing negotiations with the EU to establish a Voluntary Partnership Agreement which may have increased awareness levels among the country's manufacturers and exporters.

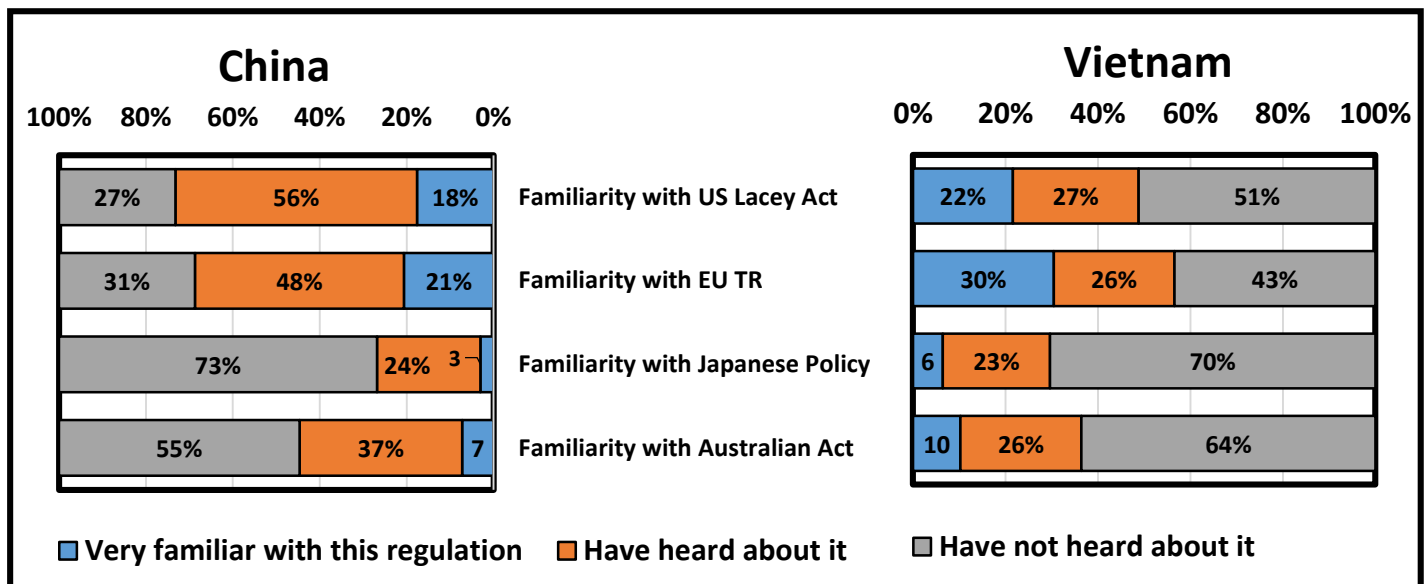


Figure 42. Firms' awareness of timber legality regulations

For Chinese respondents, levels of awareness for both the U.S. Lacey Act and EU TR were relatively constant across firms' annual sales revenue. As the size of Chinese firms increases there is an increase in the proportion of firms which were very familiar with the regulations (**Figure 43**). However, this increase did not reach the level of significance. Evaluation of Vietnamese firms' awareness of the U.S. Lacey Act showed that a higher proportion of small firms had not heard about the U.S. Lacey Act while larger firms were more likely to be very aware of the regulation. Similarly, firm size had a significant impact on awareness of the EUTR, with a higher proportion of larger firms reporting they were 'very aware' and 'somewhat aware' of the EUTR relative to their smaller counterparts, of which a majority had not heard of the EUTR ($\chi^2 = 8.678, d.f. = 2, p = .013$).

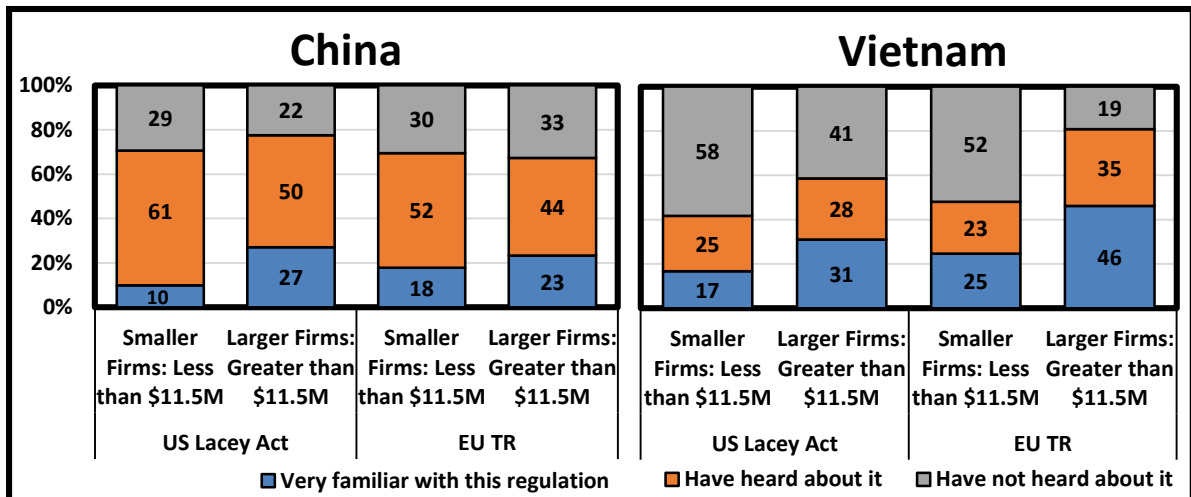


Figure 43. Awareness of timber legality regulations and firm’s annual sales revenue

Further analysis was carried out on average levels of awareness across revenue categories. This score ranges from 1 or ‘Have not heard’ of the regulation to 3, ‘Very familiar with this regulation’ (see Figure 44). Across the board, there is an increase in average level of awareness as firm size increases. This relationship was significant with Chinese firms and awareness of the Lacey Act and with Vietnamese firms and the EUTR. Larger Chinese firms showed a significantly higher level of awareness than small firms ($p=.004$) while larger Vietnamese firms were significantly more aware of the EUTR ($p=.005$).

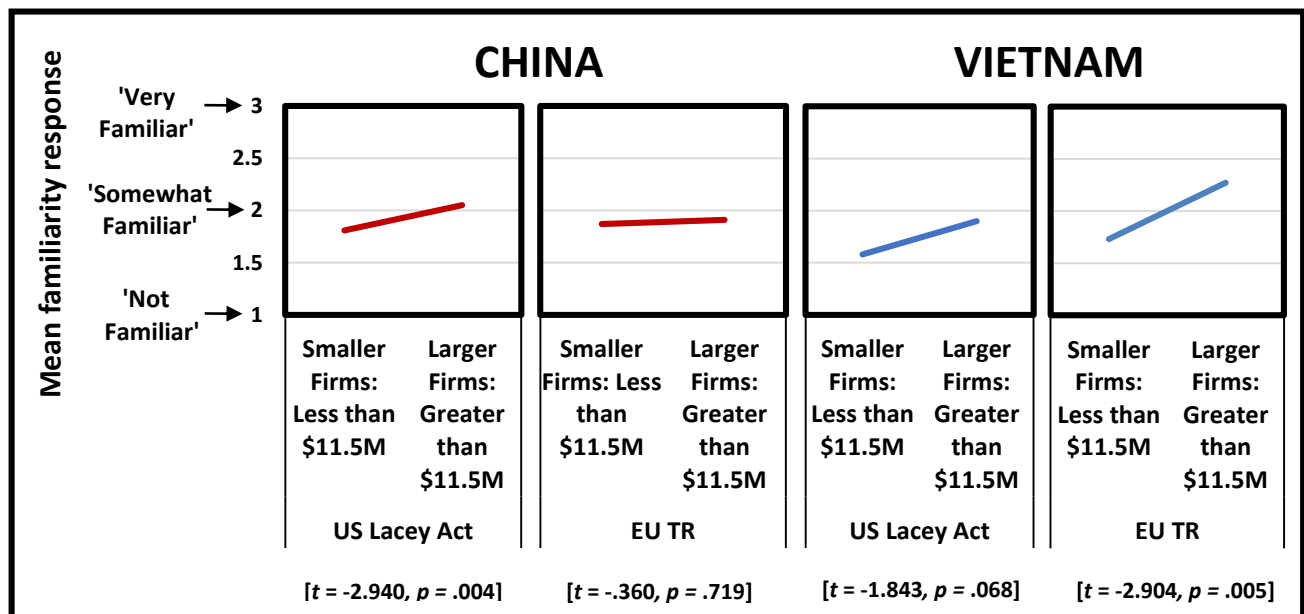


Figure 44. Mean Familiarity with the U.S. Lacey Act and EU TR by annual sales revenue.

A comparison of awareness of regulations and business type reveals some interesting differences between Chinese and Vietnamese furniture manufacturers (Figure 45). Chinese furniture firms have a significantly lower proportion of firms which are ‘very aware’ of the U.S. Lacey Act compared to other types of companies ($\chi^2 = 10.3, d.f. = 2, p=0.006$). However, Vietnamese furniture manufacturers show the opposite, with furniture firms having a significantly larger proportion of firm

‘very aware’ of the Lacey Act ($\chi^2 = 11.6, d.f. = 2, p=0.003$). Chinese plywood manufacturers have the highest proportion of firms which ‘have not heard of’ the Lacey Act and EU TR while Vietnamese flooring companies have the lowest levels of awareness of the two policies.

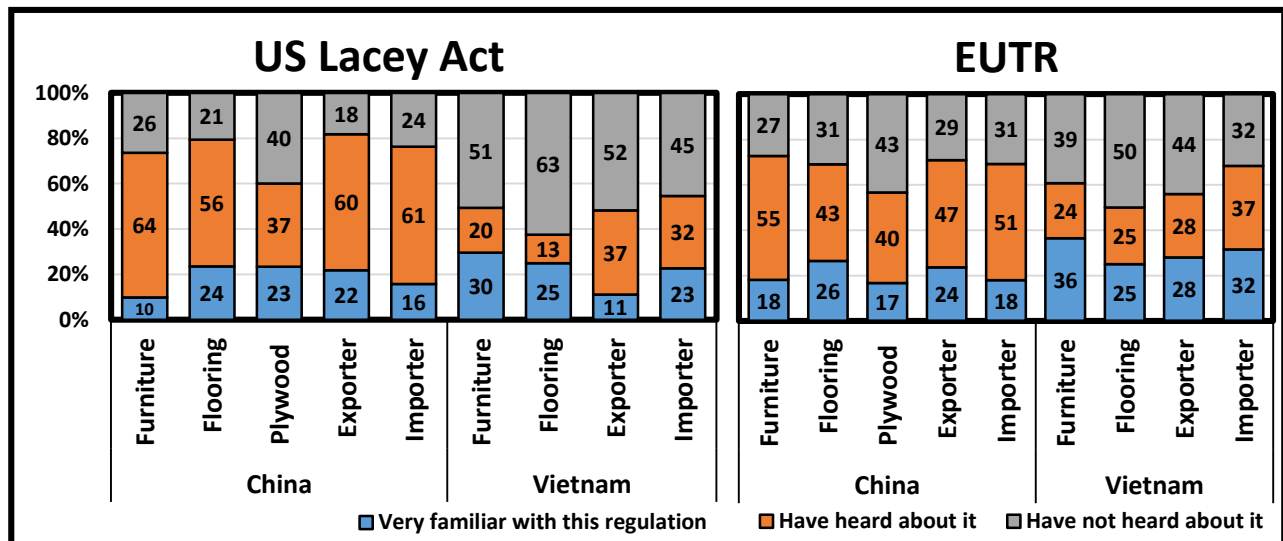


Figure 45. Awareness of timber legality regulations and business types.

Evaluation of firms’ channels of distribution across their level of awareness reveals a distinct pattern, wherein firms which are very familiar with the regulation have significantly higher average levels of direct exports and lower sales to the domestic market, while firms which ‘have not heard about it’ show the opposite, with more domestic sales and less direct exports (Figure 46). For Chinese respondents, firms which are ‘very familiar’ with the Lacey Act and EU TR show a significantly higher proportion of direct exports ($F(2,255) = 7.538, p = .001$) and significantly lower proportion of domestic sales ($F(2,255) = 8.189, p < .001$) than firms with low awareness. Similarly in Vietnam we see the same pattern for the Lacey Act and EU TR, with very familiar firms showing higher direct exports than unaware firms ($F(2,109) = 4.585, p = .012$) as well as lower levels of domestic sales than their smaller counterparts ($F(2,109) = 4.047, p = .020$).

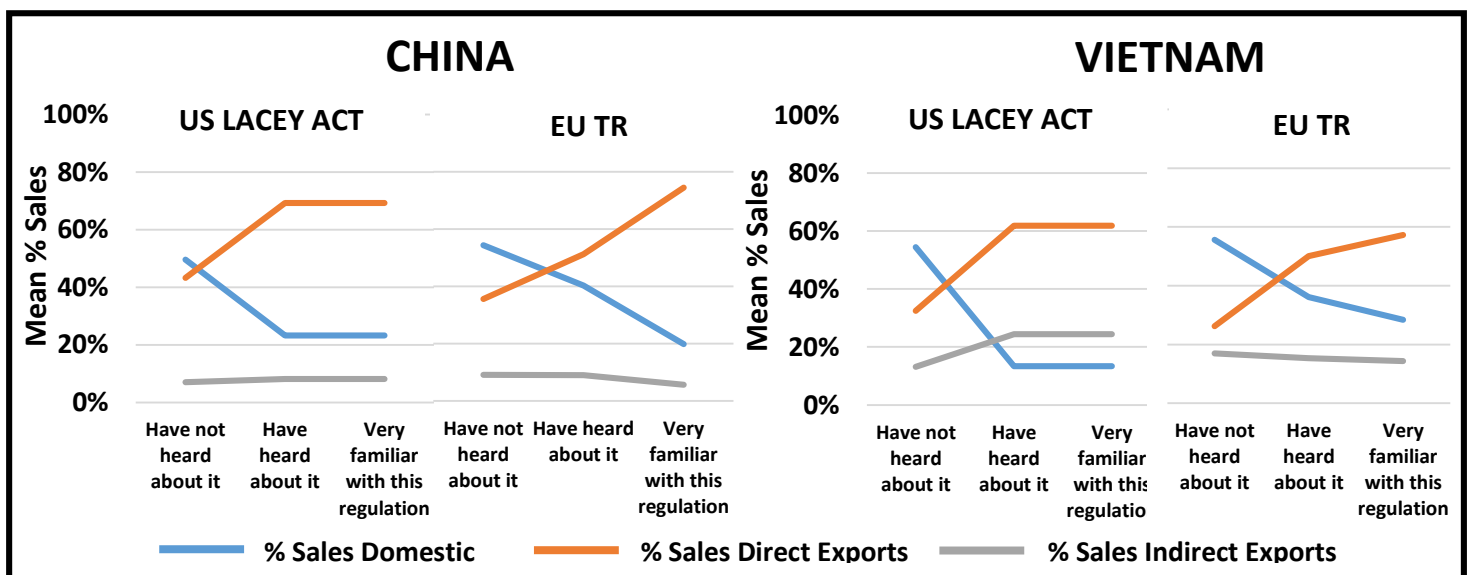


Figure 46. Awareness of timber legality regulations and channels of distribution.

Finally, comparing awareness of timber legality regulations and the proportion of firms which make use of Chain-of-Custody certification reveals that across both FSC and PEFC CoC certifications, firms which are more aware of timber legality regulations are more likely to use CoC certification, while firms with low awareness are the least likely to use CoC certification (see Figure 47). The highest proportion of certification usage was among Chinese firms which were very familiar with the Lacey Act. Eighty-three percent of this group reported they had used FSC CoC certification, significantly higher than those Chinese firms which were not aware of the policy ($\chi^2 = 12.29$, $d.f. = 2$, $p = 0.002$). A similar pattern for Chinese firms' use of FSC was present across awareness of the EU Timber Regulation ($\chi^2 = 9.39$, $d.f. = 2$, $p = 0.009$). In Vietnam firms, awareness of the EU TR had a much greater impact on usage of CoC certification than awareness of the U.S. Lacey Act. While comparing usage of CoC certification and awareness of the U.S. Lacey does follow the same trend, with very familiar firms more likely to use certified wood than unfamiliar firms, this pattern did not reach the level of significance. However, Vietnamese firms familiarity with the EU Timber Regulation result in significant differences in use of FSC ($\chi^2 = 15.83$, $d.f. = 2$, $p < 0.001$) and PEFC chain-of-custody certification ($\chi^2 = 9.62$, $d.f. = 2$, $p = 0.008$).

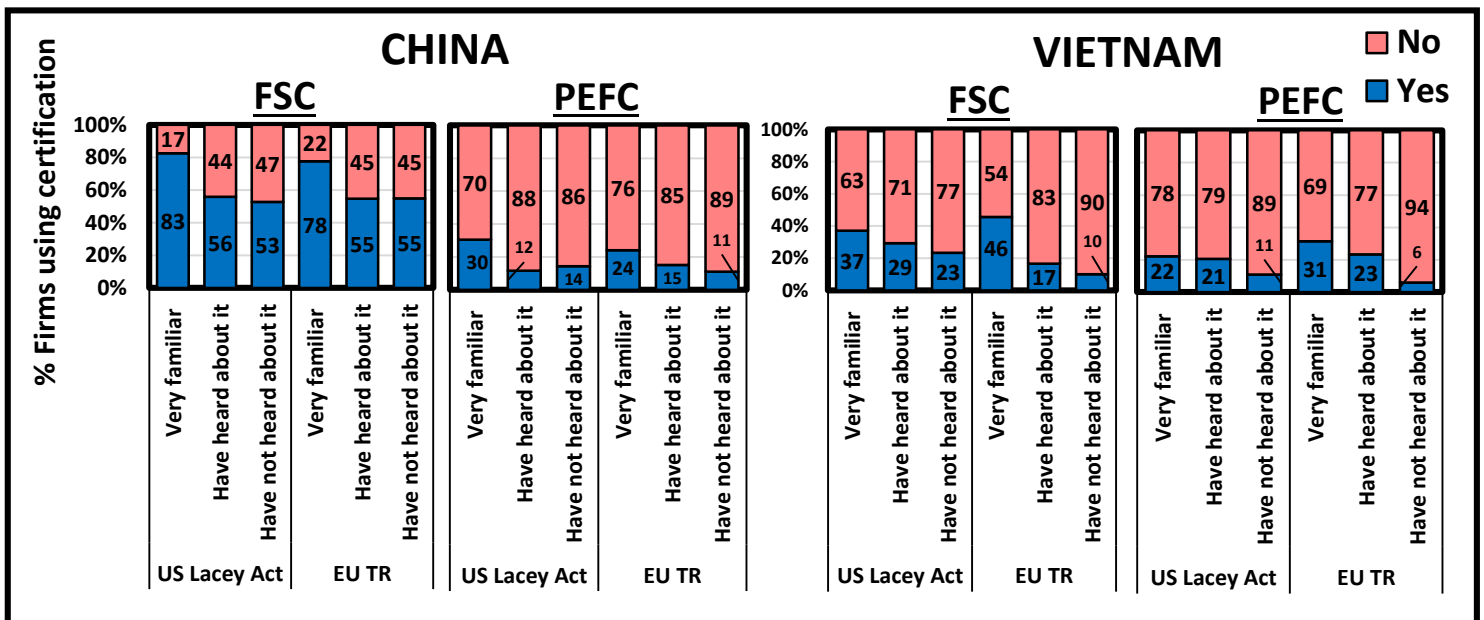


Figure 47. Awareness of timber legality regulations and proportion of firms using certification.

Perceptions Regarding Timber Legality Regulations

Respondents were asked a series of questions to evaluate their perceptions on illegal logging and recent timber legality regulations. A series of nine wide ranging agree-disagree questions were posed which focused on the efficacy of regulations, a firm's intention to shift away from regulated markets, costs incurred from new regulations, whether firms would increase use of certified products and general attitudes regarding environmental impacts and trade restrictions. Responses from Chinese and Vietnamese firms showed some interesting similarities and differences (Figure 48). Chi-squared tests were performed to examine the extent to which Chinese and Vietnamese firms differed in their perception of timber legality regulations. Chinese and Vietnamese firms only responded similarly to three of the perceptual questions. There was broad support across both countries for the statements "Legality regulations are an effective way to reduce illegal timber," "Timber legality regulations cause timber prices to increase" and "Illegal Logging is a major environmental problem."

However, there were distinct differences between responses to questions intended to measure firms' intention to shift away from regulated markets. Chinese firms showed a significantly higher proportion which agreed to the statements "I intend to increase my exports to countries that do not have timber legality regulations" ($\chi^2 = 8.745, d.f. = 1, p = 0.003$) "I intend to decrease my exports to countries that have timber legality regulations" ($\chi^2 = 20.442, d.f. = 1, p < 0.001$) and "I intend to sell more products domestically because of timber legality regulations" ($\chi^2 = 8.278, d.f. = 1, p = 0.004$). This disparity indicates that Chinese firms show a strong intention to shift away from regulated markets and towards unregulated or domestic markets.

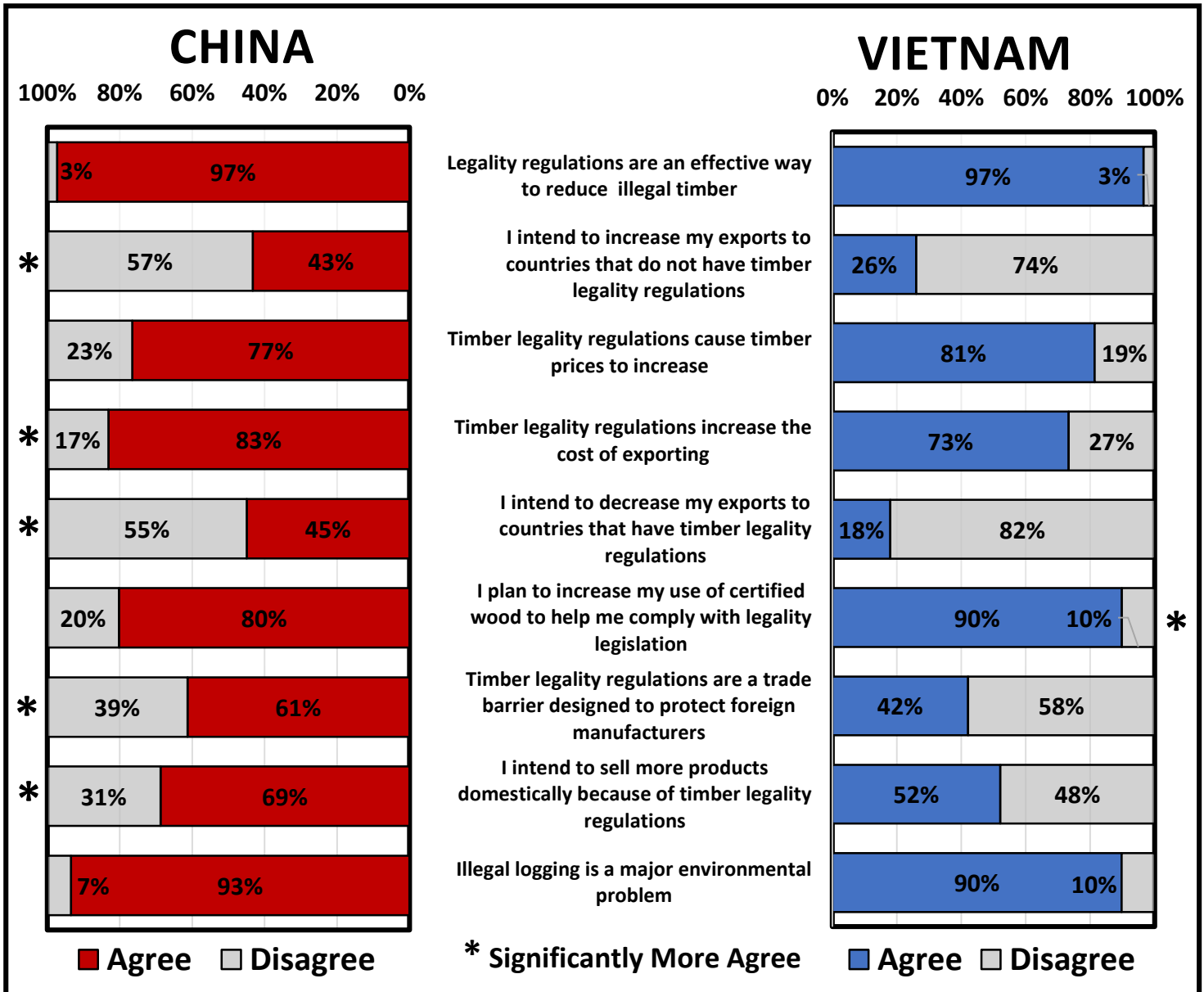


Figure 48. Firms' perceptions regarding illegal logging and timber legality regulations.

Chinese firms were also significantly more likely to agree that “Timber legality regulations increase the cost of exporting” ($\chi^2 = 4.559, d.f. = 1, p = 0.033$) and that “Timber legality regulations are a trade barrier designed to protect foreign manufacturers” ($\chi^2 = 10.427, d.f. = 1, p < 0.001$). Overall, Chinese responses to the questions were more negative and showed greater opposition to timber legality regulations than the Vietnamese. Interestingly, not only did Vietnamese firms respond more positively towards timber legality regulations but they also presented a significantly higher proportion of firms which agreed to the statement “I plan to increase my use of certified wood to help me comply with legality legislation” ($\chi^2 = 4.575, d.f. = 1, p = 0.032$), than the Chinese.

A contingency analysis comparing the proportion of responses to the perception statements and firm revenues resulted in few significant differences across firm size. Chinese firms showed a significant difference in mean responses to the question ‘I intend to decrease my exports to countries that have timber legality regulations’ across firm sizes. Smaller Chinese firms with annual sales revenue less than \$1.5 million were significantly more likely to positively express that they intended to decrease sales to regulated markets ($F(5,248) = 2.629, p = .024$). Similarly, the smallest firms in Vietnam had a significantly higher average score on the question ‘I intend to sell more products domestically because of timber legality regulations,’ however although this result is significant it is somewhat confounded because one of the largest revenue categories also presented a high positive response to this question ($F(5,78) = 4.67, p = .002$).

Lacey Act Specific Perception Questions

As a follow up to the general questions regarding timber legality regulations, firms which reported moderate or high awareness of the U.S. Lacey Act were asked a series of five questions related to their perceptions and experiences specific to the U.S. policy (**see Figure 49**). Chi-squared tests were performed to examine the extent to which Chinese and Vietnamese firms differed in their responses. Chinese and Vietnamese firms responded similarly to four of the five Lacey Act questions, with broad support for the statements ‘I acquired chain-of-custody certification to help me comply with the Lacey Act’, ‘the Lacey Act has made me more careful about sourcing logs/lumber’ and ‘it is easy to comply with the Lacey Act’ by both Chinese and Vietnamese firms. Firms were evenly split regarding the statement ‘I will increase my use of wood from the U.S. to help my company comply with the Lacey Act’ with 48% of both countries’ firms agreeing to the statement. While firms across both countries showed general agreement to the set of questions, there were significant differences in responses to the statement ‘The Lacey Act will cause me to reduce my exports of wood products to the U.S.’ ($t = 3.59, d.f. = 227, p < .001$). A significantly higher proportion of Chinese firms agreed to the statement (56%) while only 25% of Vietnamese firms responded positively. This indicates that Chinese firms may be more likely to reduce sales to regulated markets such as the U.S.

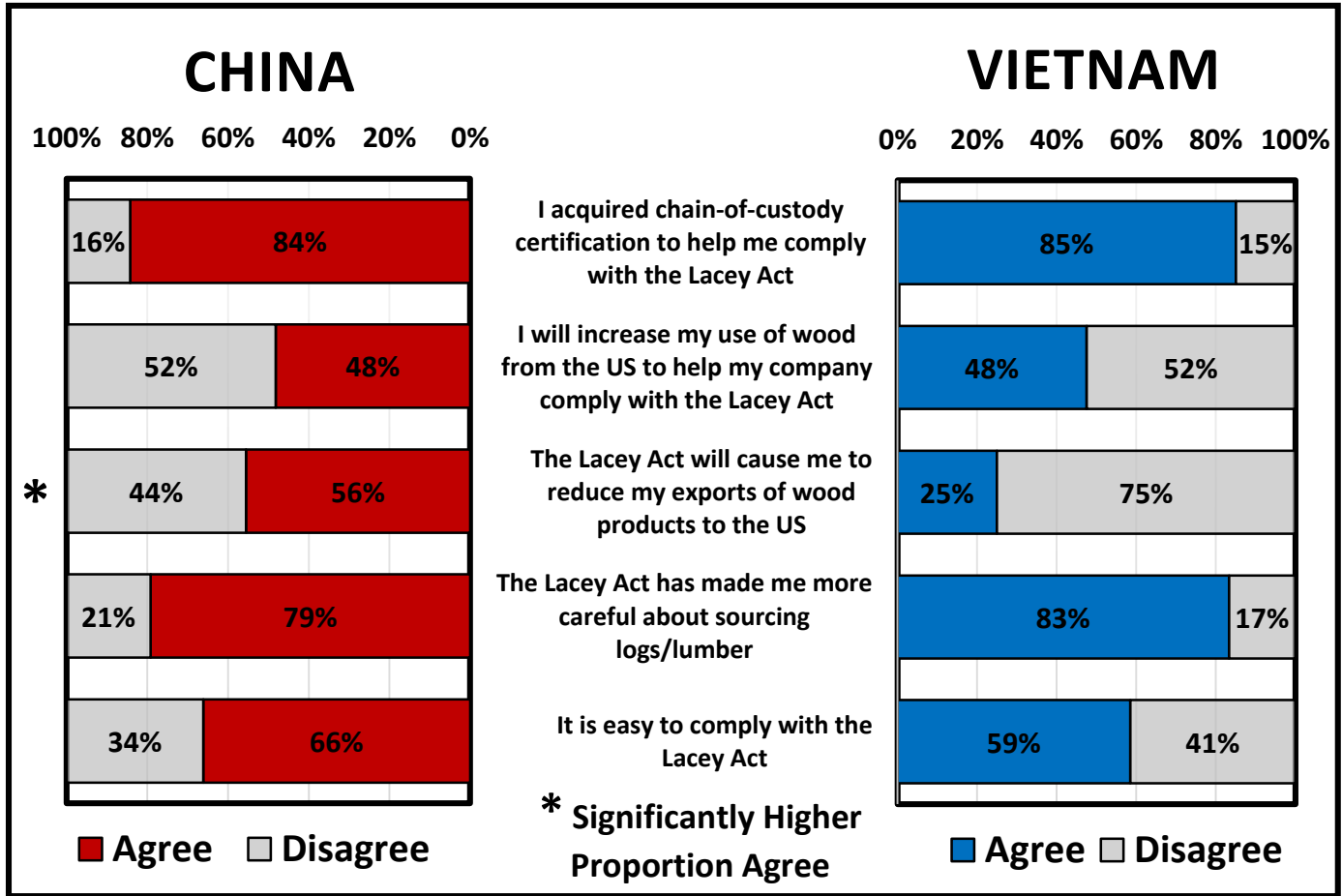


Figure 49. Firms' perceptions and experiences specific to the U.S. Lacey Act.

Shifts in Sales and Sourcing

A series of questions related to the markets to which firms sell finished products and source raw materials revealed major differences between China and Vietnam as well as several dramatic changes to firms' supply chain over the last five years. With regard to sales, Chinese firms displayed major increases across all eight of the sales markets included in the study and were significantly more likely than their Vietnamese counterparts to have increased sales to the U.S., Middle East, Australia, Russia and to the Chinese domestic market (Figure 50). The Vietnamese firms reported a much more narrow set of consumer markets and showed significantly higher rates of 'Don't sell to this region' than the Chinese firms for all markets except Japan and Southeast Asia. One notable difference between the Chinese and Vietnamese relates to firms which responded that they 'decreased' sales in the last five years. Chinese firms were significantly more likely than the Vietnamese to report that they decreased their sales to the United States over the last five years ($\chi^2 = 29.16, d.f. = 3, p < 0.001$). A relatively large proportion of Chinese firms reported a 'decrease' in sales to the EU (14% of firms reporting) however this did not reach the level of statistical significance. This trend may indicate a shift in Chinese sales away from the U.S. and EU markets.

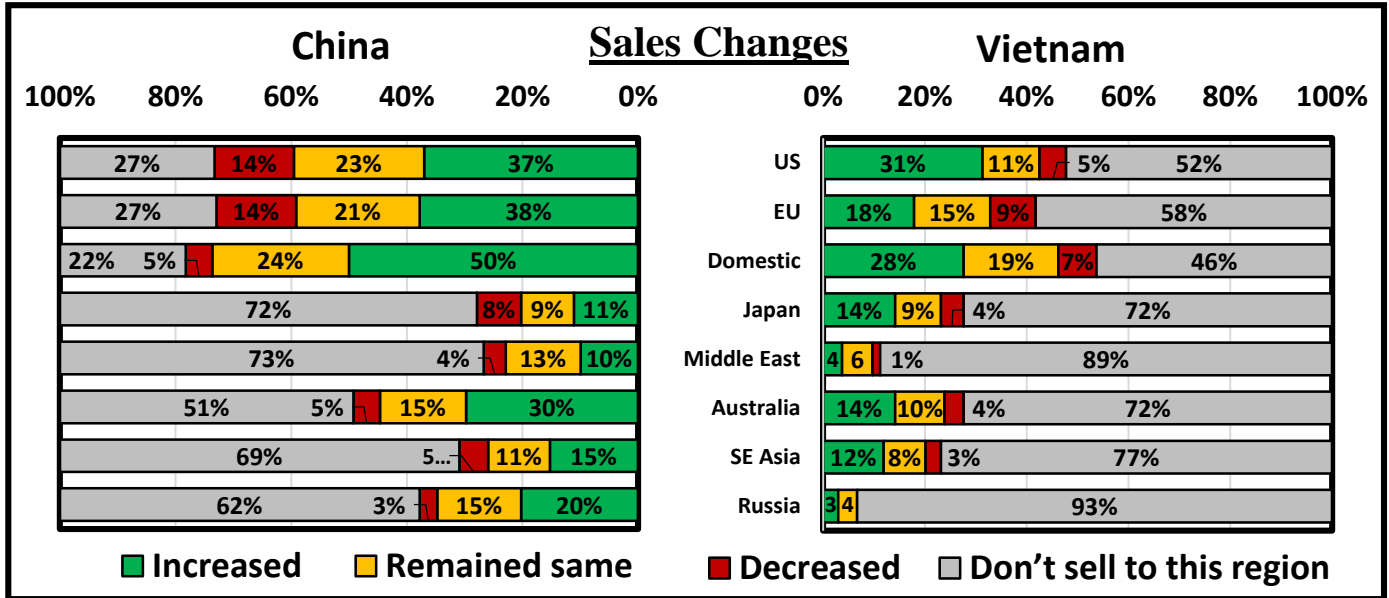


Figure 50. Changes to Firm's Sales over the Last 5 Years

Similar to the responses to the sales questions, when asked how sourcing from major markets had changed in the last five years, Chinese firms reported more increases than their Vietnamese counterparts (Figure 51). In particular Chinese firms reported significantly higher proportions of increased sourcing from Russia, Canada, Southeast Asia, Africa and from the domestic market. Vietnam reported relatively large increases in sourcing from the U.S. and the domestic market. It may seem odd that Chinese and Vietnamese firms reported increases in sourcing from domestic markets, as neither China nor Vietnam are particularly large timber producers. However, most wood product manufacturers from this region purchase timber raw materials in local timber markets rather than directly importing and are likely to be two to three steps removed from the original importer along the supply chain (Xinjian and Qian 2015). Thus an increase in domestic sourcing most likely refers to increases in sourcing from intermediaries within the domestic market. Similar to sales responses, the Vietnamese appear to have a much narrower set of source countries, with higher levels of 'Don't source from this region' than the Chinese across all markets except Latin America.

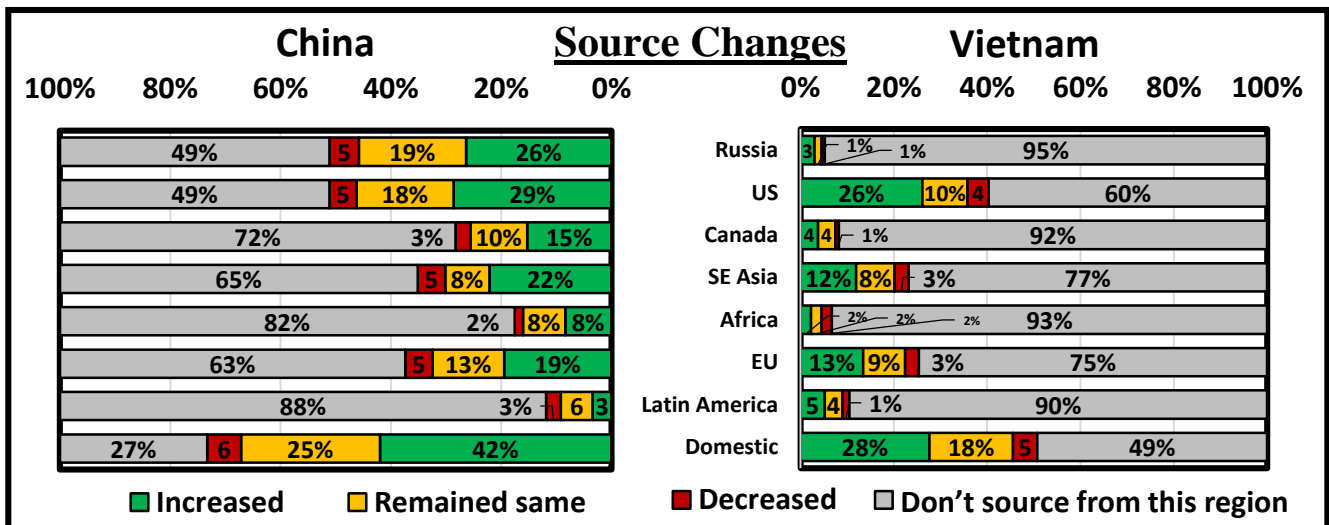


Figure 51. Changes to Firm's Sourcing over the Last 5 Years

Looking at changes in sales across respondents' annual sales revenue, there were only a few sales markets which were significantly impacted by firm size (Figure 52). Sales to the U.S. were particularly affected by firms' annual sales revenue, with smaller firms more likely to not sell to the U.S. and larger firms more likely to have increased sales to the region, a result that was significant for both Chinese ($\chi^2=32.01, d.f. = 15, p = 0.006$) and Vietnamese firms ($\chi^2 = 36.70, d.f. = 15, p < 0.001$). The Vietnamese firms also showed a similar significant pattern for sales to Australia, with few small firms selling to the market and increases in sales coinciding with firm revenue ($\chi^2 = 50.02, d.f. = 15, p < 0.001$).

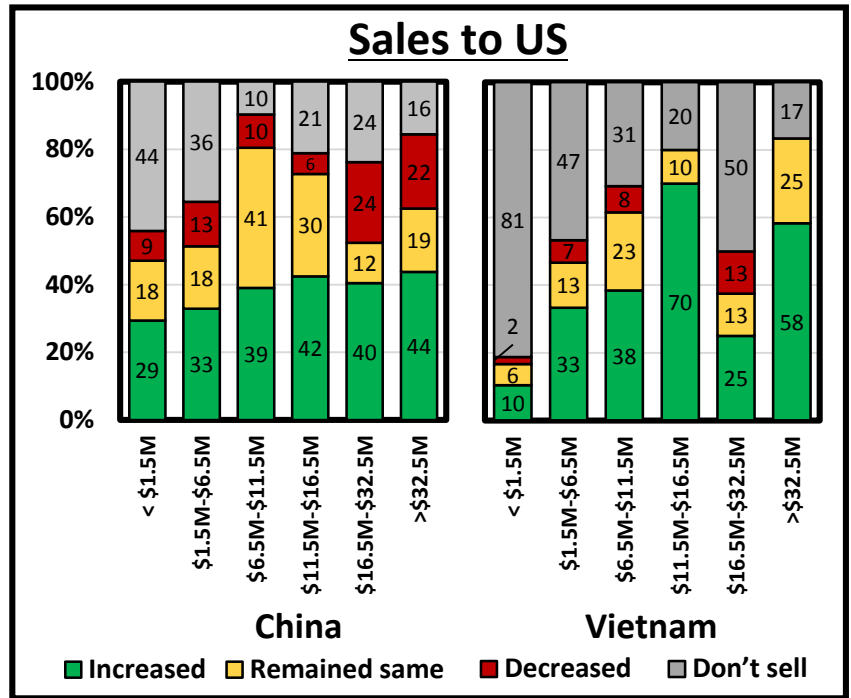


Figure 52. Changes in firms' sales to the US by annual sales revenue.

A comparison of firms responses' to the question of how sourcing changed over the last five years against annual sales revenue only showed one significant relationship, between firm size and Chinese sourcing from Southeast Asia. Figure 53 shows a particularly clear pattern emerging wherein small firms barely source from southeast Asian countries and as firm size increases, the proportion of firms responding that sourcing 'increased' over the last five years steadily increases across the revenue categories ($\chi^2 = 40.71, d.f. = 15, p < 0.001$). This pattern may not necessarily relate to the issue of illegal logging. Instead what may be occurring is that firms with higher revenue may be producing higher-end products which may necessitate the use of premium tropical hardwoods that can most readily be obtained from markets in Southeast Asia.

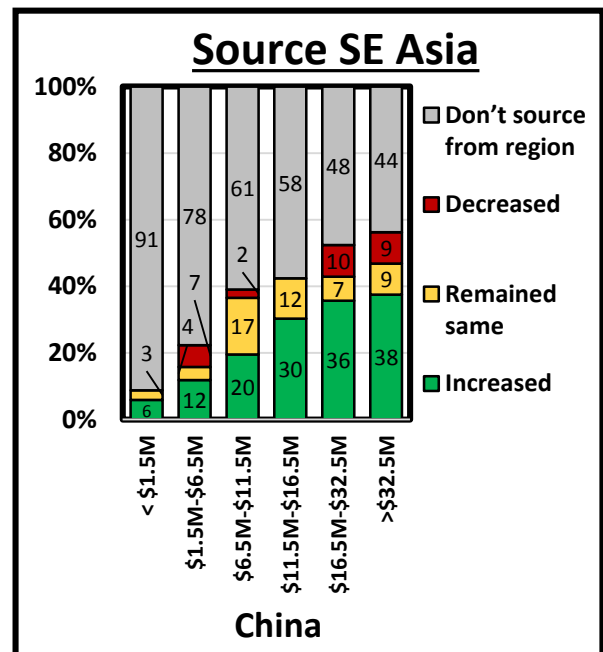


Figure 53. Changes in Chinese firms' sourcing from Southeast Asia by annual sales revenue.

When comparing awareness of timber legality policies and changes in sales, a clear pattern emerges. In both China and Vietnam, firms which were very familiar with the U.S. Lacey Act and EU Timber Regulation were far more likely to sell to the U.S. and EU markets (**Figure 54**). In China, 98% of firms which were ‘very familiar’ with the U.S. Lacey Act sold to the U.S. market and of these firms 59% had increased sales to the U.S over the last five years. This was significantly different from those firms which had not heard of the regulation, of which only 49% actually sold to the U.S. market and a much smaller percent indicated any increase in sales over recent years ($\chi^2 = 43.45, d.f. = 6, p < 0.001$). The same relationship exists between high awareness of the EU Timber Regulation and increases in sales to the EU for Chinese firms ($\chi^2 = 42.99, d.f. = 6, p < 0.001$) as well as between Vietnamese awareness of the Lacey Act and sales to the U.S. ($\chi^2 = 16.95, d.f. = 6, p = .009$) and European markets ($\chi^2 = 24.78, d.f. = 6, p < .001$).

While not included in **Figure 54**, the same relationship is present between firms’ awareness of the Japanese Goho-wood policy and sales to Japan ($p < .001$) as well as between awareness of the Australian Illegal Logging Prohibition Act and sales to Australia ($p < .001$). This pattern is not present between familiarities of regulation and sales to unregulated markets. It is not possible to say conclusively whether the act of selling to a regulated market causes firms to be increasingly aware of regulations or instead that familiarity with policies increases firms’ confidence in trading with regulated markets and thus increase the likelihood that a firm will increase sales to those markets of which they are most knowledgeable.

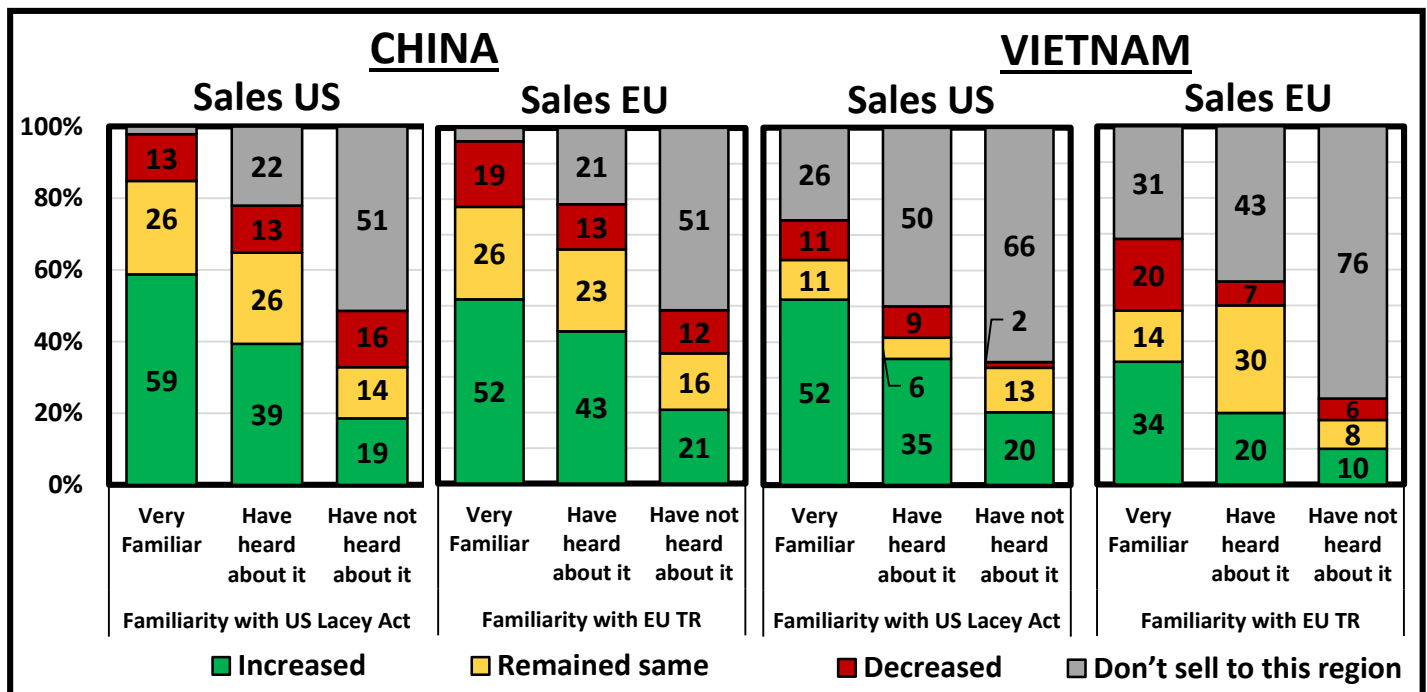


Figure 54. Comparison of sales to U.S. and EU against awareness of the Lacey Act and EUTR.

Although the pattern is not as distinctive as with sales, there is a strong relationship between firms’ awareness of timber legality regulations and sourcing from the United States (**Figure 55**). Chinese firms with moderate awareness of the policy demonstrated a significant increase in sourcing from the U.S., while firms which had not heard of the Lacey Act were significantly more likely to not

source from the U.S. ($\chi^2 = 24.64, d.f. = 6, p < 0.001$). Similar to Chinese firms, Vietnamese firms which were moderately or highly aware of the Lacey Act and EUTR were much more likely to source from the U.S. while firms which were unaware of these policies were significantly more likely to respond that they don't source from the United States.

Analysis of the results also showed that Chinese firms which were very familiar with the Lacey Act reported significant increases in sourcing from Southeast Asia ($p = .002$). At the same time, a comparison of sourcing by business type showed that Chinese flooring manufacturers were significantly more likely to source from Southeast Asia ($F(1,260)=15.80, p < .001$). Together these findings indicate that flooring manufacturers, which source from Southeast and sell to the U.S. must have greater awareness of U.S. regulations in order to ensure the legality of the tropical raw materials necessary to produce their products.

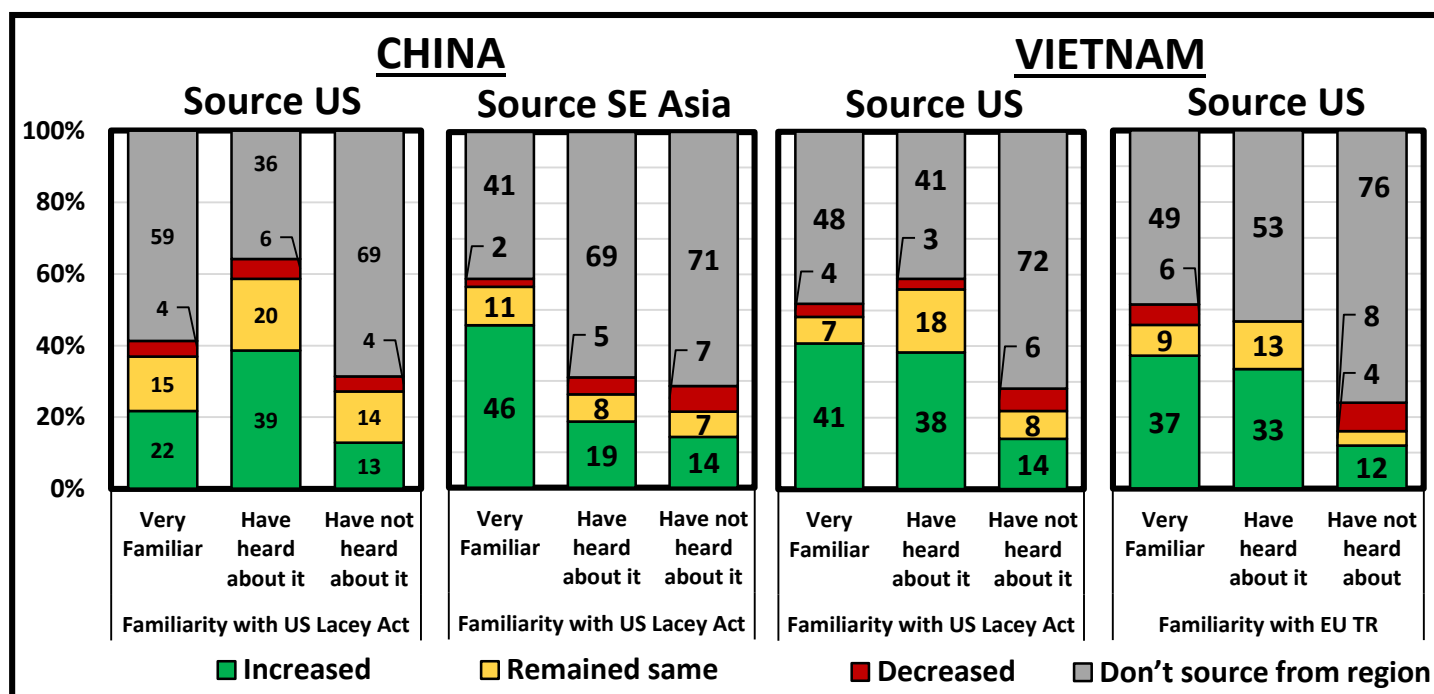


Figure 55. Firms' sales to the U.S. and SE Asia and awareness of the U.S. Lacey Act and EUTR.

A series of analyses were carried using contingency tables which compared responses to the questions regarding sales and sourcing changes and firms perceptions of timber legality and illegal logging. Several perception questions stood out as having a relationship with recent changes to firms' sales markets, particularly statements expressing an 'intent to shift.' Significant relationships were found between sales changes and support for the following statements:

- 'I intend to sell more products domestically because of timber legality regulations'
- 'I intend to increase my exports to countries that do not have timber legality regulations'
- 'Timber legality regulations are a trade barrier designed to protect foreign manufacturers'

These relationships suggest that firms which expressed this intention have been actively adjusting their sales markets over the last five years and are shifting away from regulated markets and towards unregulated and domestic markets. Comparison of responses to the statement 'I intend to sell more products domestically because of timber legality regulations' and changes to sales over the last

five years shows a strong relationship with Sales to the U.S. for Chinese firms ($p = .040$) (Figure 56). Specifically, a significantly higher proportion of Chinese firms which do not sell to the United States responded that they intend to increase domestic sales. This is mirrored in the relationship between the perceptual statement and domestic sales for both Chinese and Vietnamese firms, with firms which have increased or maintained sales to the domestic market showing significantly higher response rates to the statement, indicating that they will strengthen this focus on the domestic sales market.

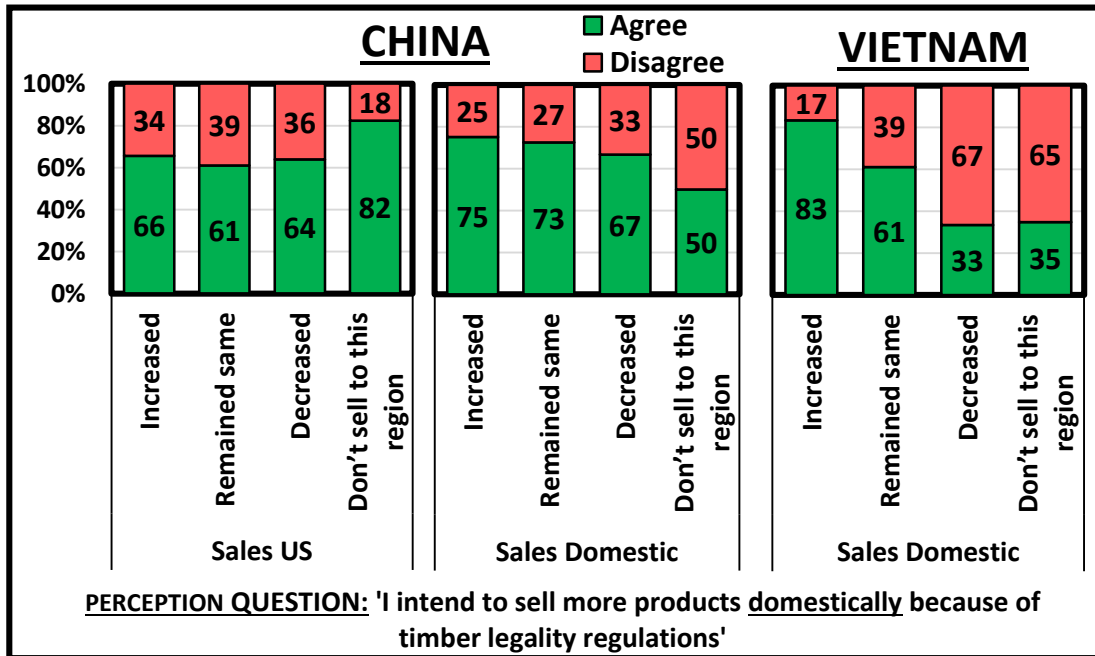


Figure 56. Sales to the U.S. and SE Asia and firms who intend to increase domestic sales.

Chinese firms which had increased or maintained sales to Southeast Asian markets demonstrated a significantly higher level of agreement to the question gauging firms' intent to increase exports to unregulated markets (Figure 57). The same pattern is present with Chinese firms which have increased or maintained sales to Russia. This indicates that firms expressing an intent to shift away from regulated markets already have connections with unregulated regions such as Southeast Asia and Russia and in some instances have already begun to increase sales to these regions.

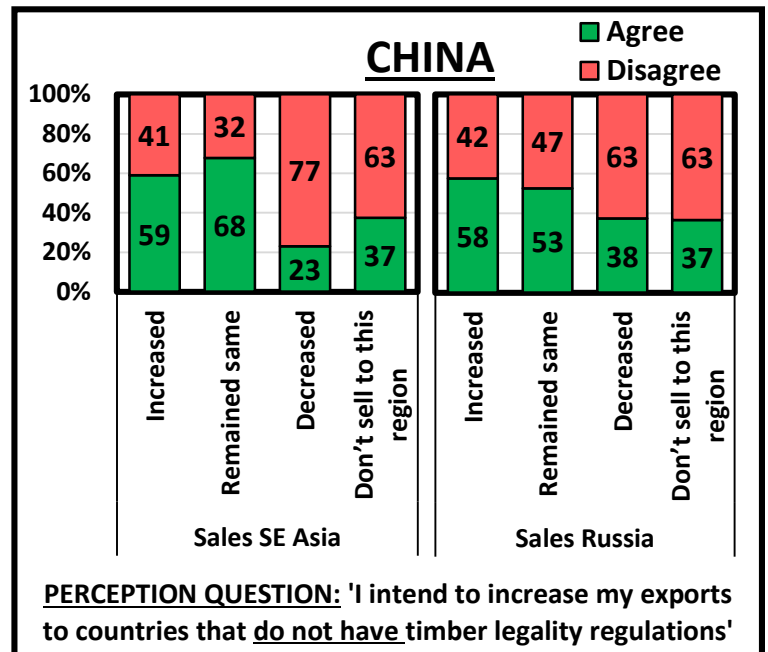


Figure 57. Sales to SE Asia and Russia and firms intending to increase sales to unregulated markets.

Chinese firms showed a strong connection between the question ‘timber legality regulations are a trade barrier designed to protect foreign manufacturers’ and changes to sales in the last five years (**Figure 58**). Firms which do not sell to the United States showed a significantly higher level of agreement with this statement than firms which do engage in trade with the U.S. ($p = .022$). This suggests that negative reactions may largely be held by firms which do not directly trade with the U.S. Looking at sales to Russia, agreement is relatively consistent across sales categories except for firms which decreased sales to Russia in recent years ($p = .026$). These firms showed a significantly higher rejection of the statement, indicating that firms which are supportive of the regulation may be pulling out of the Russian market. Finally, Chinese firms which increased sales to the Chinese domestic market showed significantly more support in the position that these regulations are a trade barrier. This proportion decreases gradually as sales levels reduce, with Chinese firms which do not sell domestically showing the least support for the statement.

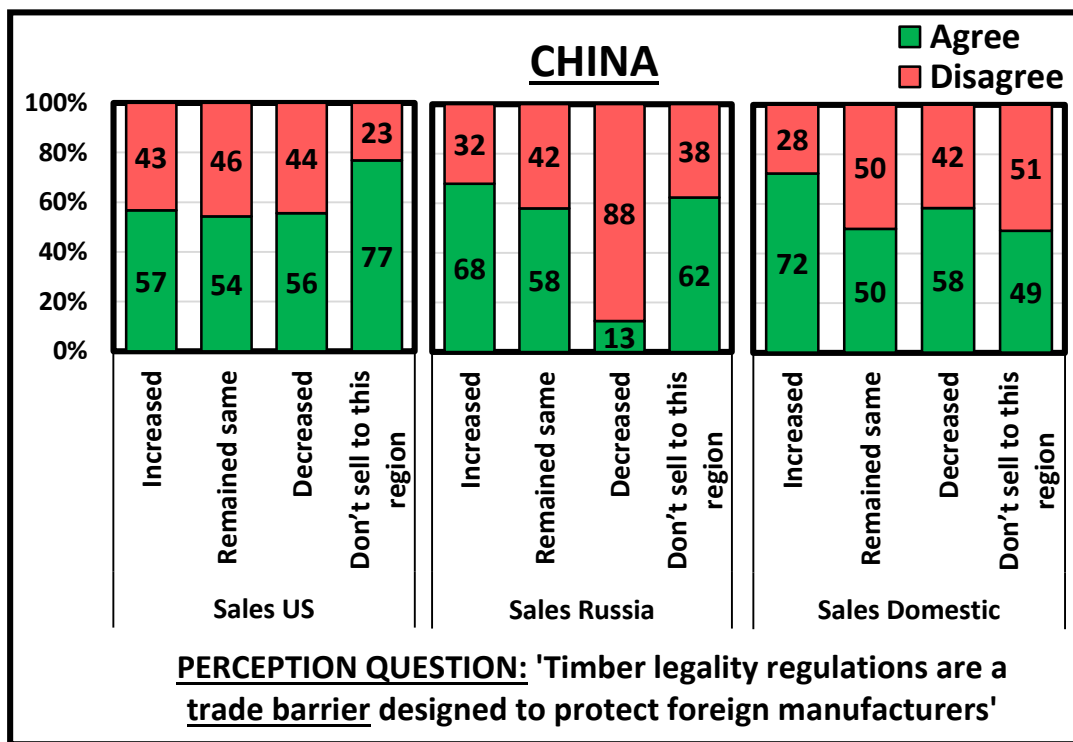


Figure 58. Chinese sales and percent of firms that believe regulations are a trade barrier.

While firms in Vietnam and particularly in China have demonstrated a marked relationship between changes to sales and perceptions regarding regulations, the relationship between changes to sourcing and firm perception is much less dramatic. The results of contingency tables only highlight a few relationships with sourcing which reach the level of significance. With regards to support of the statement ‘I intend to decrease my exports to countries that have timber legality regulations’ Chinese firms are showing significant increases in sourcing from regulated markets such as the U.S. ($p = .002$) and the EU ($p = .021$) (**See Figure 59**). The relationship with the U.S. shows that Chinese firms which intend to shift away from regulated markets have either increased or maintained sourcing from the U.S. over the last five years. Results with sourcing from the EU are more mixed, with greater support of an intent to shift among firms that have increased, maintained or decreased sourcing from the EU.

However, those firms that do source from the EU are showing significantly higher intention to shift sales than firms which don't source from the region at all. Similarly in Vietnam we are seeing higher support of the statement 'I intend to increase my exports to countries that do not have timber legality regulations' among firms that do source from the U.S. than those which don't source from the region ($p = .026$), and significant support of this 'intent to shift' among firms reporting increases in sourcing from the EU.

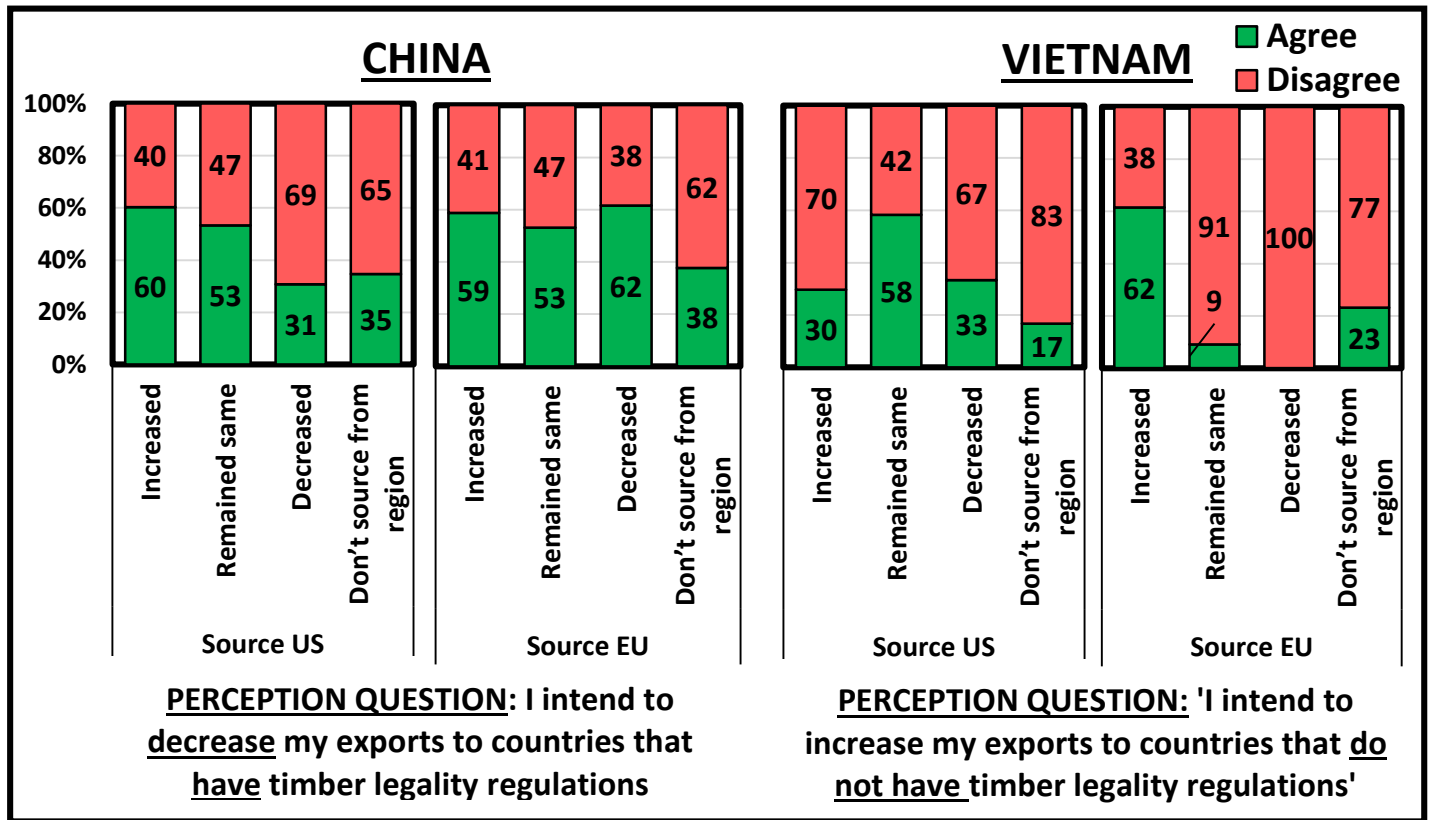


Figure 59. Sales to the U.S. and EU and regulatory leakage questions responses.

Considered together, these results suggest that firms which 'intend to shift' have made major changes over the last five years to the markets which they sell products but relatively few changes to the source markets they use for raw materials. In addition, instead of firms which indicate an intention to shift sales away from regulated markets sourcing less from regulated markets as one might expect, we are actually seeing a notable increase in sourcing from the U.S. and EU. Such a result may suggest that firms which intend to shift sales are less concerned about the legality of the raw materials they source and instead are more interested in obtaining the high volume of temperate and softwood species which are produced in the U.S. in EU, and these source countries' high level of regulation may be a lesser concern.

Firms' Sources of Information

Firms were asked to indicate where they would be most likely to go to get information about timber legality regulations (**Figure 60**). The most popular source of information for both Chinese and Vietnamese firms was from industry associations, followed closely by government agencies. Chinese firms showed significantly higher use of industry associations, other exporters and foreign customers for obtaining information on policy than their Vietnamese counterparts. It is worth noting that in nearly every information source category, Chinese firms expressed a higher likelihood of obtaining information. This may be related to the higher level of maturity in the Chinese wood products industry where firms may be more open to the idea of carrying out market research and seeking information on regulations as well as increased flexibility regarding information sources.

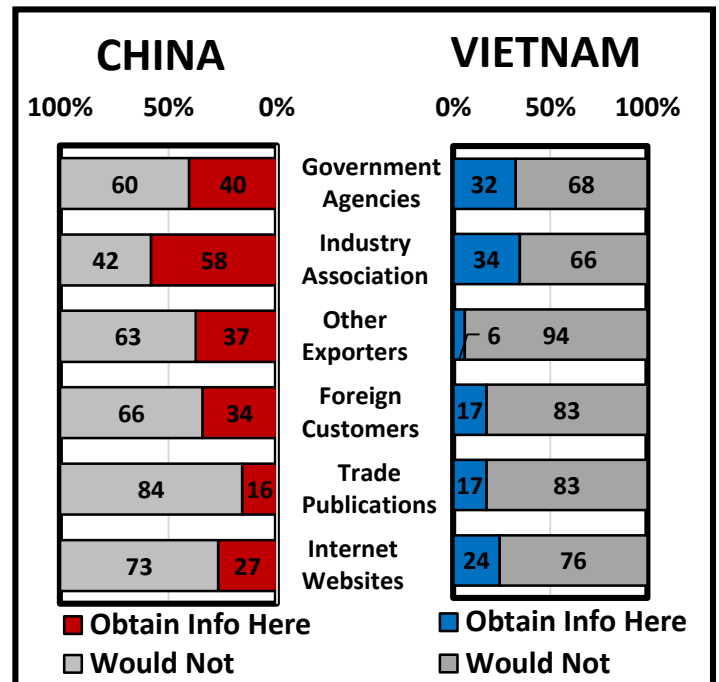


Figure 60. Where firms reported they would go to get information about timber legality regulations.

Responses to questions regarding firms' sources for information was broken down into business type and the results of a contingency table analysis are shown graphically in **Figure 61**. For Chinese firms, reliance on government agencies was relatively constant, although importers showed a

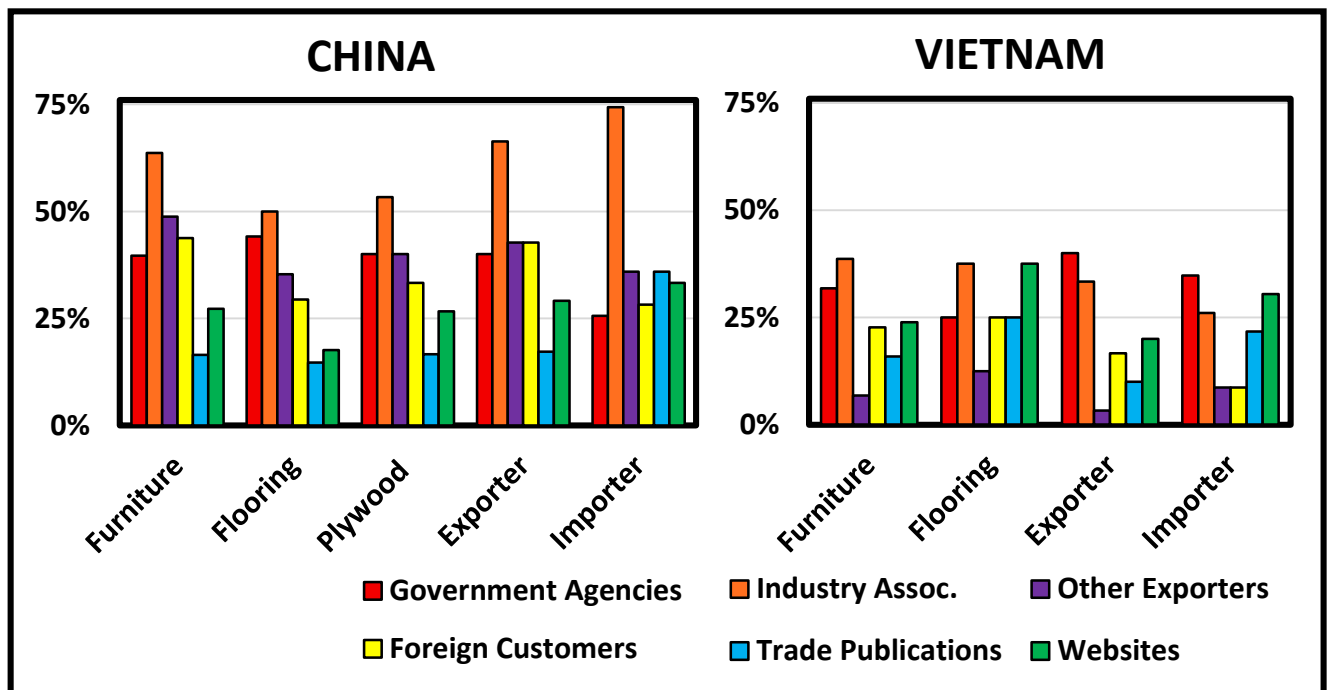


Figure 61. Reported sources of information on timber legality regulations by business type.

significantly lower reported usage rate ($p = .041$). Chinese importers and exporters reported a significantly higher reliance on industry associations than other firms ($p = .025$). Furniture firms showed significantly higher use of ‘other exporters’ to gain additional information on regulations ($p < .001$) and both furniture and exporting firms depended more heavily on foreign customers for information. Chinese importers were the most highly reliant on trade publications and although use of the internet for information was low across the board, flooring firms were the least likely to consult websites. Sourcing of information by Vietnamese firms was notably consistent across all business types. The only exception was among furniture firms which showed a higher reliance on foreign customers for information than other business types. Although flooring has a similar proportion of responses regarding foreign customers, due to the low number of Vietnamese flooring respondents this finding does not reach the level of significance.

In order to evaluate differences in information sources by firm size, firms’ responses were compared against annual sales revenue (**Figure 62**). Chinese firms showed some interesting trends, with the smallest firms showing the lowest use of government agencies and the highest reliance on industry associations. As firm size increases this reverses and larger firms are increasingly reliant on the government and less dependent on industry associations for information. With regard to information from government agencies, Vietnamese firms show a similar trend, with smaller firms showing less usage compared to larger firms. The smallest Vietnamese firms show a notably higher reliance on trade publications compared to other firm sizes. The medium sized firms in Vietnam with revenue between \$11.5 and \$16.5 million showed a significantly higher usage of information from industry associations, foreign customers and websites; however this trend may be largely due to the small sample of firms in this category.

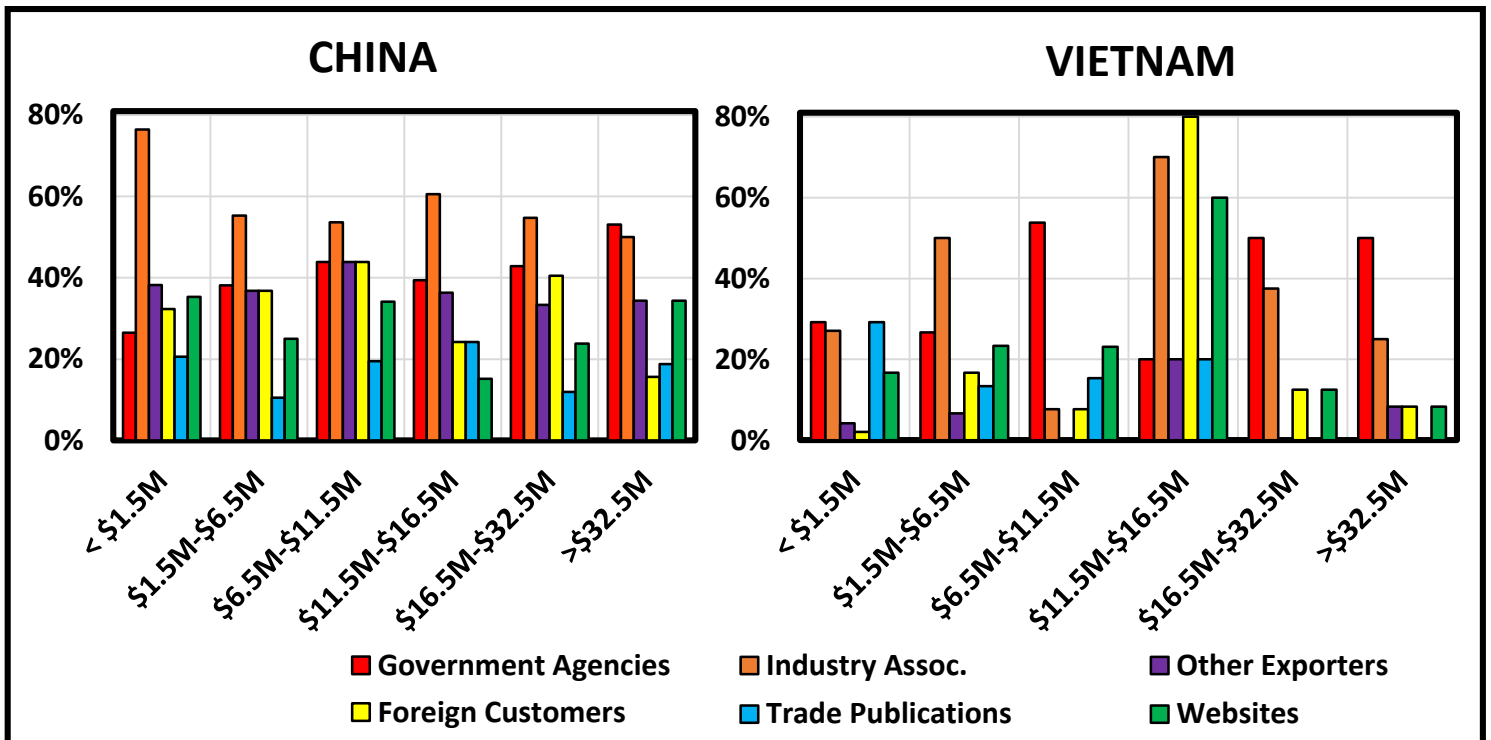


Figure 62. Reported sources of information on timber legality regulations by annual sales.

Table 7. Summary of Results for Chinese and Vietnamese Companies

	China	Vietnam	Comments
Regional Distribution	Over 96% of responses from eastern provinces, with 48% from Central China and 23% from South China	74% from Southeast region followed by 6.8% in Mekong River Delta and 6% in Red River Delta.	Good representation of major China manufacturing regions. Vietnamese results cover southern provinces but more responses needed for central and northern provinces.
Business Types	More uniform distribution, led by Furniture (32%), Exporter (30%) and Flooring (18%). Firms are more integrated, with 34% reporting more than one main business type.	Large majority (60%) are wood products manufacturers, of which 74% produce indoor furniture. Most firms (75%) report only one business type.	Chinese companies represent all sectors in the supply chain, while Vietnamese companies are mostly wood products manufacturers and are not vertically integrated.
Company Size	Over half of Chinese respondents (57%) are larger firms with annual sales revenue over \$6.5 million.	Majority of firms (65%) are small and medium sized enterprises with annual sales revenue under \$6.5 million.	Chinese firms surveyed were generally larger than their Vietnamese counterparts
Certification Usage	Majority (60%) of Chinese firms reported use of FSC CoC certification, PEFC usage remained low (16%). Furniture firms have lower rates of CoC certification use.	Chain-of-custody certification usage relatively low for both FSC (28%) and PEFC (16%). Significantly more outdoor furniture manufacturers use FSC than indoor furniture firms.	Usage of FSC is significantly higher in China and higher usage is related to firm size. In Vietnam, use of FSC and PEFC by large firms is significantly higher.
Channels of Distribution	Higher percent of Chinese sales are through direct exports. Importers focused on domestic market, flooring firms target direct exports.	Larger proportion of firms' sales are through indirect exports. Smaller firms show higher domestic sales, larger firms have larger percent of direct exports.	Chinese firms are more vertically integrated and export directly to international markets while Vietnamese export indirectly through intermediaries.
Awareness of Regulations	Higher awareness of Lacey Act and EUTR, and increasing awareness with higher revenue. Furniture firms have smallest proportion of firms responding 'very aware' of Lacey Act, plywood manufacturers have lowest awareness overall.	Low awareness overall, however more firms reported they were 'very familiar' with EU TR than Chinese. Increase in awareness with firm size. Furniture firms have largest percent responding 'very aware' of Lacey Act (30%).	Furniture firms behaving differently across countries, with many reporting 'very aware' in Vietnam but few in China. Vietnamese awareness of EUTR may be related to current VPA negotiations. Familiarity positively related to direct exports and use of CoC certification.
Perceptions Towards Regulations	Large proportion intends to shift sales away from regulated countries and towards unregulated and domestic markets. Smallest Chinese firms expressed higher intent to shift sales away from regulated markets	Firms reacted more positively towards regulations and higher proportion planned to increase use of certified wood.	Chinese firms responded more negatively and expressed intent to shift sales towards less regulated markets. Strong relationships present between statements on cost and pricing, as well as 'intend to shift' statements.
Shifts in Sales and Sourcing	Increases in sales and sourcing across all markets, but large minority reported 'decrease' in sales to the U.S. and EU. Larger firms increasing sales to U.S. and increasing sourcing from Southeast Asia. Awareness of regulations highly related to increased sales to the U.S. and EU and increasing sourcing from the U.S.	Narrower set of sales and source markets. Larger firms increasing sales to U.S. and Australia. Awareness of regulations highly related to increased sales to the U.S. and EU. Awareness of Lacey Act and EUTR related to increases in sourcing from U.S.	Strong relationship between awareness of policy and sales to regulated markets. Marked increase in sales to domestic and unregulated markets among firms expressing 'intent to shift'. Firm perceptions show large impacts on sales but limited effect on sourcing. Awareness of regulations may be resulting in increased sourcing from United States.
Information Sources	High reliance on government and industry associations. Importers and Exporters more dependent on industry associations, Furniture more dependent on foreign customers. Smallest firms show lowest use of government agencies and highest reliance on industry associations.	Firms mainly rely on government agencies and industry associations. Furniture manufactures highly dependent on foreign customers for information. Smallest firms show lowest use of government agencies and greatest use of trade publications.	Chinese companies generally open to a wider selection of information sources. Small firms are much less likely to source information from government agencies.

Logistic Regression: Drivers of Certification Usage

In order to address the research question of how firm characteristics drive usage of CoC certification the data were reviewed to identify potential dependent and predictor variables for further analysis. Two dependent variables were selected, which included whether the firm obtained FSC as well as whether the firm obtained PEFC CoC certification. After reviewing the results of the descriptive analysis it was determined that there existed interesting relationships between the dependent variables and the firms' location, use of tropical hardwood in firms' supply chain, annual sales revenue as well as awareness of the U.S. and EU timber legality regulations. After cleaning the responses to remove missing data, our study ended up with a final sample of 330 cases.

Logistic Regression

The aim of this study is to describe the relationship between the independent variables as well as to predict the values of two binary dependent variables, thus a multiple logistic regression was used to analyze the data. A sequential predictor entry method was used to control for the effects of country as well as to evaluate interaction effects. In developing a model, we had two potential options, one option was to control for country effects using an interaction term and the alternative was to carry out separate analyses for Chinese and Vietnamese respondents for a total of four models. Thus, the interaction term was selected to provide the most parsimonious model and allow for greater ease of interpretation. We ran two separate models, one to predict usage of FSC and the second to predict PEFC usage, entering the independent variables in three blocks with country in Block 1, awareness of U.S. policy, awareness of EU policy, percent of tropical hardwoods, and company sales revenue in Block 2 and the four interaction terms in Block 3.

Data Preparation

After selecting the variables for analysis the data were recoded to aid analysis and interpretation. The dependent variables for the model included whether firms obtained FSC chain-of-custody certification and whether firms obtained PEFC CoC certification. These binary coded variables were entered into the model without further recoding. The independent variable of firm's location was effect coded so as to allow for easier interpretation of interaction effects. The survey initially included questions regarding the U.S. Lacey Act and EU Timber Regulation where firms reported that they 1) Have not heard about it. 2) Have heard about it but am not sure of the details of this regulation. 3) Am very familiar with this regulation. Responses to the two original variables were re-categorized into two categories of 1) Have not heard about it. 2) Have heard about it and effect coded to aid in further estimation of interaction effects. The variables percent of firms' products containing tropical hardwoods and firms' annual sales revenue were standardized so as to avoid skewing the results and to aid interpretation.

Finally a number of interaction terms were included in the model so as to allow for the identification of country effects and highlight specific independent variables where Chinese and Vietnamese respondents reported diverging results. These included interactions between country and Awareness of the Lacey Act, country and Awareness of the EU Timber Regulation, country and percent tropical hardwoods and finally country and annual sales revenue. An outline of the coding for dependent and independent variables used in the linear regression model is shown in **Table 8**.

Table 8. Coding for variables included in logistic regression model of certification use.

Variables	Variable Type	Coding
<u>Dependent Variables</u>		
Firm obtained FSC	Binary	0 = Did not obtain FSC certification 1 = Firm obtained FSC certification
Firm obtained PEFC	Binary	0 = Did not obtain PEFC certification 1 = Firm obtained PEFC certification
<u>Independent Variables</u>		
Country firm is located	Binary, Effect Coded	-1 = China 1 = Vietnam
Awareness of Lacey Act	Binary, Effect Coded	-1 = Have not heard about Lacey Act 1 = Have heard about the Lacey Act
Awareness of EU Timber Regulation	Binary, Effect Coded	-1 = Have not heard about EUTR 1 = Have heard about the EUTR
Percent Tropical Hardwoods	Standardized, Z-score	-3 = Percent tropical hardwoods is 3 st.dev below mean, 0.15% score lower 0 = Percent of products with tropical hardwoods is same as mean 3 = Percent tropical hardwoods is 3 st.dev above mean, 99.85% score lower
Annual Sales Revenue	Standardized, Z-score	-3 = Firm's annual sales revenue is 3 st.dev below mean, 0.15% score lower 0 = Firm's annual sales revenue is same as mean 3 = Firm's annual sales revenue is 3 st.dev above mean, 99.85% score lower
<u>Interaction Terms</u>		
Country * Familiarity with Lacey Act (Effect coded)	Country * Percent Tropical Hardwoods (Z-score)	
Country * Familiarity with EU TR (Effect coded)	Country * Annual Sales Revenue (Z-score)	

Bivariate Correlations

In order to explore potential correlations among use of FSC and PEFC and the independent variables in the logistic regression model, a bivariate correlation analysis was performed (**Table 9**). The results show that there is not a significant correlation between use of FSC and use of PEFC, which supports the decision to separate out these dependent variables into two different logistic models. FSC was found to be significantly correlated with awareness of the Lacey Act and the EU Timber Regulation as well as with annual sales revenue. However only awareness of EU policy was significantly correlated with whether a firm has obtained PEFC certification. Looking at the independent variables, it appears that awareness of U.S. and EU policy, percent tropical hardwoods and sales revenue are all significantly correlated with one another. This suggests that the predictor variables could overshadow one another, and it was unclear which variables would have a unique effect on either outcome variable. Of particular concern is the country variable, which correlates significantly with all of the other predictors and has a significant interaction with awareness of U.S. and EU policy as well as with annual sales revenue. It appears that the first model will account for significant variance in firms' use of FSC as all four of the main predictors are significantly correlated with this outcome. However, it is less likely that the second model will account for a significant portion of the variance in usage of PEFC as only one variable has a significant correlation.

Table 9. Bivariate Correlation Table - Logistic Regression Using Sequential Predictor Entry

Measure	<i>M</i>	<i>(SD)</i>	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
<i>Outcomes</i>													
1. Obtained FSC Certification	0.50	(0.50)	--										
2. Obtained PEFC Certification	0.16	(0.37)	-.03	--									
<i>Block 1 Predictors</i>													
3. Country	0.26	(0.44)	-.35 ***	.05	--								
<i>Block 2 Predictors</i>													
4. Awareness of US policy	0.69	(0.46)	.21 ***	.05	-.25 ***	--							
5. Awareness of EU policy	0.66	(0.47)	.14 **	.12 *	-.16 **	.34 ***	--						
6. Percent tropical hardwoods	36.58	(35.65)	-.03	.04	.16 **	.01	-.12 *	--					
7. Company sales revenue	3.06	(1.69)	.24 ***	.09	-.23 ***	.16 **	.14 *	.04	--				
<i>Block 3 Predictors</i>													
8. Country X Awareness of US	-0.38	(0.93)	-.08	.04	.24 ***	-.38 ***	-.04	-.08	-.05	--			
9. Country X Awareness of EU	-0.28	(0.96)	-.06	.05	.23 ***	-.06	-.42 ***	-.04	.02	.35 ***	--		
10. Country X Percent tropical hardwoods	0.14	(0.99)	-.07	-.06	.08	-.14 *	-.09	-.31 ***	-.23 ***	.07	-.08	--	
11. Country X Company sales revenue	-0.20	(0.98)	-.01	.09	-.11 *	.04	.09	-.23 ***	-.45 ***	.08	.08	.07	--

Note. *N* = 330. FSC = Forest Stewardship Council; PEFC = Program for the Endorsement of Forest Certification.

* *p* < .05, ** *p* < .01, *** *p* < .001.

Model Results

Drivers of Forest Stewardship Council Usage

The first model addressed the outcome ‘Obtained FSC Certification’ (Table 10) and the first block which included the variable country was significant ($\chi^2 = 41.84, p < .001$) indicating that country reliably distinguishes firms who obtained FSC certification from firms which do not. The approximate variance in whether a firm had or had not obtained FSC certification accounted for by country was 0.16 using Nagelkerke’s formula. Block 2 controlled for awareness of U.S. and EU policy, percent tropical hardwoods and sales revenue together, and accounted for a significant variance in FSC use ($\chi^2_{\text{change}} = 15.62, p < .001$), indicating that the inclusion of these predictor variables further distinguished firms which obtained FSC certification from those which do not. The approximate variance accounted for by the additional predictors in Block 2 was increased to 0.21 using Nagelkerke’s formula. Finally, including the interaction terms in Block 3 accounted for an additional 2% of the variance in FSC usage above and beyond the main effects ($\chi^2_{\text{change}} = 3.91, p = .418$). The approximate variance in whether a firm had obtained FSC certification accounted for by the full model was 0.23 using Nagelkerke’s formula. Model sensitivity was 79.9% and specificity was 50.0% with an overall hit rate of 64.8%, which was better than the null model’s hit rate of 50%.

Table 10. Multiple Logistic Regression for ‘Obtained FSC Certification’

	Block 1				Block 2				Block 3					
	χ^2_{total}	Pseudo R^2	HR	<i>b</i>	χ^2_{change}	χ^2_{total}	Pseudo R^2	HR	<i>b</i>	χ^2_{change}	χ^2_{total}	Pseudo R^2	HR	<i>b</i>
<i>Model Fit</i>	41.84 ***	0.16	0.65		15.62 **	57.45 ***	0.21	0.65		3.91	61.37 ***	0.23	0.65	
<i>Coefficients</i>														
Intercept				-0.47 **										-0.63 **
Country				-0.88 ***										-0.90 ***
Awareness of US policy								0.26						0.39 *
Awareness of EU policy								0.13						0.23
Percent tropical hardwoods								0.02						0.11
Company sales revenue								0.35 **						0.42 *
Country X Awareness of US														0.22
Country X Awareness of EU														0.16
Country X Percent tropical hardwoods														0.08
Country X Company sales revenue														0.12

Note. $N=330$. Block 1 chi-square change test $df = 1$; Block 2 $df = 4$; Block 3 $df = 4$. FSC = Forest Stewardship Council.
* $p < .05$, ** $p < .01$, *** $p < .001$.

The firm’s country of establishment was uniquely negatively predictive of whether or not they obtained FSC certification ($b = -0.90, p < .001$), which indicates that Vietnamese firms were predicted to be 0.90 logits lower than Chinese firms for obtaining FSC certification, holding all other variables constant at zero. In other words, the model predicted that Vietnamese firms had a 17.80% probability of obtaining FSC certification compared to a 56.71% probability of obtaining FSC for Chinese firms.

Whether a firm was aware of the U.S. Lacey Act was also uniquely positively predictive of whether a firm obtained FSC certification ($b = 0.39, p = .037$). This indicates that firms which were aware of U.S. policy were predicted to be 0.39 logits higher than firms that were not aware with regards to obtaining FSC certification, holding all other variables constant at zero. Holding all else constant, firms that were aware of U.S. policy had a 43.9% probability of obtaining FSC compared to firms that were unaware which had a 26.6% probability of obtaining FSC certification.

Sales revenue for surveyed companies was uniquely positively predictive of whether or not a firm obtained FSC certification ($b = 0.42, p = .010$). For every standard deviation increase in sales revenue, we expect a 0.42 logit increase in use of FSC certification, holding all other variables constant. Firms with higher sales revenue (one standard deviation above the mean) had a 44.77% probability of obtaining FSC certification compared to only a 29.92% probability of obtaining FSC for lower revenue firms (one standard deviation below the mean).

Although awareness of the EU Timber Regulation showed a significant correlation with FSC usage in the bivariate correlation analysis, neither this variable nor percent tropical hardwoods uniquely predicted whether a firm obtained FSC certification. In addition, the four interaction terms did not uniquely predict whether a firm obtained FSC certification.

Drivers of Programme for the Endorsement of Forest Certification Usage

The second logistic regression model addressed the outcome ‘Obtained PEFC Certification’ (Table 11). The first block, which included the variable ‘country’ did not significantly account for variation in the outcome and the variance in use of PEFC accounted for by country was 0.004 using Nagelkerke’s formula. This suggests, that unlike FSC, a firm’s location on its own does not strongly impact usage of PEFC. The second block resulted in a significant change in the amount of variance in PEFC usage accounted for ($\chi^2_{\text{change}} = 9.66, p = .047$), however the model still did not significantly account for the variance in PEFC usage ($\chi^2_{\text{total}} = 10.51, p = .062$). Looking at the variables included in block 2, only awareness of EU policy showed a significant relationship with PEFC usage. Finally the inclusion of Block 3 accounted for an additional 3.9% of the variance in PEFC usage (above and beyond the main effects) and the full model accounted for significant variance in PEFC usage ($\chi^2_{\text{total}} = 18.47, p = .030$). This indicates that the addition of interaction variables was enough to allow the model to account for significant variance in firms’ use of PEFC. The approximate variance accounted for by the full model was 0.09 using Nagelkerke’s formula. Model sensitivity was 9.3% and specificity was 98.9% with an overall hit rate of 84.2%, which was slightly better than the null model’s hit rate of 83.6%.

Table 11. Multiple Logistic Regression for ‘Obtained PEFC Certification’

	Block 1				Block 2				Block 3					
	χ^2_{total}	Pseudo R^2	HR	<i>b</i>	χ^2_{change}	χ^2_{total}	Pseudo R^2	HR	<i>b</i>	χ^2_{change}	χ^2_{total}	Pseudo R^2	HR	<i>b</i>
<i>Model Fit</i>	0.85	0.004	0.84		9.66 *	10.51	0.05	0.84		7.96	18.47 *	0.09	0.84	
<i>Coefficients</i>														
Intercept				-1.57 ***					-1.74 ***					-1.73 ***
Country				0.15					0.27					0.10
Awareness of US policy									0.05					0.05
Awareness of EU policy									0.41 *					0.48 *
Percent tropical hardwoods									0.12					0.26
Company sales revenue									0.24					0.40 *
Country X Awareness of US														0.04
Country X Awareness of EU														0.24
Country X Percent tropical hardwoods														0.05
Country X Company sales revenue														0.43 *

Note. $N=330$. Block 1 chi-square change test $df = 1$; Block 2 $df = 4$; Block 3 $df = 4$. PEFC = Program for the Endorsement of Forest Certification.
* $p < .05$, ** $p < .01$, *** $p < .001$.

One of the major differences in the two models is that Country was not uniquely predictive of obtaining PEFC certification, whereas this variable had the largest effect on FSC usage. In addition, controlling for all other variables, awareness of U.S. policy was not uniquely predictive of obtaining PEFC certification, which is also different than the results from the first model. Percent tropical hardwoods was not uniquely predictive of obtaining PEFC certification, a result which mirrors those of the other model.

However, whether a firm was aware of the EU Timber Regulation was uniquely positively predictive of whether a firm obtained PEFC certification ($b = 0.48, p = .033$), which indicates that firms which were aware of EU policy were predicted to be 0.48 logits higher than firms that were not aware with regards to obtaining PEFC certification, holding all other variables constant at zero.

Another way to interpret this is that firms that were aware of EU policy had a 22.3% probability of obtaining PEFC compared to a 9.9% probability for unaware firms.

Sales revenue for surveyed companies was uniquely positively predictive of whether or not a firm obtained PEFC certification ($b = 0.40, p = .027$). For every standard deviation increase in sales revenue, we expect a 0.40 logit increase in use of PEFC certification, holding all other variables constant. In other words, higher revenue firms have a 20.9% probability of obtaining PEFC certification compared to only a 10.6% probability of obtaining PEFC for lower revenue firms.

While three of the interaction terms were not uniquely predictive of whether a firm obtains PEFC certification, there was a significant interaction between country and company sales revenue ($b = 0.43, p = .018$). To understand the nature of the interaction, predicted values were plotted for Chinese and Vietnamese firms by level of revenue (**Figure 63**). As illustrated in Figure 63, the interaction is disordinal, indicating that while there appears to be little difference between PEFC usage by Chinese firms across revenue categories, change in revenue has a greater impact on Vietnamese firms' use of PEFC. Chinese firms' probability of obtaining PEFC certification was quite stable. The smallest firms, with annual revenues of less than \$1.5 million, were predicted to have a 14.3% probability of obtaining PEFC certification while Chinese firms with revenues greater than \$32.5 million were predicted to have a slightly lower 13.3% probability of obtaining certification. However, predicted usage of PEFC by Vietnamese firms was significantly different across firm sizes. The smallest firms showed a low probability of usage, with a predicted rate of only 6.5%. As firm size increased this rose dramatically and the model predicted that the largest firms, with revenue over \$32 million, had a 45.3% probability of obtaining PEFC certification.

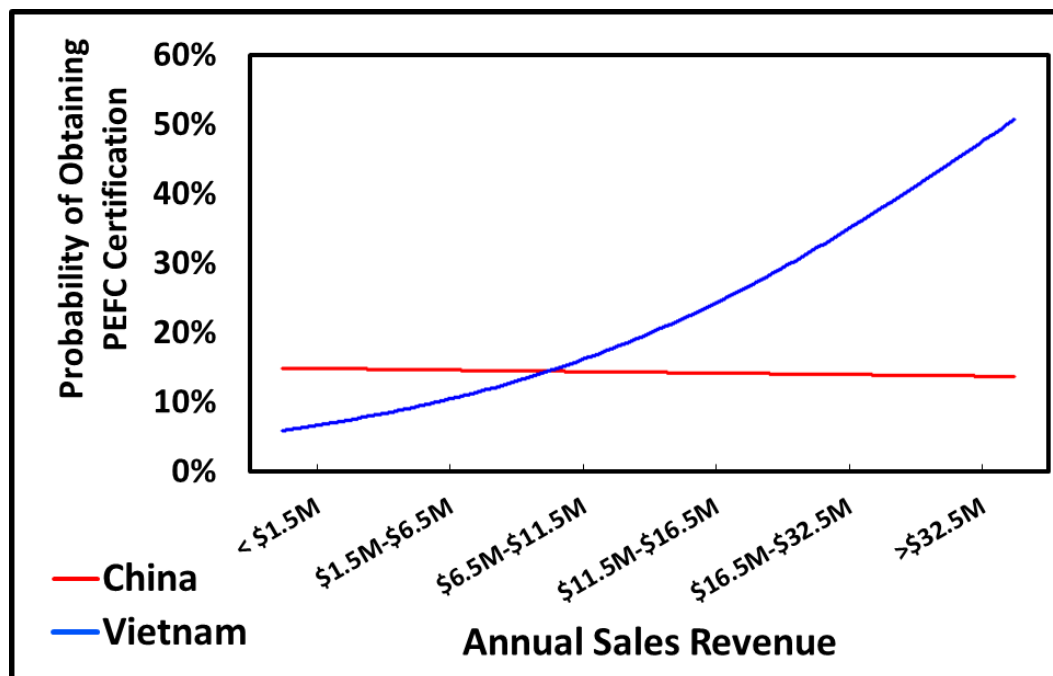


Figure 63. Interaction of PEFC usage and annual sales revenue.

Discussion

The results of the logistic analysis suggest that firm characteristics play a major role in whether a firm decides to obtain FSC or PEFC CoC certification. However, there are distinct differences in the variables which uniquely predict use of the two certifications. It appears that the probability of FSC usage increases significantly for Chinese firms, firms which are more highly aware of U.S. policy and firms with higher annual sales revenue. PEFC on the other hand increases with sales revenue and awareness of EU policy. The shared driver for both chain of custody certification schemes, annual sales revenue, suggests that larger firms which are more likely to use CoC certified products may be more concerned with the issue of timber legality. This may be due to larger firms having an export focus and directing their products to more scrupulous consumer markets. Alternatively, larger firms may be interested in using certified products to develop an international reputation for sourcing products from legal sources, serving to minimize risk and as a marketing mechanism to gain access to buyers in regulated markets.

Although both certifications are significantly impacted by firm size, the interaction between country and company sales revenue indicates a distinction between Chinese and Vietnamese firms. While there is little change in usage of PEFC CoC certification across different revenue levels by Chinese firms, Vietnamese firms with higher revenue are much more likely to have obtained PEFC certification. This difference in awareness may be due to relative differences in maturity within both markets. The Chinese wood products market is well established, and as a dominant player in the global marketplace for more than two decades it is logical that firms of varying sizes would be open to using certification in their products. However, in the Vietnamese market which is still emerging, firms may have inadequate information as well as limited access to certified products. This could result in smaller firms having reduced access and limited education regarding certified wood products. Assuming that certification use would be higher in more scrupulous firms which do not make use of illegal wood products, the results indicate that small Vietnamese firms with revenues below \$6.5 million could be considered as having a higher risk for using illegal wood products.

Usage of FSC and PEFC are both directly impacted by awareness of policy, however it is noteworthy that each certification is affected by one regulation more strongly than the other. Specifically, FSC use is uniquely predicted by awareness of the U.S. Lacey Act while PEFC is predicted by awareness of the EU Timber Regulation. These results suggest that use of FSC may be more prevalent in firms which have stronger ties to the United States while firms which focus on the European Union are more likely to use PEFC. This may be related to differences between the major timber legality regulations regarding acceptance of CoC certification as proof of legality. The EU Timber Regulation states that certification can serve as a tool in assessing risk of timber under a due diligence system. In combination with a risk assessment procedures, both FSC and PEFC certified wood can be placed on the EU market with no further mitigation measures (European Commission 2013a). Unlike the EU Timber Regulation, under the U.S. Lacey Act certifications are not considered a guarantee against violation of export laws and use of certified products does not relieve firms from requirements to obtain documentation proving their product's chain of custody (WRI 2009). Thus, firms which sell to the United States may be using FSC as a way to market their products towards environmentally minded consumers, rather than as a way to meet the legality standards of the U.S. Lacey Act.

Factor Analysis of Perceptions

An assessment of respondents' perceptions regarding illegal logging and recent timber legality regulations found a number of significant relationships between the survey's perception variables. In order to explore these interrelationships the correlations between each perception statement was calculated to identify whether there exists a statistically significant linear relationship between each pairing of variables. The correlations were calculated based on the overall dataset as well as for Chinese and Vietnamese responses; however the country level results did not differ significantly from the overall results. Correlations between each perception statement (**Table 12**) showed that eight of the perception variables showed a significant relationship ($p < .05$) with at least one other statement, suggesting a high level of inter-correlation between these variables.

Table 12. Correlation Table comparing perception statements regarding timber regulations

Measure	1.	2.	3.	4.	5.	6.	7.	8.	9.
<i>Outcomes</i>									
1. Regs are an effective way to reduce illegal timber	--								
2. Intend increase exports to countries without regs	-.16 **	--							
3. Timber legality regs cause timber prices to increase	.06	-.14 **	--						
4. Timber legality regs increase the cost of exporting	.07	-.06	.42 ***	--					
5. Intend to decrease my exports to countries with regs	.06	.19 ***	-.06	.04	--				
6. I plan to increase my use of certified wood to comply	.13 *	.01	-.02	-.12 *	-.15 **	--			
7. Timber legality regulations are a trade barrier	.07	.08	.01	.14 **	.18 ***	-.09	--		
8. Intend to sell more domestically because of regs	.00	.05	.02	.04	.09	.07	.18 ***	--	
9. Illegal logging is a major environmental problem	.01	-.05	.02	.07	-.01	.05	.01	.00	--

Note. $N=396$. * $p < .05$, ** $p < .01$, *** $p < .001$.

In order to explore firms' perceptions further, and to eliminate multi-collinearities among the perception variables, a principal components analysis (PCA) was performed to reduce the dimensions of the data and highlight differences between Chinese and Vietnamese perspectives (Lattin 2003). PCA is a method used to reduce the number of dimensions in multivariate data by identifying underlying sources of variance and attributing observed variation in each variable to underlying 'factors.' This analysis identifies these common factors and further analysis uses inference and theoretical evaluation to explain the relationship of these factors to the data (Lattin 2003).

In selecting variables for the factor analysis eight of the perception variables showed a significant relationship ($p < .05$) with at least one other statement, suggesting a certain level of correlation between these variables. However the question "Illegal logging is a major environmental problem" did not correlate significantly with any of the other variables. Therefore this question was eliminated from the factor analysis. The remaining eight perception questions have adequate correlation but at the same time are not too highly correlated (all have a correlation less than 0.50). Using the eight correlated variables, the Kaiser-Meyer-Olkin measure of sampling adequacy was calculated to be 0.510, which is above the recommended value of 0.5 and Bartlett's test of sphericity was found to be significant ($\chi^2 = 145.7$, $d.f. = 28$, $p < 0.001$), showing that there are strong relationships between the variables included in the analysis (Field 2005). Therefore we can conclude that a factor analysis is appropriate for this data.

In order to identify and compute the scores of factors underlying the eight perception variables, the principle components analysis was performed using a Varimax rotation. The Varimax rotation was used to facilitate interpretation by maximizing the sum of the variances of the square loadings between the variables and factors (Abdi 2003). The initial Eigenvalues showed that the first factor explained 18.1% of the variance, the second factor explained 17.8%, a third explained 15.0% and a fourth explained 13.5%. The three and four factor solutions were compared, using Varimax rotations of the factor loading matrix. Although the four factor model explained 64.4% of the variation, higher than the 51.4% explained by a three factor solution, the three factor solution was preferred because of the difficulty of interpreting a four factor model. In addition there was a noticeable break between the third and fourth factor on the scree plot, indicating a decline in the amount of variance explained by each successive factor, which supports the decision to use a three factor model (**Figure 64**).

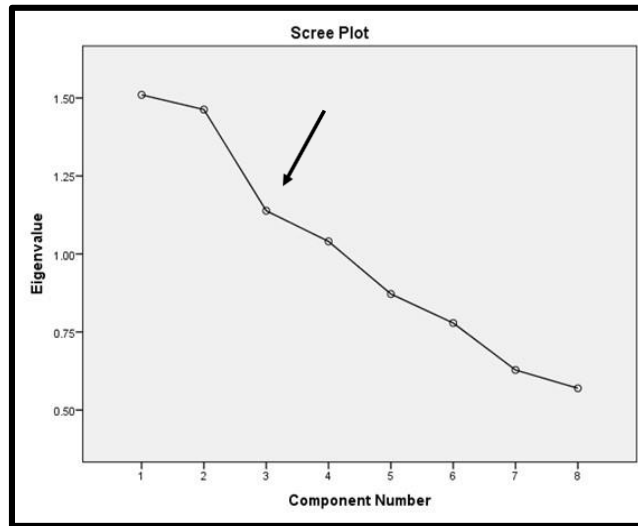


Figure 64. Scree plot of Eigenvalues against potential factors. Note the obtuse angle at Factor 3, which shows that each successive factor explains less variance.

The factor analysis of the eight perception variable (excluding ‘illegal logging is a major environmental problem’) was conducted using a three factor solution which explained 51.4% of the variance. The factor loading matrix for this final solution is presented in **Table 13**. Positive factor loadings are presented in black, while the small number of negative factor loadings are presented in red. The first factor is associated with firms who responded that they were concerned with issues of increased costs and higher prices for raw materials, so this factor was identified as relating to firms who are ‘Cost Conscious.’ The second factor, is highly associated with firms who believe timber regulations are a trade barrier, as well as with those who intend to shift sales away from regulated markets and towards either the domestic market or less regulated markets. As a result this factor has been labelled ‘Intend to Shift.’ The third factor is related to firms which plan to increase certified wood and agree that timber legality regulations are an effective way to comply with legislation, so this factor is identified as ‘Eco-minded.’ The negative factor loadings highlighted in red support the factor identifiers as only the ‘Intend to Shift’ score is positively correlated to an intent to increase exports to countries without timber legality regulations.

Table 13. Factor loadings based on a principle component analysis with Varimax rotation.

	Cost Conscious	Intend to Shift	Eco- Minded
Timber legality regulations increase the cost of exporting	.785		
Timber legality regulations cause timber prices to increase	.775		
Timber legality regulations are a trade barrier designed to protect foreign manufacturers		.687	
I intend to decrease my exports to countries that have timber legality regulations		.664	
I intend to sell more products domestically because of timber legality regulations		.554	
I intend to increase my exports to countries that do not have timber legality regulations	-.405	.301	-.458
Legality regulations are an effective way to reduce illegal timber			.739
I plan to increase my use of certified wood to help me comply with legality legislation			.617

Note: Factor loadings < .3 are suppressed. (N=326)

Based on the three factors identified, firms were assigned composite scores based on their responses to the eight perceptual questions. The composite variables assigned to each firm are standardized, so scores range from -3 to 3 and have a mean of 0. A high value on a factor score means that the firm answered in the affirmative to questions which are strongly associated with each factor. As the Varimax rotation maximizes the variance between each factor, firms' scores for each factor are relatively independent and each firm receives a separate value for each factor based on their responses to the eight perception questions. Composite scores for the three factors are used as variables in subsequent modelling.

Factor Scores and Country Effect

The three factor scores were evaluated to determine if there were differences in the responses between Chinese and Vietnamese firms. Only the 'Intend to Shift' factor showed a significant country effect (**Figure 65**). Chinese firms had an average 'Intend to Shift' factor score of 0.16, which means that Chinese firms were more likely to respond that they intend to shift away from regulated markets and towards unregulated and domestic markets. Vietnamese firms on the other hand had a mean score of -.54, meaning that on average they showed less support for intend to shift perception statements.

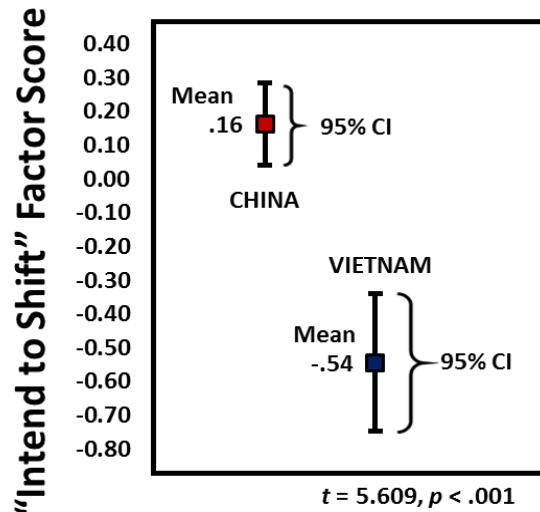


Figure 65. Mean scores on ‘Intend to Shift’ factor for Chinese and Vietnamese firms.

The results of independent samples t-test show that the mean score for Chinese firms was significantly higher than those of the Vietnamese ($t=5.609, p<.001$). A comparison of mean factor scores between Chinese and Vietnamese firms for all three factors is outlined in **Table 14**. The only factor which showed a significant differential effect between China and Vietnam was the ‘Intend to Shift’ factor which supports the decision to use this variable for further comparisons of Chinese and Vietnamese firms. In addition as one of the main focuses of this research is the issue of regulatory leakage, the “Intend to Shift” factor will be the main focus for further analysis.

Table 14. Mean Factor Scores by Country.

	Mean Factor Score		t	d.f.	p
	China	Vietnam			
Cost Conscious	.006	-.020	0.201	324	.840
Intend to Shift	.162	-.543	5.608	324	<.001
Eco-minded	-.058	.194	-1.923	324	.055

Model Selection

In order to evaluate how firms’ demographic characteristics and sourcing and sales decisions may shape their attitudes towards timber legality decisions a regression model was developed to predict firms’ ‘Intend to Shift’ factor scores. Firm characteristics and survey responses were assessed to determine which independent variables would be selected for the model. This process allowed for the preservation of degrees of freedom while at the same time removing extraneous variables and simplifying the model. The assessment selected variables depending on whether there were significant differences in mean ‘intend to shift’ factor scores across firm response categories.

Effect of Firm Characteristics on ‘Intend to Shift’ Factor

Annual Sales Revenue

A comparison of firms’ annual sales revenues and mean ‘Intend to shift’ factor scores showed an interesting trend for both Chinese and Vietnamese firms (**Figure 66**). Both Chinese and Vietnamese firms with annual sales revenues less than \$1.5 million showed high mean intend to shift scores. The Vietnamese respondents did show a spike in mean scores in the \$16.5 to \$32 million and greater than \$32 million annual revenue categories. However, the number of respondents in these categories was quite low, with only 4 and 8 firms respectively.

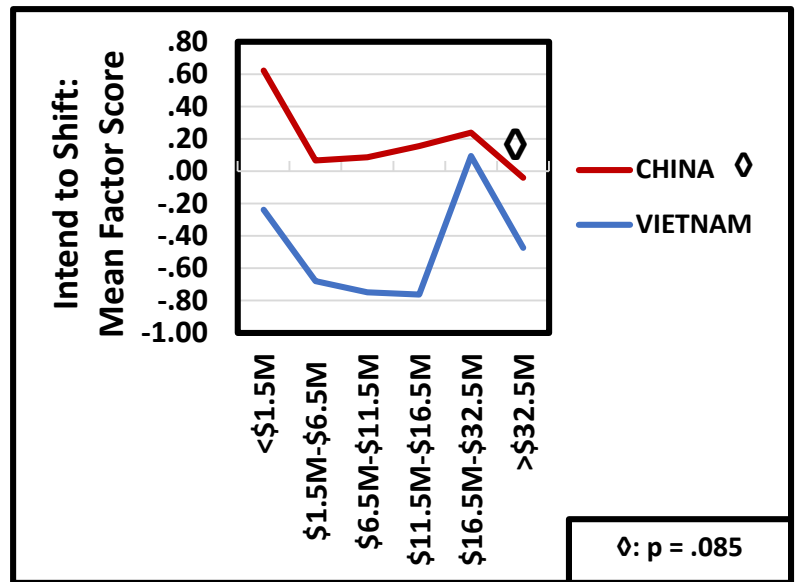


Figure 66. Mean factor scores and annual sales revenue.

An evaluation of responses using a one way ANOVA did not show significance at the $p < 0.05$ level for either China or Vietnam. However, analysis of the Chinese firms had a significance of $p = 0.85$, which while not significant, is worth taking into consideration ($F(5,241) = 1.959, p = .085$) and suggests that small firms will be more likely to shift markets in China. Although this finding is of interest, because it did not rise to the level of significance it will not be included in the linear regression model. The ANOVA results did not show a significant difference in mean factor scores across revenue categories for Vietnamese firms.

Business Types

Responses by firms regarding their business type were compared against mean factor scores for the ‘Intend to shift’ composite variable. An independent samples t-test found that there was a significant difference between Chinese firms which are furniture manufacturers and those which are not ($t = -2.380, d.f. = 249, p = .018$), with furniture manufacturers showing a significantly higher mean score on the ‘Intend to shift’ factor (**Figure 67**). This relationship was not significant for Vietnamese.

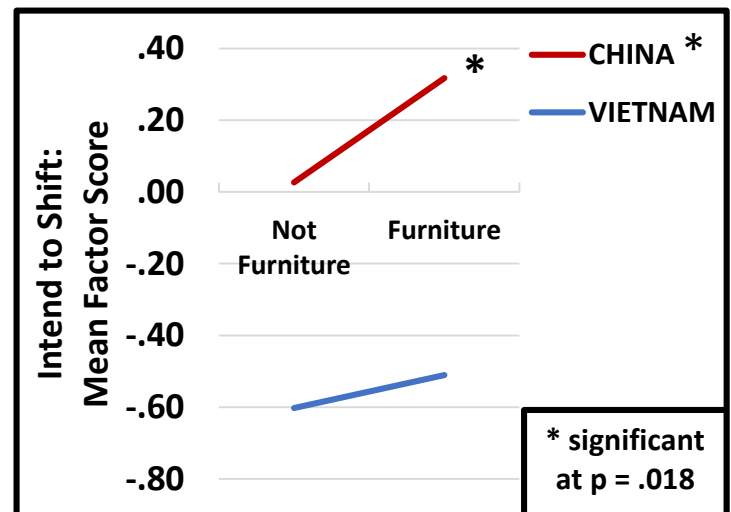


Figure 67. Mean factor scores by furniture manufacturer category.

Assessment of mean factor scores across the other surveyed business type categories using an independent samples t-test found no significant difference in mean ‘Intend to Shift’ factor scores for flooring manufacturer, plywood manufacturer, exporter and importer categories and these variables will not be included in the regression model.

Interaction of Sales Revenue and Business Type

As average scores on the ‘Intend to Shift’ factor showed strong relationships with business type and annual sales revenue for Chinese firms, further investigation was carried out on the interaction between these two variables. As **Figure 68** shows, Chinese furniture firms show a high intent to shift across all sales revenue categories. Interestingly, while flooring firms have a much lower average ‘Intend to Shift’ scores than their furniture counterparts, there is large variation across firm sizes. Specifically, flooring firms with annual revenue less than \$1.5 million have an average intend to shift score of .56, which is far higher than any of the other flooring firms and matches that of the smallest Chinese furniture firms. This suggests that there may be a split among firms into two groupings, a ‘high intent to shift’ group comprised of furniture firms and the smallest flooring firms and a ‘low intent to shift’ group made up of larger flooring manufacturers.

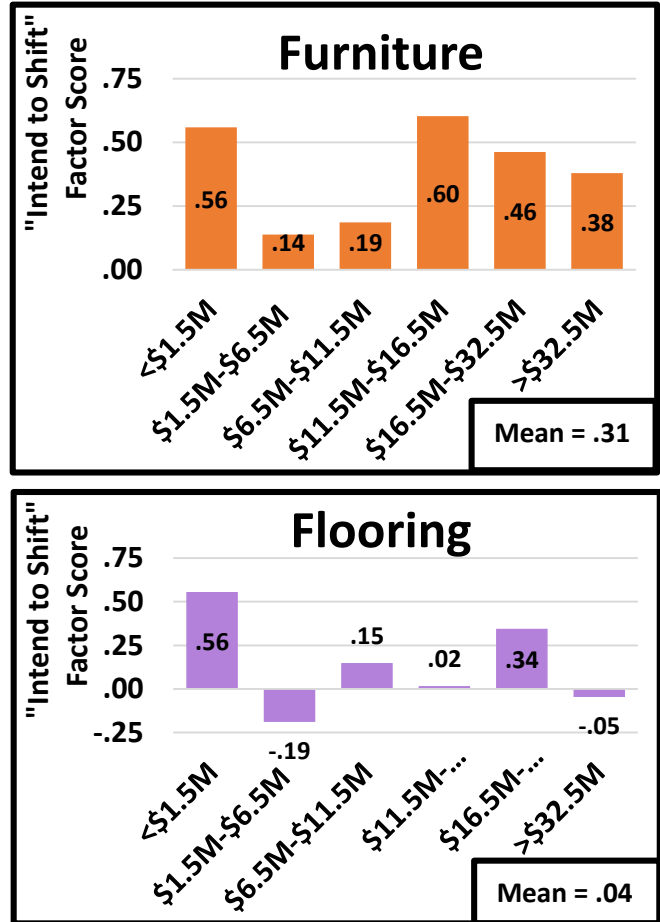


Figure 68. Factor scores for Chinese furniture and flooring firms by annual sales revenue.

Effect of Response Variables on ‘Intend to Shift’ Factor

Chain-of-Custody Certification Usage

The decision to obtain FSC was found to significantly impact Chinese firms’ mean scores for the ‘Intend to Shift’ factor ($t = 3.406, d.f. = 249, p < .001$), with firms which obtained FSC certification showing a significantly lower ‘intend to shift’ mean factor score (Figure 69). Usage of FSC by Vietnamese firms was not found to significantly affect scores on ‘Intend to Shift.’

Using the same analysis on usage of PEFC certification did not show a significant effect on intention to shift for Chinese or Vietnamese firms.

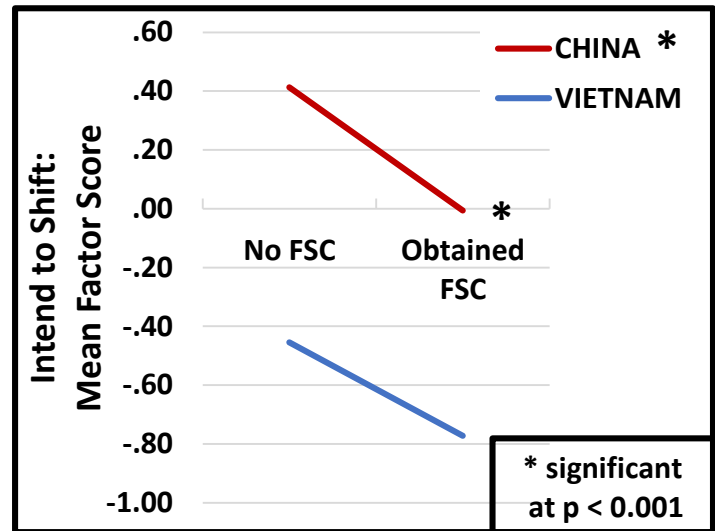


Figure 69. Mean factor scores and usage of FSC certification.

Familiarity with Timber Legality Regulations

Intend to shift mean factor scores were found to be closely associated with awareness of the U.S. Lacey Act. Based on a one way ANOVA, a significant difference in mean factor scores across awareness levels was reported for both Chinese ($F(2,248) = 3.751, p = .025$) and Vietnamese firms ($F(2,68) = 4.838, p = .011$). Further analysis using pairwise t-tests using a Bonferroni adjustment showed that there was no significant difference between mean factor scores of firms which ‘have not heard about it’ and ‘have heard about it but am not sure of the details.’ However, both Chinese and Vietnamese firms which reported they were ‘very familiar with this regulation’ were found to have a significantly lower intend to shift score than those who fell into the other categories based on pairwise t-tests (Figure 70).

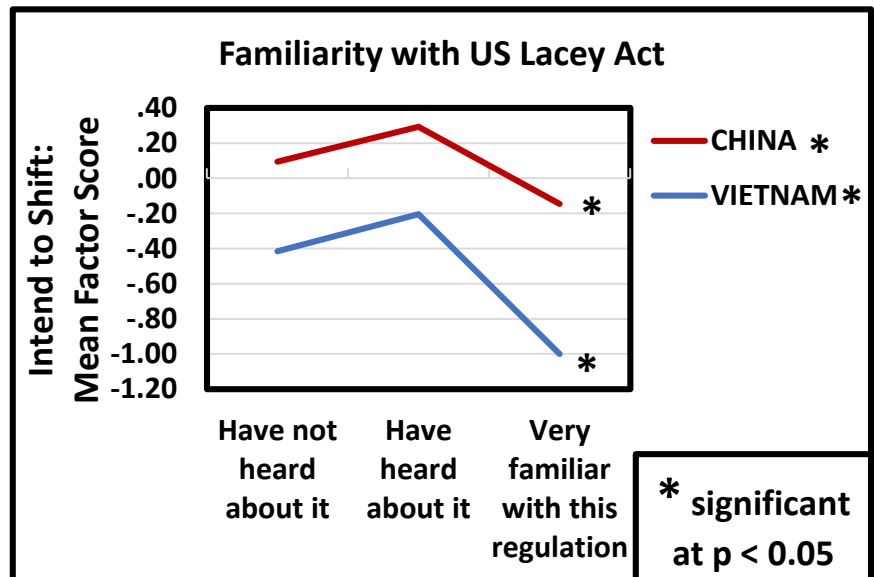


Figure 70. Mean factor scores & familiarity with the Lacey Act.

A comparison of mean factor scores and familiarity with the EU Timber Regulation, based on a one way ANOVA found a significant difference in mean factor scores across awareness levels for Chinese firms ($F(2,248)=3.815, p = .023$). Pairwise t-tests using a Bonferroni adjustment showed that there was no significant difference in factor scores for firms which ‘have not heard about it’ and ‘have heard about it but am not sure of the details’, but Chinese firms which are ‘very familiar with this regulation’ showed a significantly lower intent to shift score (Figure 71). This relationship was not significant for Vietnamese.

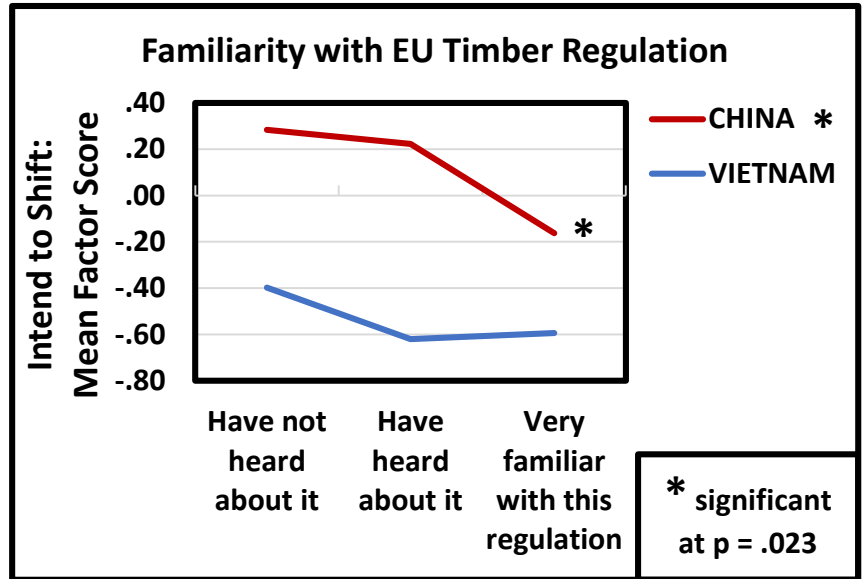


Figure 71. Mean factor scores and familiarity with the EU Timber Regulation.

Assessment of significant differences in mean factor scores for the Japanese Public Procurement Policy and the Australian Illegal Logging Prohibition Act using one way ANOVA did not show a significant difference in means scores across levels of awareness for either Chinese or Vietnamese firms.

Sales Changes

Comparing sales to the United States and mean factor scores, a one way ANOVA found a significant difference in mean factor scores across sales categories for both Chinese ($F(3,247)=2.693, p =.047$) and Vietnamese firms ($F(3,71) =3.349, p=.024$). A pairwise t-test using a Bonferroni adjustment shows that Chinese firms which sell to the United States (firms reporting they Increased, Remained Same, and Decreased) all had a significantly lower mean intend to shift factor score than those firms which don't sell to the U.S (Figure 72).

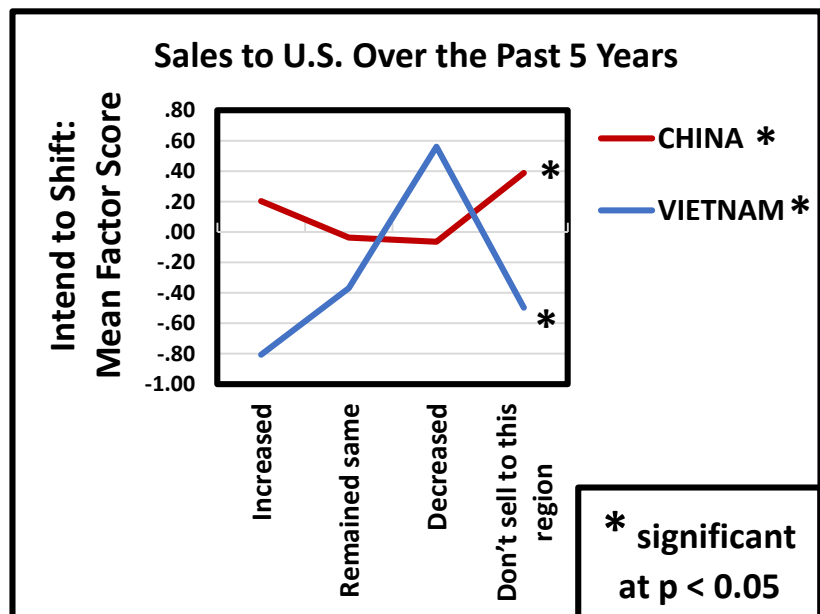


Figure 72. Mean factor scores and sales to the United States over the last 5 years.

Vietnamese firms on the other hand, behaved quite differently from their Chinese counterparts. Pairwise t-tests using a Bonferroni adjustment show that firms that decreased sales to the U.S. had a significantly higher mean ‘intend to shift’ score than those who increased sales or don’t sell to this region. This suggests that firms with a high intend to shift score have already begun to decrease their sales to the U.S. over the last five years and that they are not just planning to change markets but are already actively shifting away from the U.S. market.

A one way ANOVA comparing change to domestic sales over the last five years and mean ‘Intend to Shift’ factor scores (**Figure 73**) found a significant difference in mean factor scores across sales categories for Chinese firms ($F(3,247)=7.312, p < .001$). Further evaluation using pairwise t-tests showed that Chinese firms which reported an increase in domestic sales over the last five years had a significantly higher mean ‘Intend to Shift’ factor score. This suggests that Chinese firms with a high intent to change markets may be shifting their sales to the Chinese domestic market. This relationship was not significant for Vietnamese firms.

Assessment of significant differences in mean factor scores using ANOVA were carried out for sales to the EU, Japan, the Middle East, Australia, Southeast Asia, and Russia. These evaluations found no significant differences in means across sales categories for these sales markets.

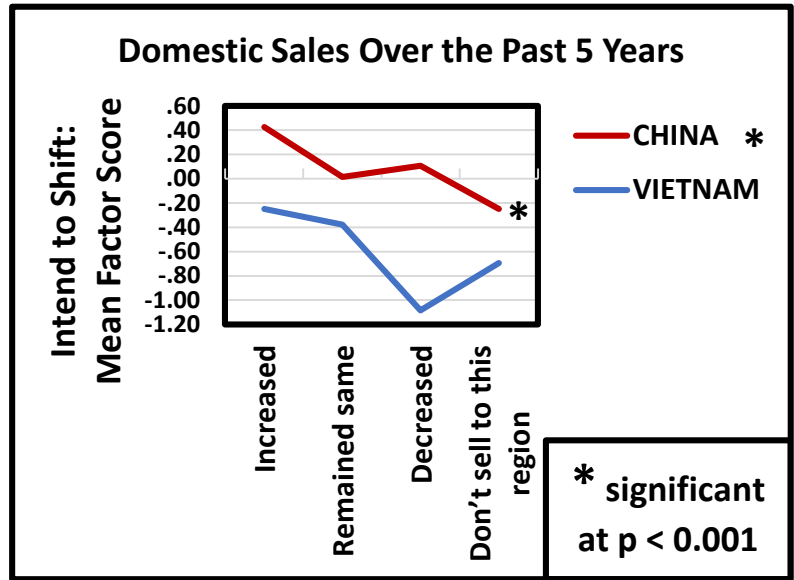


Figure 73. Mean factor scores and domestic sales over the last 5 years.

Sourcing Changes

Comparing sourcing from the United States and mean factor scores (**Figure 74**), a one way ANOVA found a significant difference in mean factor scores across sales categories for Chinese firms ($F(3,247)=8.99, p <.001$). Pairwise t-tests using a Bonferroni adjustment showed that Chinese firms which ‘increased’ their sourcing or where sourcing ‘remained the same’ had a significantly higher mean ‘Intend to Shift’ factor score than firms which ‘decreased’ sourcing or ‘do not source’ from the United States. This indicates that in spite of an intention to shift sales away from regulated markets, Chinese firms are continuing to source raw materials from the United States. This relationship was not significant for Vietnamese firms.

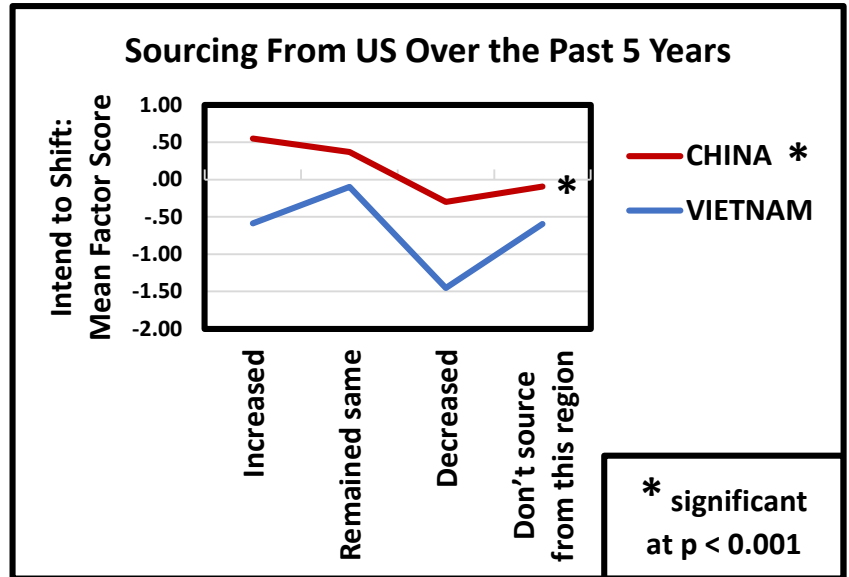


Figure 74. Mean factor scores and sourcing from the United States over the last 5 years.

A one way ANOVA comparing mean factor scores and sourcing from Russia (**Figure 75**) found a significant difference in mean factor scores across sales categories for Chinese firms ($F(3,247)=2.926, p=.034$). Pairwise t-tests using a Bonferroni adjustment showed that Chinese firms which increased sourcing from Russia had a mean factor score of .45 which was significantly different from firms which remained the same or firms which don’t source from Russia. This suggests that Chinese firms which intend to shift away from regulated markets are more likely to have increased sourcing from Russia over the last 5 years. This relationship was not significant for Vietnamese firms.

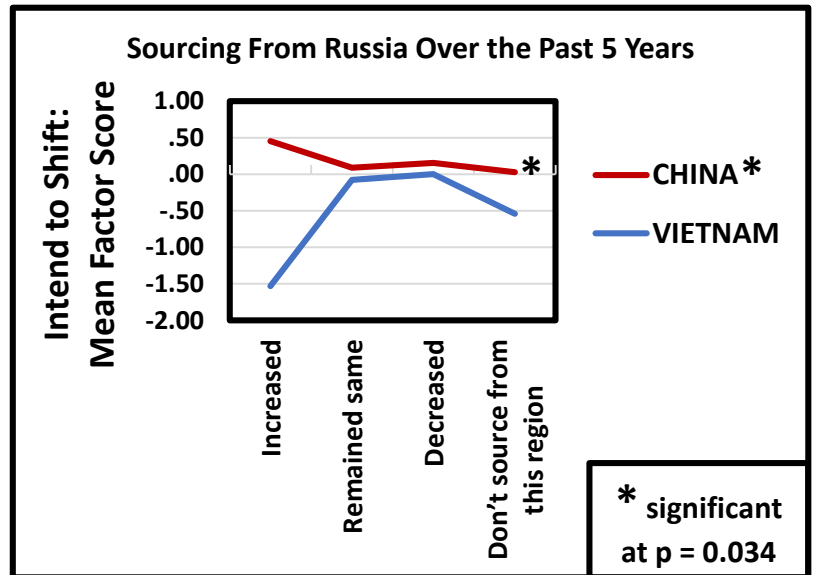


Figure 75. Mean factor scores and sourcing from Russia over the last 5 years.

Evaluating changes in sourcing from Southeast Asia (Figure 76), the results of a one-way ANOVA found a significant difference in mean factor scores across sales categories for Chinese firms ($F(3,247)=3.358$, $p=.019$). Pairwise t-tests using a Bonferroni adjustment showed a significant difference between the means of Chinese respondents which increased sourcing from Southeast Asia and firms which ‘remained the same’. This suggests that Chinese firms which do not intend to shift away from regulated markets are increasing their sourcing from Southeast Asia. This relationship was not significant for Vietnamese firms.

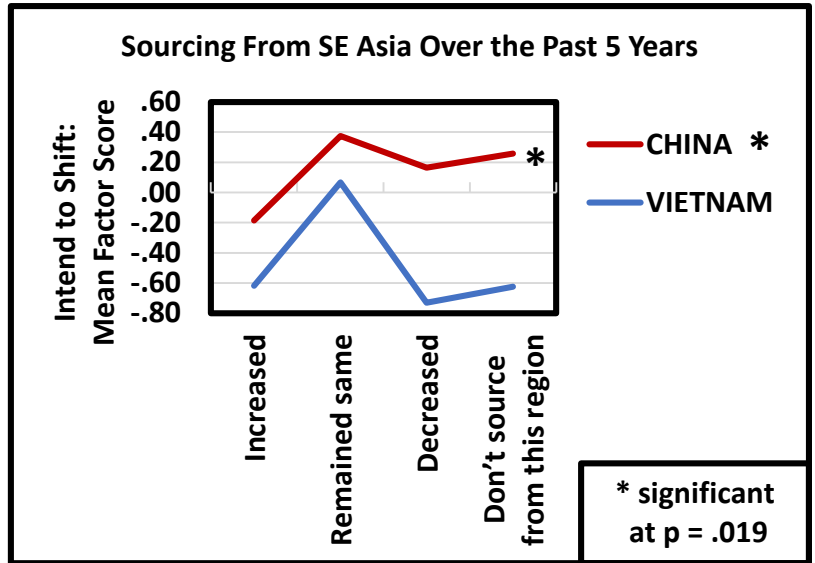


Figure 76. Mean factor scores and sourcing from Southeast Asia over the last 5 years.

Assessing changes in sourcing from the domestic market, a one-way ANOVA (Figure 77) showed a significant difference in mean factor scores across sales categories for Chinese firms ($F(3,247)=2.997$, $p=.031$). Pairwise t-tests using a Bonferroni adjustment showed that the mean factor score for Chinese firms whose sourcing from the domestic market stayed the same was significantly different from those who increased, decreased or don't source domestically. The low factor score displayed from firms whose domestic sourcing remained the same suggests that Chinese firms which do not intend to shift are maintaining their level of sourcing from Chinese suppliers. This relationship was not significant for Vietnamese firms.

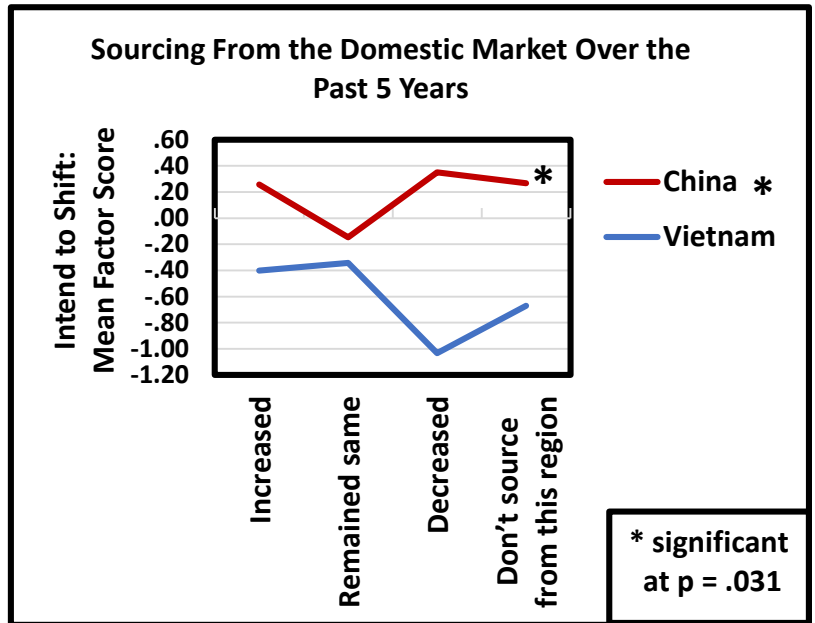


Figure 77. Mean factor scores and sourcing from the Domestic market over the last 5 years.

Linear Regression

One of the major goals of this study is to evaluate how demographic characteristics and sourcing and sales decisions shape firms' attitudes towards timber legality decisions. A linear regression using stepwise forward selection was conducted to estimate firms' 'Intend to Shift' factor scores. The linear regression was conducted with 'Intend to Shift' as the dependent variable and prediction was based on a number of independent variables. The independent variables chosen for the regression model were selected based on comparisons of the mean factor scores for the demographic, sales and sourcing variables using ANOVA and independent samples t-tests from the preceding section. Based on the results of the initial screening, those predictors which showed significant differences in mean factor scores were included in the regression model. The demographic variables selected for the model include whether the firm is a furniture manufacturer, use of FSC certification, and familiarity with the U.S. Lacey Act and EU Timber Regulation. The sales variables selected include firms' change in sales over the last five years to the U.S. and domestic market, and the sourcing variables include change to sourcing over the last five years from the U.S., Russia, Southeast Asia, and Domestic market.

Data Preparation

The independent variables for the linear regression model include a combination of binary, ordinal and nominal categorical variables. The binary variables 'furniture manufacturer' and 'obtained FSC' can be entered into the model without requiring re-coding. The 'Familiarity with U.S. Lacey Act' and 'Familiarity with EU Timber Regulation' are categorical ordinal variables coded as: 1) Have not heard about it. 2) Have heard about it but am not sure of the details of this regulation. 3) Am very familiar with this regulation. These variables have a clear order and the spacing between the variables is relatively consistent and can be adequately addressed by linear regression analysis (Cohen and Cohen 2003).

However, the Sales and Sourcing Variables are categorical variables which are coded as: 1) Increased. 2) Remained the Same. 3) Decreased. 4) Do not source/sell to this region. These variables do have an order, however the distance between categories, in particular between 'decreased' and 'do not source/sell' is unknown, so we cannot assume uniform spacing. In order to evaluate these nominal variables using a regression model, it was necessary to create dummy variables from the original nominal variable, creating a new binary variable for each category.

An important consideration for transforming a categorical variable into binary or dummy variables is the potential 'Dummy Variable Trap' (Wendorf 2004). This occurs when binary variables for every category are included in a regression model. In such a situation, the sum of all category dummy variables for each row is equal to the intercept value of that row. Thus, the model would have perfect multi-collinearity and if you knew three of the four binary variables the final variable could always be predicted. In order to address this potential problem, the sales and sourcing variables will be recoded as:

- Source/Sales: Increased - Binary
- Source/Sales: Remained Same - Binary
- Source/Sales: Decreased –Binary
- Source/Sales: Do not source/sell from this region – Dropped

Dropping one of the variables allows us to use the excluded variable as the reference value and the fit values of the remaining categories represent the change from this reference, which is effectively picked up by the constant. This method avoids the dummy variable trap and potential multi-collinearity problems. An outline of the coding for the independent variables used in the linear regression model is shown in **Table 15**.

Table 15. Coding for variables included in linear regression model

Variable		Variable Type	Coding
DV: "Intend to Shift" Factor Score		Scalar	Composite score ranging from -3 to 3. Score: -3 = Responses not associated with factor Score: 3 = Responses strongly associated with factor
Furniture Manufacturer		Binary	0 = Not a Furniture Manufacturer 1 = Furniture Manufacturer
Obtained FSC		Binary	0 = Did not obtain FSC Certification 1 = Obtained FSC Certification
Familiarity w/ Lacey Act		Ordinal	1 = Have not heard about Lacey Act 2 = Have heard about it but am not sure of the details 3 =Am very familiar with this regulation
Familiarity w/ EU Timber Regulation		Ordinal	1 = Have not heard about EU Timber Regulation 2 = Have heard about it but am not sure of the details 3 =Am very familiar with this regulation
Sales to U.S., Domestic:	• Increased	Binary	0 = Sales did not increase 1 = Sales increased over the last 5 years
	• Same	Binary	0 = Sales did not remain the same 1 = Sales remain the same over the last 5 years
	• Decreased	Binary	0 = Sales did not decrease 1 = Sales decreased over the last 5 years
Source from U.S., Russia, SE Asia, Domestic:	• Increased	Binary	0 = Sourcing did not increase 1 = Sourcing increased over the last 5 years
	• Same	Binary	0 = Sourcing did not remain the same 1 = Sourcing remain the same over the last 5 years
	• Decreased	Binary	0 = Sourcing did not decrease 1 = Sourcing decreased over the last 5 years

Bivariate Correlations

In order to explore potential correlations between the ‘intend to shift’ factor and the linear regression model’s predictor variables, bivariate analysis was performed. Correlations between Chinese firms’ responses to the independent variables are presented in **Table 16**. The results show a number of strong relationships between business type, use of certification, and awareness of regulations and sales and sourcing changes. The correlation table also presents a number of strong correlations between changes to U.S. and Domestic sales, as well as a number of strong relationships between Sales and Sourcing changes.

Table 16. Correlations between independent variables for Chinese respondents.

Measure	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.
<i>Outcomes</i>																						
1. Furniture Manufacturer	1																					
2. Obtained FSC	-.12*	1																				
3. Familiarity w/ Lacey Act	-.10	.18**	1																			
4. Familiarity w/ EUTR	.02	.15*	.30**	1																		
5. Sales US: • Increased	-.09	.13*	.28**	.07	1																	
6. • Same	.07	.03	.10	.07	-.41**	1																
7. • Decreased	.03	.17**	-.03	.04	-.31**	-.22**	1															
8. Sales Domestic: • Increased	.07	-.25**	-.09	-.17**	.02	-.08	-.07	1														
9. • Same	-.03	.07	.09	.06	-.05	.15*	-.01	-.56**	1													
10. • Decreased	-.06	-.04	-.08	.01	-.05	-.07	.28**	-.22**	-.12*	1												
11. Source US: • Increased	.07	.02	.10	-.06	.30**	-.24**	-.11	.18**	-.09	-.02	1											
12. • Same	.08	.03	.02	.08	-.04	.21**	.02	.10	.07	-.05	-.29**	1										
13. • Decreased	.00	.05	.01	-.06	-.10	-.04	.22**	-.05	.04	.20**	-.15*	-.11	1									
14. Source Russia: • Increased	.12*	.10	.06	.05	.13*	.09	-.14*	.18**	-.05	-.13*	.22**	.02	-.02	1								
15. • Same	.01	.03	.08	-.01	-.02	.15*	.03	-.16**	.32**	-.02	-.14*	.43**	.11	-.29**	1							
16. • Decreased	-.12	.16**	.01	.04	.03	-.13*	.30**	.10	-.09	.11	.07	.02	.02	-.14*	-.12	1						
17. Source SE Asia: • Increased	-.25**	.14*	.22**	.09	.01	.09	.13*	-.06	.16*	-.07	-.16*	.04	.22**	.04	.18**	.00	1					
18. • Same	-.05	-.07	.04	.02	-.02	.08	-.04	-.10	.20**	.07	-.06	.05	.00	-.05	.14*	.05	-.16*	1				
19. • Decreased	-.07	.01	-.07	.01	.12	-.08	.06	.05	-.13*	.12	.01	.13*	.03	-.14*	.11	.42**	-.12*	-.07	1			
20. Source Domestic: • Increased	.13*	.01	-.02	.00	.13*	.04	.00	.28**	-.18**	-.08	.04	-.01	-.02	.16*	-.09	-.06	-.04	.03	-.12*	1		
21. • Same	-.03	-.01	.08	.09	-.06	.11	-.03	-.26**	.46**	-.04	-.19**	.10	.15*	-.07	.27**	-.06	.18**	.09	-.01	-.50**	1	
22. • Decreased	.05	.11	-.11	-.03	.00	-.14*	.22**	.00	-.07	.25**	.01	.05	.02	-.08	.00	.37**	-.02	-.08	.31**	-.22**	-.15*	1

Note: * p < .05, ** p < .01

Correlations between Vietnamese firms’ responses to the independent variables are presented in **Table 17** and only show a few significant relationships. Unlike the Chinese, there is not a strong relationship between business type and sales and sourcing changes. However, there are a number of strong relationships between use of certification and awareness of regulations and changes to sourcing and sales. Relative to China, there are very few strong relationships between changes to sales and changes to sourcing for Vietnamese firms. It should be noted that there is a small difference between the two models, as ‘Source Russia – Decrease’ is not included in the Vietnamese model. This was excluded from the model because none of the Vietnamese responses noted a decrease in sales to Russia.

Table 17. Correlations between independent variables for Vietnamese respondents.

Measure	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.
<i>Outcomes</i>																					
1. Furniture Manufacturer	1																				
2. Obtained FSC	.00	1																			
3. Familiarity w/ Lacey Act	.15	.12	1																		
4. Familiarity w/ EUTR	.16	.35**	.52**	1																	
5. Sales US: • Increased	.08	.18*	.27**	.32**	1																
6. • Same	.06	.25**	-.04	.00	-.24**	1															
7. • Decreased	.10	.00	.18*	.17	-.16	-.08	1														
8. Sales Domestic: • Increased	-.08	.13	-.17	.01	-.20*	.15	.01	1													
9. • Same	.06	.00	.07	-.05	-.12	.01	-.03	-.29**	1												
10. • Decreased	.03	.01	-.09	.01	-.07	-.10	.06	-.17*	-.14	1											
11. Source US: • Increased	-.04	.30**	.27**	.25**	.22*	.06	-.06	.05	.06	-.17	1										
12. • Same	.02	.02	.03	.08	-.06	.36**	.04	.08	.10	-.09	-.19*	1									
13. • Decreased	.00	.10	-.06	-.06	.01	-.08	.11	-.13	.08	.35**	-.13	-.07	1								
14. Source Russia: • Increased	.03	.28**	.07	.03	.26**	-.06	-.04	-.11	.03	-.05	.00	-.06	.38**	1							
15. • Same	-.04	.06	-.03	.01	-.08	.15	-.03	.19*	-.06	-.03	.07	.17	-.03	-.02	1						
16. Source SE Asia: • Increased	.02	.07	.02	.06	.10	-.06	-.09	.03	.06	-.02	-.11	-.04	.03	.07	-.05	1					
17. • Same	.04	-.07	-.03	.08	-.03	-.11	.05	.00	.00	-.08	.01	-.01	-.06	-.05	-.04	-.11	1				
18. • Decreased	.13	-.01	.18*	.14	.07	-.06	.16	-.11	.03	.12	.00	-.06	.17*	-.03	-.02	-.06	-.05	1			
19. Source Domestic: • Increased	.09	.09	-.14	.02	-.06	.10	.01	.44**	-.17	-.17*	-.03	.02	-.05	-.01	.06	.13	.06	-.11	1		
20. • Same	.17*	-.08	.15	-.08	-.11	.02	.07	-.11	.32**	-.06	-.14	.11	-.10	-.08	.10	-.05	.07	.03	-.28**	1	
21. • Decreased	.03	-.15	-.13	-.15	.06	-.08	-.06	-.14	-.11	.44**	-.06	-.08	.11	-.04	-.03	-.09	.05	.16	-.14	-.11	1

Note: * $p < .05$, ** $p < .01$

Model Results

The main goal of this study is to explore how a firm’s characteristics, its use of CoC certified wood, awareness of regulations and changes to sales and sourcing affect the decision to shift sales away from regulated markets. In order to address this subject, a linear regression using stepwise forward selection was conducted to predict firms’ ‘Intend to Shift’ score. As significantly different average ‘Intend to Shift’ scores were observed for Chinese and Vietnamese firms, the decision was made to evaluate each country separately so as to avoid obscuring any patterns present in the data.

The forward method of stepwise selection starts with no variables in the model, and then iteratively adds in variables, keeping those variables which are shown to improve the model based on comparison criteria. There are a number of potential selection criteria which can be used to identify variables to include in the final model. This model makes use of the two most popular selection criteria, the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC). Both methods attempt to minimize the selection criteria in order to select the best approximating model which is further assessed to draw inferences and conclusions (Buckland 1997).

The independent variables left in the final model of Chinese responses included use of FSC, U.S. sales, Domestic sales, sourcing from Russia and sourcing from Southeast Asia (**Table 18**). While the adjusted- R^2 declined, the F-value increased and the AIC and BIC values of the final model were estimated to be lower than the base model, hence the final model is favored as a closer approximation

of the true model. The linear regression of Vietnamese responses resulted in a final model which included familiarity with the Lacey Act, and sales to the United States. The final Vietnamese model had a higher F-value than the original, a more significant p-value, as well as lower AIC and BIC scores, all of which favor the final model over the original. It is worth noting that the results from the base and stepwise model do not differ dramatically. None of the independent variables change their sign direction or become significant following the stepwise selection, which supports the choice to employ a stepwise selection method.

Table 18. Multiple Linear Regression with Standard and Sequential Predictor Entry

	China						Vietnam					
	Base Model			Stepwise			Base Model			Stepwise		
Coefficients	<i>b</i>	(SE)	<i>p</i>	<i>b</i>	(SE)	<i>p</i>	<i>b</i>	(SE)	<i>p</i>	<i>b</i>	(SE)	<i>p</i>
Constant	.19	(.27)	.474	-.08	(.16)	.606	-.29	(.39)	.461	-.05	(.26)	.845
Furniture Manufacturer	.15	(.13)	.238				.21	(.28)	.463			
Obtained FSC	-.29	(.13)	.035 *	-.34	(.13)	.009 **	-.33	(.32)	.302			
Familiarity w/ Lacey Act	.08	(.10)	.442				-.42	(.17)	.018 *	-.28	(.12)	.027 *
Familiarity w/ EUTR	-.14	(.08)	.105				-.02	(.19)	.910			
Sales US: • Increased	-.23	(.17)	.185				.03	(.33)	.935	-.13	(.23)	.559
• Same	-.35	(.19)	.061				.47	(.45)	.305	.13	(.31)	.682
• Decrease	-.25	(.22)	.258				1.02	(.57)	.083	1.24	(.45)	.008 **
Sales Domestic: • Increased	.34	(.17)	.052	.37	(.16)	.024 *	.20	(.33)	.552			
• Same	.30	(.20)	.122	.16	(.18)	.384	.04	(.39)	.929			
• Decrease	.33	(.33)	.313	.25	(.31)	.429	.16	(.61)	.798			
Source US: • Increased	.39	(.15)	.011 *	.48	(.15)	.001 ***	.44	(.31)	.167			
• Same	.41	(.19)	.035 *	.35	(.19)	.069	.54	(.51)	.295			
• Decrease	-.15	(.28)	.607	-.12	(.28)	.655	1.01	(1.20)	.404			
Source Russia: • Increased	.35	(.15)	.025 *	.29	(.15)	.057	-1.27	(.99)	.203			
• Same	.09	(.19)	.638	.05	(.19)	.780	.55	(1.11)	.623			
• Decrease	.08	(.32)	.805	.06	(.30)	.848	-	-	-			
Source SE Asia: • Increased	-.20	(.16)	.211	-.33	(.15)	.030 *	.29	(.39)	.462			
• Same	.21	(.22)	.346	.14	(.22)	.525	.52	(.40)	.199			
• Decrease	-.03	(.33)	.922	-.09	(.31)	.774	.43	(.70)	.544			
Source Domestic: • Incr.	-.09	(.16)	.554				.02	(.31)	.942			
• Same	-.38	(.19)	.043 *				.28	(.36)	.444			
• Decrease	.09	(.29)	.750				-.44	(.76)	.565			
Model Fit												
N	250			250			62			70		
R^2_{total}	0.252			0.206			0.384			0.181		
$R^2_{adjusted}$	0.179			0.163			0.069			0.131		
<i>F</i>	3.483			4.732			1.218			3.634		
<i>d.f.</i>	22			13			21			4		
<i>p</i>	< .001			< .001			0.287			0.01		
AIC	7.08			-4.52			24.12			-4.49		
BIC	15.83			0.65			19.76			-5.11		

Note. FSC= Forest Stewardship Council, PEFC = Programme for the Endorsement of Forest Certification

* $p < .05$, ** $p < .01$, *** $p < .001$.

It should be noted that the R^2 of the model, or the percent of variability that the model explains is low. The stepwise Chinese model explains 16.3% of the variation while the stepwise Vietnamese model only explains 13.1%, indicating that this model does not provide good explanatory power. While the amount of variation in the data explained is lacking, this model can still be used to identify broad trends which can be used as the basis of subsequent interpretation and analyses.

Results of Chinese Regression Model

When considered individually, a number of firm characteristics displayed significant relationships with ‘Intend to Shift’ scores for Chinese firms. However, when considering these predictors together as part of a regression model, only a small subset of these demographic characteristics played a significant role in determining Chinese firms’ intent to shift away from regulated markets. Of the potentially important characteristics included in the linear model, only use of FSC certification had a significant impact on the dependent variable. Whether a firm obtained FSC certification showed a negative relationship to the intend to shift score, indicating that firms which expressed a higher intention to shift away from regulated markets were significantly less likely to obtain chain-of-custody certification. While business type and awareness of regulation had a relationship with the dependent variable when considered on a case by case basis, these variables did not have a significant impact on the overall model. It is important to note that based on the results of a descriptive analysis, 54% of Chinese firms received a positive ‘intend to shift’ factor score, suggesting that the majority of firms reported at least some intention to shift away from regulated markets.

Results of the Chinese regression showed dramatic relationships between ‘intent to shift markets’ and changes to both sales and sourcing over the last five years. Chinese firms with a higher intent to shift were significantly more likely to report an increase in domestic sales over the last five years. Previous descriptive analyses show that firms which supported the statement ‘I intend to sell more products domestically because of timber legality regulations’ were significantly more likely to have increased or maintained sales to the domestic market. Together these findings suggest that Chinese firms which show a high ‘intent to shift’ score have already begun to shift towards the domestic market and will likely further strengthen their focus on the Chinese market in coming years.

Not only have Chinese firms which reported an intent to shift shown a transition towards the domestic market, respondents also demonstrated major changes to their source markets for raw materials. The results of the linear regression show that firms which intend to shift are significantly more likely to have increased sourcing from both the U.S. and Russia. This result is somewhat surprising as the U.S. represents a highly regulated market for raw materials (Seneca Creek Associates 2004), while recent investigations have shown Russia to be a major supplier of illegally harvested wood products (EIA 2013b). These mixed results suggest that while firms are choosing to shift sales away from regulated markets, this decision may have only limited impacts on source markets for raw materials. Instead, these increases in sourcing may come largely as a result of the incredible growth of the Chinese wood products industry over the last decade. In the last ten years, Chinese imports of wood raw materials have grown considerably from \$6.3 billion in 2004 to \$18.1 billion in 2013, an increase of 188% (GTIS 2014). Thus, the results of the regression analysis suggest that firms which intend to shift sales are less concerned about the legality of the raw materials they source and instead are more interested in obtaining a high volume of temperate and softwood species which are produced in the U.S. and Russia, and these source countries’ level of regulation may be a minor concern.

While Chinese firms with a high ‘intent to shift’ increased sourcing from temperate regions, the regression analysis showed these same firms were significantly less likely to have increased sourcing from Southeast Asia. As noted before, firms which demonstrated the highest intent to shift scores were largely comprised of furniture firms and the smallest flooring manufacturers, while those firms with the lowest intent to shift scores were made up of larger flooring firms. Previous analyses of firm responses showed that Chinese flooring manufacturers were significantly more likely to have increased sourcing from Southeast Asia ($F(1,260)=15.80, p <.001$) and that these flooring firms showed significantly higher awareness of the U.S. Lacey Act and a lower proportion of domestic sales.

Together these findings indicate that flooring manufacturers, which source from Southeast Asia, have a distinct export focus and greater awareness of timber legality regulations. These firms report both a higher use of certification and a lower intention to shift away from regulated markets. On the other hand, Chinese firms with a domestic market focus are generally comprised of furniture firms and small enterprises. These firms use less certified wood and while they are increasing sourcing from across temperate regions, these firms are increasingly directing their sales towards the domestic market and report a distinct intention to further shift away from regulated markets.

Results of Vietnamese Regression Model

The results of the Vietnamese linear regression model are dramatically different from those of the Chinese. To start with, descriptive analysis of the results show that only 17% of Vietnamese firms received a positive ‘intend to shift’ factor score, as compared to 54% with the Chinese. Another marked difference between the two models is that there are relatively few independent variables which significantly impact firms’ intent to alter sales markets. Of the firm characteristics included in the model, only familiarity with the U.S. Lacey Act was significant, with firms which intended to shift showing a significantly lower level of familiarity with the Lacey Act. The lack of significance of this predictor in the Chinese model is notable and suggests the higher relative influence of the U.S. market and its regulations on the Vietnamese market.

Vietnamese firms which reported an intent to shift from regulated markets were significantly more likely to decrease sales to the United States. Earlier analyses of the survey results showed that Vietnamese firms which were moderately or highly aware of the Lacey Act and EUTR were much more likely to source from the U.S. while firms which were unaware of these policies were significantly more likely to respond that they don’t source from the United States. This awareness of regulation is largely tied to firm size, with larger firms demonstrating increased sales to the U.S. and significantly higher awareness of the Lacey Act while small firms decreased U.S. sales and reported significantly lower awareness of the Lacey Act

While the Chinese regression results showed strong relationships between intent to shift and changes to sales and sourcing, this was not the case with Vietnamese firms. Although Vietnamese firms which intend to shift are showing active decreases in sales to the U.S. these firms are not demonstrating changes to sourcing in the same manner as Chinese firms. While Chinese firms reported major changes to sourcing from the U.S., Russia and Southeast Asia, the regression model does not indicate any significant relationships between Vietnamese intent to shift and source changes. This may come as a result of the relative maturity of the Chinese market which has been a

longstanding leader in the global wood products market and thus may have greater flexibility in sourcing raw materials. Vietnam on the other hand has only recently begun to increase its market share and as an emerging market for wood products Vietnamese firms may have limited ability to rapidly change their sources for raw materials.

Discussion

The results of the analysis show substantial differences between Chinese and Vietnamese firms regarding their intent to shift away from regulated markets and the factors driving this decision. The most notable difference is the significantly larger proportion of Chinese firms which reported an intent to shift markets. While only 17% of Vietnamese firms reported such an intention, more than half of Chinese firms gave at least some indication that they would reduce sales to regulated markets and increase sales to unregulated markets, particularly the domestic market. This ‘intent to shift’ also manifests itself in different ways across the two countries. Chinese firms do not report a withdrawal from regulated markets, but rather display a distinct shift in sales towards the rapidly expanding Chinese domestic market for wood products. The smaller subset of Vietnamese firms which indicated an intent to shift markets showed a marked reduction in sales to regulated markets, pulling back sales from the United States. Interestingly, the Chinese displayed major shifts not only to their sales markets, but also reported dramatic changes across source markets, changes which were not evident in the emerging Vietnamese market.

Another distinct difference between the two countries relates to the composition of firms which displayed a high intent to shift. Results from the Chinese respondents showed a distinct divide across business types, with Chinese furniture firms displaying a significantly higher intent to shift. The same relationship is not present across Vietnamese business types. Taking this into consideration along with the large percent of Chinese firms indicating an intent to shift away from regulated markets, it becomes clear that Chinese firms are segmenting into two distinct groups, one with a domestic focus and the other with an export market focus. The domestic focused group is largely composed of furniture firms and firms with smaller sales revenue and along with a high intent to shift score, this group reported increasing domestic sales, lower use of certification, low awareness of regulations and increased sourcing from temperate regions regardless of regulation. The export focused group on the other hand is mainly comprised of larger flooring manufacturers which have decreased domestic sales, increased sourcing from Southeast Asia and decreased sourcing from Russia. These firms report a low intent to shift as well as higher use of FSC certification and higher awareness of the U.S. Lacey Act.

While Chinese firms’ intent to shift markets is largely defined by business type, the decision to shift markets by Vietnamese firms is more closely aligned with firm size. Vietnamese firms show distinct differences in the percent of sales derived from the domestic market across levels of annual sales. Smaller firms report an average of 63% of sales from domestic markets, significantly higher than larger firms which report major reductions in domestic sales as annual revenue increases (**see Figure 40**). This split in the Vietnamese market, while less extreme than that of the Chinese, does evidence significant impacts on sales to regulated markets and awareness of regulations. Smaller firms are more likely to report an intent to shift markets, have actively begun to decrease sales to the United States and are significantly less aware of the Lacey Act. Larger firms on the other hand are more aware of the Lacey Act and are significantly more likely to have increased sales to the U.S. over the last five years.

The segmenting of the Chinese market and to a lesser extent the Vietnamese market suggest that there may be a redistribution of wood products taking place among processing countries, with legal wood products being sold to regulated markets and suspect products diverted towards domestic consumption. This finding supports the idea that regulatory leakage may be taking place, wherein sales of wood products from suspicious sources are shifting towards unregulated markets which are experiencing rapid increases in demand for wood products. While major consumer countries may reduce their consumption of suspicious wood products, increased consumption in unregulated markets offset this reduction in demand, resulting in a decrease in the overall impact of timber legality regulations. This pattern of leakage is troubling as it allows illegally harvested wood to maintain its position within the global wood products supply chain and, with the increasing purchasing power of countries which are less concerned about timber legality, it is possible that overall consumption of illegal timber may rise in spite of timber legality regulations.

Multivariate Analysis to Identify Broad Trends

The preceding analyses in this study employed regression models to test the effects of experimental factors on individual dependent variables. While these methods are effective at determining the impacts of a set of independent variables on target dependent variables, these techniques emphasize one dependent variable and can ignore interrelations between variables which may obscure patterns in the dataset. The survey results highlight a number of complex interactions between firm characteristics and behavior and with such interdependencies in the data it is challenging to use regression analysis to evaluate how the variables relate to one another. Therefore, a series of multivariate analyses were used in an exploratory analysis to evaluate how variables interact, extracting major trends in the data and highlighting the drivers behind patterns of firm behavior.

In order to address the large heterogeneity of the survey results, this analysis first addresses whether any natural groupings occur in the data set with regard to firms' attitudes towards timber legality regulations. In order to perform this evaluation, a cluster analysis was used, taking the varied results from the survey population and dividing the data into more homogenous subsets of firms. The goal of this cluster analysis was to divide the data into smaller groups, categorizing firms in order to identify their membership or non-membership across a number of clusters. The end result is that firms within each grouping are relatively similar while firms in different groups are relatively dissimilar (Lattin 2003). The results of the cluster analysis were then compared against perceptions and demographic variables in order to describe the make-up of each cluster.

While the regression and factor analyses focus on patterns of association and correlation among variables, the multivariate analyses in this section focus on patterns of similarities among firms. Multidimensional scaling (MDS) was used to obtain spatial representations of the similarities of firms in the data set. This technique allows for assessment of the relative proximity between each pair of firms, which is used to create a map of firms across a multi-dimensional space. Mapping firm location allows for visual assessment of firm groupings while mapping the component variables which define firms' position in the space allows for the identification of firms' relationships to the original descriptor variables.

Multidimensional scaling is well suited for variables which are metric, where there is a linear association along the scale of responses. However, a number of the variables included in the study are non-metric, particularly questions regarding sales and sourcing, which included response options such as whether firms increased, remained the same, decreased or did not source/sell to a set of regions. Because we cannot assume the distance between firms that do sell and those which do not, this analysis employs Non-Metric Multidimensional Scaling (NMDS) which uses a rank order of distances rather than the distance values themselves (Kruskal and Wish 1978). This method develops a graphical representation of the firms where relative differences instead of absolute differences are emphasized, avoiding the assumption of linear relationships among variables. The results of the NMDS were not just used to develop a spatial representation of the data, but were further analyzed using Analysis of Similarity (ANOSIM) in order to determine if there are statistically significant differences between specific demographic groups. This allows for investigation of the key issues this study seeks to address, specifically whether firm characteristics differ significantly between Chinese and Vietnamese firms and how firm characteristics are impacted by firm size.

Data Structure

The wide variety of variable types in the survey is well suited for inclusion in a multivariate analysis. However, it is critical to only include those variables where there is a prior reason to believe they would strongly influence overall firm behavior, so as to avoid obscuring patterns and limit issues of multi-collinearity. Based on the preliminary analyses, a subset of variables was selected to be included in the multivariate analysis (**Table 19**). The selected variables included demographic questions relating to firms' business type and annual sales revenue as well as discrete data on the number of full time workers employed by each firm.

Table 19. Coding for variables included in multivariate analysis.

Variables	Type	Coding
Demographic Variables		
Business Types : Furniture, Flooring & Import/Exporter	Binary	0 = Did not report this business type 1 = Firm reported this business type
Annual Sales Revenue	Categorical	6 categories: ranging from <\$1.5M to >\$32.5M
Number of Full Time Workers	Continuous	Range of numbers: 0 to 7200
Supply Chain Variables		
Percent Tropical Hardwoods, % CoC Certified	Percent	% = Ranging from 0% to 100%
Obtained FSC, Obtained PEFC	Binary	0 = Have not obtained, 1 = Have obtained this cert.
Percent Sales: Domestic, Indirect Exp., Direct Exp.	Percent	% = Ranging from 0% to 100%
Sales To Top 8 Markets	Binary	0 = Do not sell/source from this region
Source From Top 8 Markets		1 = Do sell/source from this region
Perception Variables		
Questions regarding timber legality regulations:		Questions Specific to the U.S. Lacey Act
<ul style="list-style-type: none"> • Legality regulations are effective at reducing illegal timber • I intend to increase exports to countries without regulations • Timber legality regulations cause timber prices to increase • Timber legality regulations increase the cost of exporting • I intend to decrease exports to countries without regulations • I will increase use of certified wood to comply with regs • Timber legality regs area a trade barrier • I intend to sell more products domestically due to regulations 		<ul style="list-style-type: none"> • I acquired certification to comply with the Lacey Act • I will source more from the U.S. to comply with Lacey Act • I will reduce exports to the U.S. due to the Lacey Act • The Lacey Act made me careful about sourcing timber • It is easy to comply with the Lacey Act
		Binary Variables 0 = Disagree, 1 = Agree with Statement
Awareness Variables		
Awareness of U.S. Lacey Act, EU Timber Reg. Japanese Goho-Wood, Australian ILPA	Binary	0 = Not Aware 1 = Aware of regulation

The analysis also included a series of questions relating to firms' supply chains which included questions regarding the percent of products containing tropical hardwoods, what percent of products had Chain-of-Custody (CoC) certification and a follow-up categorical question to determine which certifications the firm had obtained. The analysis also included the percent of firm's sales revenue which was derived from their domestic market and the percent derived from direct or indirect exports. The variables selected also include a series of categorical questions asking firms what countries they source their materials from and to which countries they sell their products. This series of questions included a list of the top eight source and sales markets for China and Vietnam. Firms were asked a series of eight Agree/Disagree questions designed to gauge their attitudes and perceptions towards

timber legality regulations in general. This was followed by a series of five Agree/Disagree questions specific to the U.S. Lacey Act. Finally firms were asked to indicate their level of familiarity with the four main timber legality regulations to determine whether or not they were aware of the U.S. Lacey Act, EUTR, Japanese Goho-wood or Australian ILPA regulations.

Statistical Analyses

The data was consolidated into a matrix wherein the objects were individual firms and the descriptors were the variables described earlier in the data structure section. Multivariate analysis of the data set was performed using R Statistical Software (R Core Team 2015). As the first objective of this study was to determine the groupings of firms with regards to their attitudes and perceptions, an agglomerative hierarchical cluster analysis was run on firms' perceptions towards regulations using the Ward's minimum variance method (McCune and Grace 2002). Ward's method is aimed developing compact clusters by combining groups whose merger leads to the smallest within-cluster sum of squares (Lattin 2003). The analysis was based on a squared Euclidean distance matrix containing the subset of questions related to perceptions. Using a squared Euclidean distance increases the importance of large distances while weakening the importance of objects which are closer together. Used with Ward's method, this space-conserving strategy minimizes total within-cluster variance and creates clusters of small size. The number of clusters to select was determined through a combination of scree plot and index-based assessment (Milligan and Cooper 1985). The results of the hierarchical cluster analysis were then compared against perceptions and demographic variables in order to characterize the make-up of each cluster and describe their relative positions in support or opposition of timber legality regulations.

Nonmetric Multidimensional Scaling (NMDS) was used to assess the impact of demographic variables on firms' perceptions (Legendre and Legendre 1998). The mixed nature of the study's variables as well as the large amount of missing data present in the dataset was a significant factor in the determination to use this method. NMDS is a flexible method which can be used with any distance matrix and avoids the assumption of linear relationships among variables. This method supports the use of Gower's similarity coefficient which allows for the use of objects that contain missing information. An additional benefit of using NMDS is that this method uses the rank order of distances, rather than the distances themselves and as such the assumption of linearity is relaxed, which is ideal with mixed variables (Digby and Kempton 1987). NMDS is accomplished by iteratively repositioning the objects in a multidimensional ordination space until they represent, as closely as possible the ranked dissimilarity relations between objects depicted in the distance matrix. The algorithm attempts to minimize stress, which is a measure of the degree to which the ranked ordination differs from multivariate space distances. If stress is high, the algorithm repositions points in ordination space in the direction of decreasing stress and repeats until the stress is below a certain threshold. Generally, stress under 0.05 is an excellent representation of reduced dimensions, however any stress less than 0.3 is considered acceptable (Lattin 2003).

Based on the results of the NMDS, vectors were computed based on a linear regression between perception and awareness variables and NMDS scores. These vectors were then overlaid over a plot of NMDS points representing each individual firm, allowing for visual interpretation of the differences between firms as well as the major drivers of perceptions towards timber legality regulations. Confidence ellipses were plotted in order to aid interpretation. These ellipses represent

95% confidence intervals around the centroids of specific categories of responses and can be used to visually depict firm location, size and business type across ordination space.

Finally, an analysis of similarity (ANOSIM) was carried out in order to evaluate whether there exist statistically significant differences between specific demographic groups. ANOSIM is a procedure for testing the hypothesis of no difference between two or more groups of objects. The method compares the ranks of distances between one group against ranks of distances within another group, comparing means of these two ranks. The resulting R test statistic measures whether separation of community structure is found ($R=1$) or whether no separation occurs ($R=0$). R values greater than 0.75 are considered well separated, above 0.5 are considered separated but overlapping and R less than 0.25 are considered barely separable (Clarke and Gorley 2005). This method is a non-parametric technique which can be used with any distance measure and, as it is based on rank similarity, it is commonly used in combination with NMDS (Clarke 1993). ANOSIM was conducted using a Gower's dissimilarity matrix and was calculated to determine whether there exists a significant difference between Chinese and Vietnamese firms using a one-way ANOSIM, between firms across six sales revenue categories using pairwise ANOSIMs, as well as between the results of the cluster analysis using pairwise ANOSIMs. The results of the ANOSIM were then compared with the NMDS ordinations and perception and awareness vectors, allowing for visual interpretation of the drivers of group dissimilarity.

Model Results

Cluster Analysis

The results of the hierarchical cluster analysis show distinct groupings in firms' perceptions regarding timber legality regulations. Based on a visual assessment of the cluster dendrogram (see **Figure 78**) it was challenging to determine what number of clusters to select for further analysis. The dendrogram displays the process of combining firms to minimize variance and the 'Height' on the y-axis refers to the cophenetic distance between clusters. So the greater the height when clusters are combined, the more dissimilarity there exists between the clusters. Therefore, the dendrogram shows that either two, three or four strong groupings exist within the dataset requiring further evaluation to choose the appropriate number of clusters. The results of a scree plot indicate that the amount of dissimilarity declines after four clusters, which was confirmed using an index-based assessment (Milligan and Cooper 1985) which selected four groupings as the 'optimal' number of clusters. Based on these results, a four cluster solution was selected for further analyses.

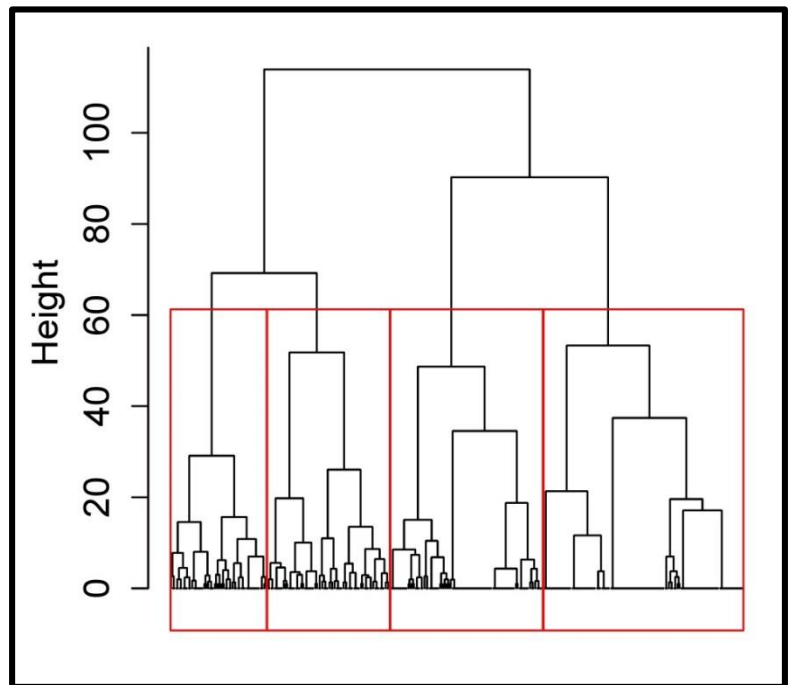


Figure 78. Hierarchical cluster dendrogram with four optimal clusters highlighted.

The cluster results were then compared against the study data in order to describe cluster membership. Results were assessed to evaluate the univariate differences between clusters based on the perception and awareness variables used to cluster the samples as well as against extrinsic demographic variables not used in the clustering. A Chi-Square test was used in this assessment to determine whether the observed frequencies for the clusters were dependent on the comparison perceptual and demographic variables. This tests to see if there are large discrepancies between the observed and expected cluster frequencies, allowing us to determine whether cluster membership affects the probability of how a member firm will respond to specific comparison questions (Larson and Farber 2012). As **Figure 79** shows, the four clusters developed by the hierarchical cluster analysis differ significantly with regards to perceptions of timber legality regulations. Across all of the perceptual categories, the responses by firms in Cluster 1 tend to be supportive of timber legality regulations, whereas Cluster 2 shows the opposite reaction, with the majority of firms' responses displaying a negative attitude towards regulations. Clusters 3 and 4 fall somewhere in between Clusters 1 and 2 and are difficult to distinguish. Comparing clusters' responses to demographic questions, the only significant result was with regard to the firm's location. Clusters 1 and 3 tended to have a higher proportion of Vietnamese firms whereas firms in Clusters 2 and 4 were more likely to be located in China. Descriptions of cluster membership based on their differences in proportions of responses are included in **Table 20**.

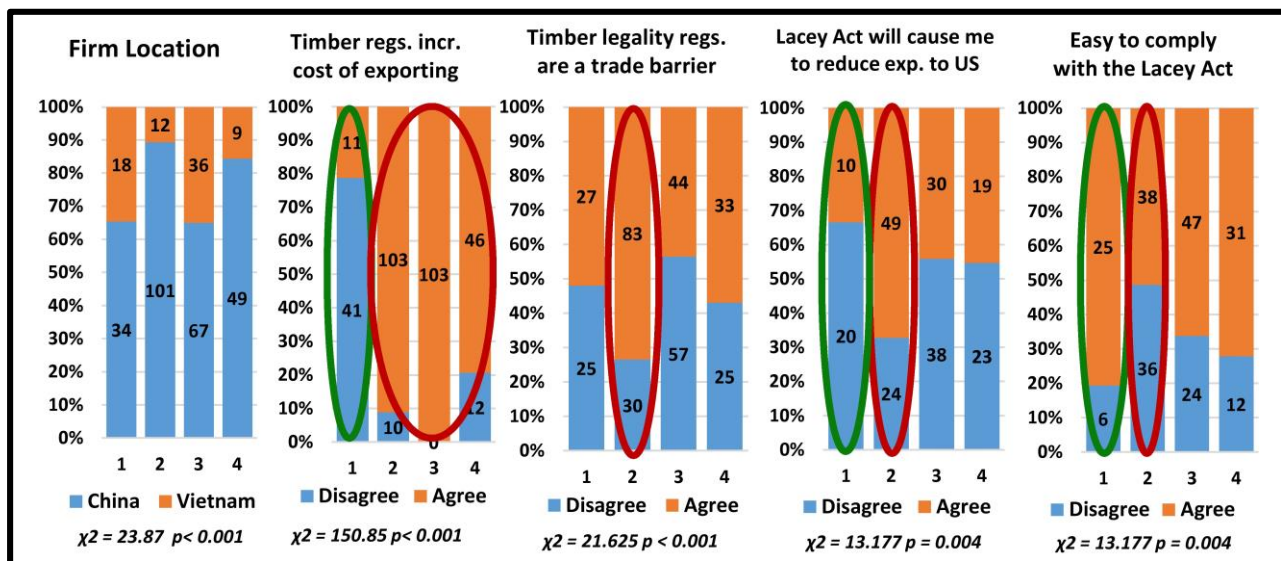


Figure 79. Comparison of cluster responses to perceptual and demographic questions. Green circles indicate positive attitudes towards timber legality regulations while red circles indicate negative perceptions.

	Country	Attitude on Regulations
Cluster 1	Vietnam	Supportive
Cluster 2	China	Opposed
Cluster 3	Vietnam	Mixed
Cluster 4	China	Mixed

Table 20. Cluster descriptions based on the relative differences in proportions of responses.

Nonmetric Multidimensional Scaling (NMDS)

NMDS ordination of the overall dataset resulted in a 2-dimensional stress value of 0.27, which is relatively high, as stress values at or below 0.30 are considered necessary to achieve an acceptable representation of the data (McCune and Grace 2002). A three dimensional NMDS results in a lower stress of 0.209, however arguments have been made that NMDS solutions in two dimensions are preferable as they are more readily interpretable (Shepard 1974). Assessment was made of a scree plot of stress vs. dimensions which indicated that the reduction of stress from additional dimensions diminishes after two dimensions. A Monte Carlo randomization test of the final stress value was conducted which resulted in a calculated p-value of less than 0.001 and a plot of the relationship between original dissimilarities and the distances in the ordination resulted in an R^2 of 0.92. As such, the two dimensional NMDS ordination will be used for the remainder of this analysis.

Based on the results of the NMDS, vectors were computed based on a linear regression between perception and awareness variables and NMDS scores. These vectors were then overlaid over a plot of NMDS points representing each firm, allowing for visual interpretation of the differences between firms as well as the major drivers of perceptions towards timber legality regulations. The vector map was computed for all of the component variables using the same distance matrix, however due to the complexity of a combined plot, the vectors were split into separate plots of perception vectors and awareness vectors. ‘Ghost lines’ are included in the vector map figures to depict where the other variables are placed in NMDS space. Vectors are interpreted based on their position relative to other vectors, so variables with an acute angle are more similar and those which are less similar have a wider angle. Thus interpretation of the NMDS dimensions are based more on a subjective assessment of the characteristics possessed by the vectors and such assessments rely on the knowledge of the analyst regarding the characteristics of the objects in the map (Lattin 2003).

The vector plot of firms’ awareness of timber legality regulations shows a clear separation between firms which are aware of regulations and those which are unaware (**Figure 80**). Vectors for awareness of the U.S. Lacey Act, EU Timber Regulation and Australian ILPA are grouped together in the second quadrant. Similarly, responses that firms were unaware of the three regulations share an acute angle and are grouped in the fourth quadrant. There is a wide obtuse angle between ‘aware’ and ‘unaware’ vectors which suggests that level of awareness is a strong driver of firm locations in the ordination space. The vectors related to awareness of the U.S. Lacey Act are closest in proximity to the first NMDS axis, revealing that these variables have a stronger relationship to NMDS 1, which generally describes firms’ level of awareness.

The vector plot of firms’ responses to the perceptual questions shows a separation along the second NMDS axis between firms who responded positively and those who responded negatively to questions related to timber legality regulations (**Figure 81**). Vectors for responses which oppose an intention to shift away from regulated markets and towards unregulated markets and which support pro-regulation statements are closely grouped in quadrant two. Vectors which express an intent to shift markets and support anti-regulation statements were closely grouped in quadrant three. Looking more closely at the vectors and their position relative to the axes, it is clear that variables relating to firms’ intent to shift markets are closest in proximity to the second NMDS axis, while ease of compliance and whether firms are careful about sourcing are more weakly related to NMDS 2, an axis which generally describes firms level of support for timber legality regulations.

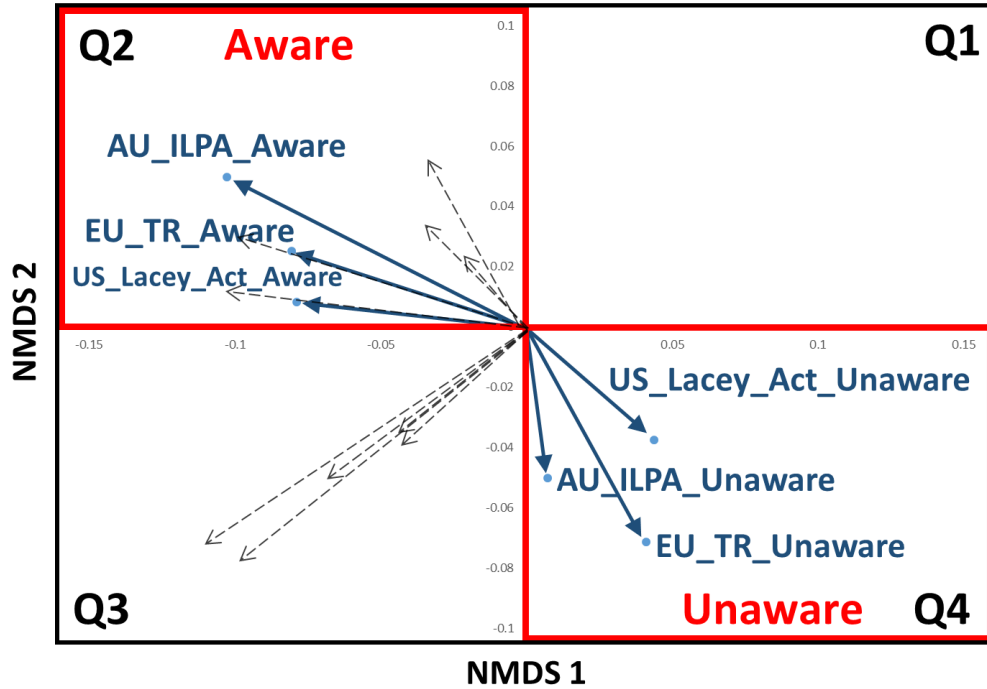


Figure 80. Vector plot of firms' awareness of timber legality regulations. Vectors for 'aware' responses are found in quadrant two while firms 'unaware' responses are located in quadrant four. The 1st NMDS axis shows a distinct separation particularly for the U.S. Lacey Act and describes firms' level of awareness. All vectors have a p-value < 0.001.

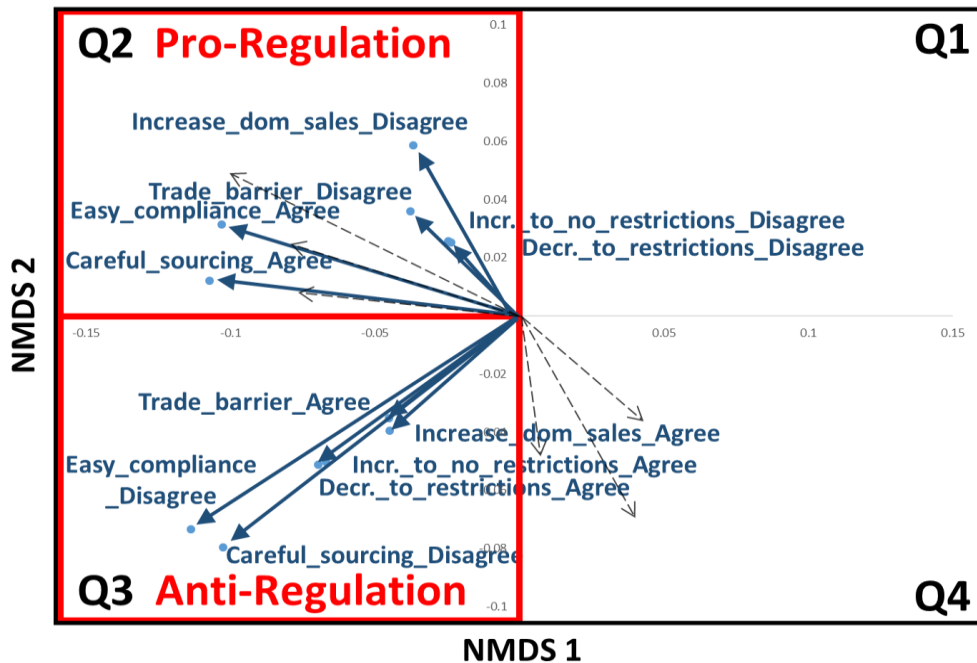


Figure 81. Vector plot of firms' responses to perceptual questions. Vectors for pro-regulation responses are located in quadrant two while anti-regulation vectors are located in quadrant three. The 2nd NMDS describes support for regulations, particularly statements regarding an intention to shift markets. All vectors have a p-value < 0.001.

Based on the results of this assessment the first NMDS axis will be defined as describing awareness of regulations, particularly awareness of the Lacey Act which is closest in proximity. The second axis will be defined as describing firms' support of regulations, and most strongly describes firms' intention to shift markets which are closest in proximity to NMDS 2. The descriptors defined for each of the four quadrants are depicted in **Figure 82**.

The descriptors 'Aware' and 'Unaware' which were selected to define the horizontal axis are relatively straightforward and refer to responses to the binary variables regarding awareness of the U.S. Lacey Act, EU Timber Regulation and Australian Illegal Logging Prohibition Act. The 'Aware' descriptor refers to firms which responded that they were aware of these policies, while the 'Unaware' descriptor refers to firms which responded that they were not aware of these policies.

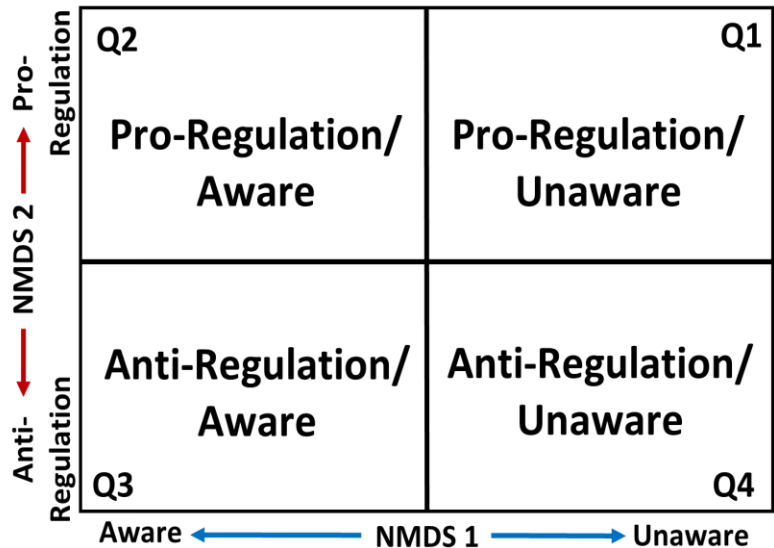


Figure 82. NMDS quadrant descriptors.

However, the pro and anti-regulation descriptors are somewhat more complex and require further explanation. These descriptors refer to firms' responses to perception questions and the descriptor was chosen to define the vertical axis because there tended to be a grouping of firms which supported regulations and a group of firms which opposed the regulation across the NMDS space. The 'Pro-regulation' descriptor refers to firms which believed that 'it is easy to comply with the Lacey Act' and 'the Lacey Act has made me more careful about sourcing' but at the same time disagreed with the statements that 'timber legality regulations are a trade barrier designed to protect foreign manufacturers.' In addition, these pro-regulation firms did not support statements expressing an intent to shift away from regulated markets and towards unregulated or domestic sales markets. The 'Anti-Regulation' descriptor refers to responses which were the opposite of the 'Pro-Regulation' group. These firms perceived that timber legality regulations are a trade barrier, compliance with the Lacey Act is not easy and has not made them careful about sourcing, and intend to shift away from regulated markets and towards domestic and unregulated markets.

Visual assessment of NMDS ordination plots suggest that firms' geographic location is a major factor driving the distance between samples. The ordination plot distinguishing firms by location shows a clear distinction between Chinese and Vietnamese firms with a distinct separation along the first NMDS axis (see **Figure 83**). Firms tend to have a closer proximity to others in their country, while there is wide separation between Chinese and Vietnamese firms in ordination space. Chinese firms were significantly more likely to be located in quadrants two and three, which are defined as 'aware' while Vietnamese firms were significantly more likely to be located on the 'unaware' side in quadrants one and four ($\chi^2 = 104.98, d.f. = 3, p < 0.001$). The centroid for Vietnamese respondents is

located in quadrant one, indicating that on average Vietnamese firms are supportive of regulations while generally being less aware of regulations.

The 95% confidence ellipse for the centroid of Vietnamese responses is tightly grouped, showing less variability in terms of perception and awareness. Chinese firms are more widely dispersed, however only Chinese firms are located in quadrant three, which is where the Chinese centroid is located. This indicates that on average Chinese firms are aware of regulations but tend to hold an anti-regulatory position. It is noteworthy that although the Chinese firms are strongly grouped in quadrant three, there is a large proportion of Chinese firms located in quadrants two and four, suggesting wider diversity of responses among Chinese firms. A one-way ANOSIM of firms' geographic location compared average rankings across Chinese and Vietnamese companies to determine if these groups were significantly different. The results of the ANOSIM gave a significance of $p < 0.001$ which supports the hypothesis that the mean of Chinese and Vietnamese responses differ significantly across the variables. Visual interpretation of confidence ellipses representing 95% confidence intervals of the centroid reveal that although there is a difference in means there is overlap between Chinese and Vietnamese firms.

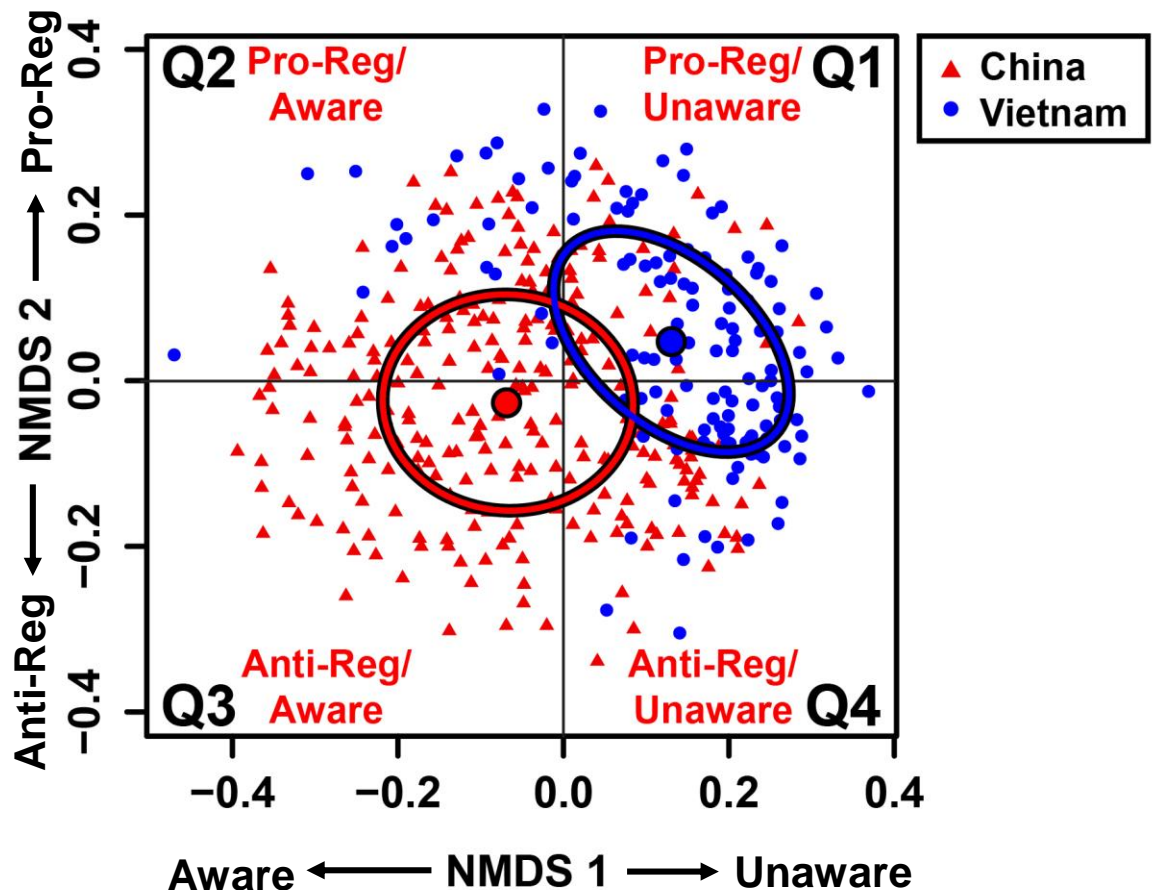


Figure 83. NMDS ordination of overall firm responses plotted by firm location. Note the Vietnamese centroid's location in quadrant one suggesting lower awareness with greater support for regulation while the Chinese firms on average are located in quadrant three, indicating higher awareness but less support for regulations.

An ordination plot of firms' location is included in **Figure 84** which depicts the percent of sales revenue firms derive from the domestic market in correspondingly sized circles. The ordination plot shows a distinct clustering of firms with a high percentage of domestic sales in the fourth quadrant. However, in quadrant two firms derive a distinctly lower percent of their revenue from the domestic market and are more export oriented. This clustering of firms suggests that firms' relative position on the ordination space, and thus their overall survey responses are strongly driven by domestic sales focus. A comparison of mean responses across quadrants reveals that firms in quadrants three and four have a significantly higher mean percent of sales from the domestic market than firms in quadrants one and two ($F(3,375)=156.1, p<.001$). This suggests that a firms' level of domestic focus has a strong impact along the second NMDS axis and directly impacts firms' support of regulations. Thus firms which have an international focus are more supportive of regulations while firms with a domestic focus hold a more anti-regulation stance. Comparing this to the previous plot of firm location, we can see that there is a relatively even proportion of Chinese and Vietnamese firms in the same area of ordination space, indicating that this pattern is present for respondents from both countries.

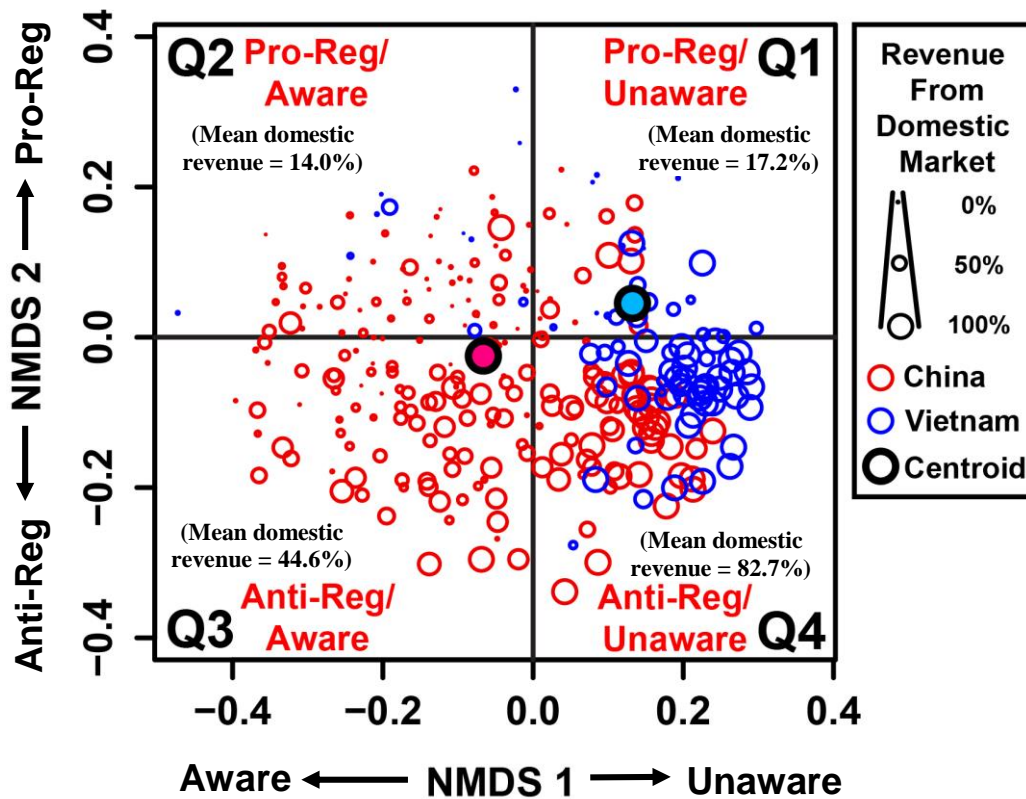


Figure 84. NMDS ordination of firm responses and percent sales revenue from domestic market. Note the clustering of domestic focused firms in the fourth quadrant, indicating that firms with a domestic focus are less aware of regulations and hold a more anti-regulation stance.

An interesting pattern appears when firm revenues are plotted across the ordination space using 95% confidence ellipses of revenue category centroids (**Figure 85**). There is a distinct progression from the bottom right to the top left, with the smallest firms located in the fourth quadrant and a progression moving up and left as firm size increases, with the largest firms located in the second quadrant. Comparison of the sales revenue ellipses against the NMDS vectors shows that smaller firms

are significantly more likely to be located in quadrant four and have a lower awareness of policies and have an anti-regulation stance ($\chi^2 = 69.97, d.f. = 15, p < 0.001$). The largest firms tend to be more aware of timber legality policies while having an overall positive attitude towards regulations. Comparing this against the earlier analysis of the proportion of sales from the domestic market, it becomes clear that smaller firms tend to have a domestic focus, and that as firm size increases there is an increased focus on international markets. Together firm size and the level of domestic focus drive firms' perceptions and awareness, with larger and more international firms showing the highest levels of awareness and support for regulations.

ANOSIMs were performed to assess whether there is a significant difference between the six classes of annual sales revenue, a variable which is used as a proxy for firm size. Results from the revenue ANOSIM gave a global-R of 0.22 with significance of $p < 0.001$, suggesting a significant difference exists but with quite a bit of overlap. Pairwise analyses (Table 21) showed that there were significant differences between each of the pairwise comparisons of annual sales revenue, which supports the hypothesis that firms differ significantly based on revenue size. The largest difference was found between firms with revenues less than \$1.5 million and firms with annual revenue greater than \$32.5 million. The ANOSIM R-statistic increases steadily as firm sizes diverge, and as a result there is a clear gradient in firm responses to the survey questions as size increases.

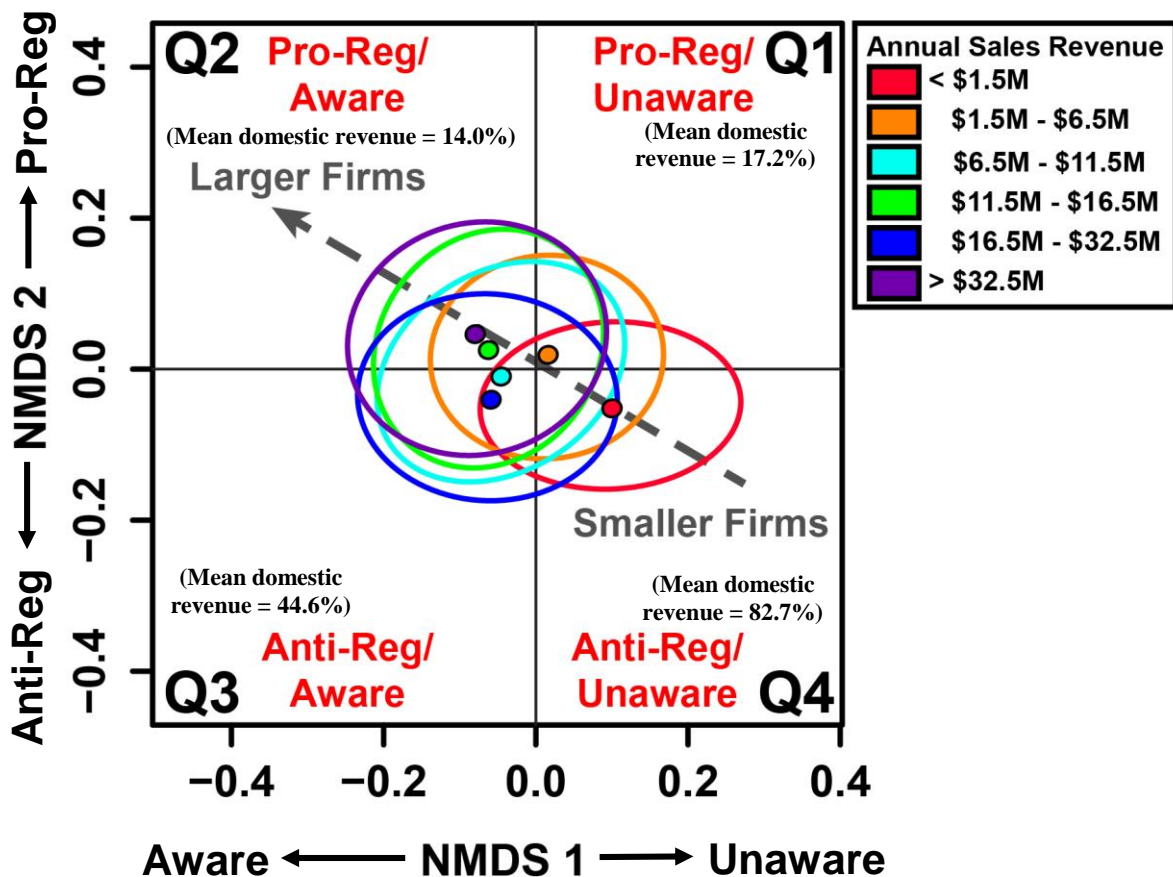


Figure 85. Plots of firms' annual sales revenue overlaid over NMDS ordination. Note that there is a distinct trend from quadrant four to quadrant two as firm revenue increases and that as size increases firms' awareness and support for regulations increases.

Annual Sales Revenue	Significance level p					
	1	2	3	4	5	6
1: Less than \$1.5 Million		<.001	<.001	<.001	<.001	<.001
2: \$1.5 - \$6.5 Million	0.18		<.001	<.001	<.001	<.001
3: \$6.5 - \$11.5 Million	0.29	0.19		<.001	<.001	<.001
4: \$11.5 - \$16.5 Million	0.35	0.22	0.15		<.001	<.001
5: \$16.5 - \$32.5 Million	0.32	0.24	0.17	0.16		<.001
6: More than \$32.5 M	0.40	0.30	0.20	0.15	0.19	
Global-R: 0.22, p < 0.001	ANOSIM-R statistic					

Table 21. ANOSIM results for pairwise comparisons of firms’ annual sales revenue. The largest separation was found to be between firms with the largest and smallest annual sales revenue.

Discussion

The results of this analysis demonstrate that firms’ awareness of policy and their attitudes towards regulations are strongly influenced by their geographic location, the amount of revenue they derive from foreign and domestic markets and their annual sales revenue. The evaluation found that firms’ perceptions towards timber legality regulations form a number of distinct groupings. The results of the cluster analysis show that there is a distinct group of Vietnamese firms which hold strong supportive attitudes and another Chinese group which strongly opposes regulations. The existence of clusters located in both China and Vietnam which have mixed attitudes towards regulation suggests that firms’ perceptions form a gradient rather than any sort of clear division.

The finding that Vietnamese firms tend to be less aware of timber legality policies while at the same time being more supportive of regulations is interesting. This may relate to the inequality in market power that exists between the Chinese and Vietnamese wood products industries. The Chinese industry is quite mature and domestic demand for wood products in China is currently experiencing rapid growth (Sun and Canby 2011). As a result, Chinese manufacturers may be less dependent on consumers in the U.S. and EU to purchase their goods. Vietnam’s wood products market is still immature and, lacking a strong domestic market for its goods, the Vietnamese wood processing industry is largely dependent on foreign markets. Less experienced Vietnamese firms may also be less informed regarding regulations than their Chinese counterparts. With a strong domestic market, more experienced Chinese manufacturers may be reluctant to comply with the legality standards of foreign purchasers. This may explain the negative attitude Chinese firms have taken in response to timber legality regulations, while Vietnamese firms with their relatively limited options when it comes to where they can sell their products are forced to take a pragmatic stance and more readily comply with the demands of foreign purchasers.

The split between firms with a domestic focus versus firms which directly export to foreign markets may have implications for the flow of illegal harvested timber worldwide. This finding supports the earlier argument that there appears to be a division in the behavior of firms which sell domestically and those who sell to foreign markets. Firms with a high percentage of domestic sales tend to be less aware of regulations and have an anti-regulatory stance, while firms which derive their revenue from direct exports are better informed and hold more positive attitudes towards regulations. When compared to firm size there is a strong relationship apparent between percentage of domestic sales and firm size, with the smallest firms tending to sell to the domestic market and larger firms

reporting a significantly more international focus. This supports the belief that as a result of recent timber legality regulations it is possible that a split has developed in the market, resulting in leakage, wherein larger and more legitimate firms sell legal products to highly regulated markets and smaller firms may have begun to sell illegally harvested wood products to unregulated local markets.

The finding that Vietnamese firms generally hold a pro-regulation stance while at the same time having relatively low level awareness of policy presents an interesting opportunity. It may be possible to build upon this supportive stance, and with outreach and education it may be possible to shift Vietnamese firms into the second quadrant, with higher awareness along with support for regulations. As larger Vietnamese firms which have higher awareness have already shown increased sourcing from the United States over the last five years, such educational outreach may present an opportunity for U.S. wood products exporters to expand demand for U.S. products within Vietnam. Increasing awareness among already supportive Vietnamese firms may be an effective method to reduce demand for illegal products within the Vietnamese supply chain.

Conclusions

Main Takeaways

- **As firm size increases, companies tend to adopt an export market focus and in turn increase their awareness of timber legality regulations and chain-of-custody usage. In contrast, smaller firms tend to focus on the domestic market, are less aware of regulations and are less likely to use chain-of-custody certification.**

The results of this research show that as annual sales revenue increases, the percent of sales that firms derive from the domestic market decreases while the percent of sales from direct exports increases (**Figure 40**). This trend is particularly significant in Vietnam and coincides with larger firms showing a higher awareness of the U.S. Lacey Act and EU Timber Regulation (**Figure 43**). Firms with higher awareness of the U.S. Lacey Act showed a higher usage of FSC chain-of-custody certification while firms which are more aware of the EU Timber Regulation are more likely to have obtained PEFC chain-of-custody certification (**Table 10 & 11**).

In addition to level of awareness, a shared driver for usage of both chain-of-custody certifications was annual sales revenue, with larger firms more likely to use CoC certified products. These larger firms are more internationally focused which may increase their incentives for obtaining FSC and PEFC chain-of-custody certification. This suggests that bigger companies may be more concerned with the issue of timber legality and may be using CoC certification to minimize risk and as a marketing mechanism to gain access to consumers in regulated markets. Once again this trend is particularly significant for Vietnamese firms (**Figure 34**) whose behavior appears to be more strongly influenced by firm size than their Chinese counterparts. One notable difference between Chinese and Vietnamese firms was that while Chinese firms showed little change in usage of PEFC across revenue levels, Vietnamese firms with lower revenue were much less likely to have obtained PEFC CoC certification (**Figure 63**). This suggests a lack of maturity in the Vietnamese market, wherein smaller firms may have limited access to information regarding timber legality which may reduce usage rates of CoC certification.

- **Export oriented firms are much more likely to use chain-of-custody certification as a mechanism to maintain or expand their relationship with consumers in regulated markets.**

The results of the logistic regression suggest that firms which are marketing their products towards regulated markets are much more likely to have obtained chain-of-custody certification. Firms which obtained PEFC CoC certification were significantly more aware of the EU Timber Regulation (**Table 11**) while firms with FSC certification showed higher awareness of the U.S. Lacey Act (**Table 10**). In addition, the results of the factor analysis show that Chinese firms which obtained FSC chain-of-custody certification were significantly less likely to express an intent to shift away from regulated markets (**Table 18**).

It appears that an evaluation of costs and benefits is taking place within processing companies, wherein firms realize that in order to sell to regulated export markets they will need to invest in their supply chain. In order to obtain chain-of-custody certification, firms must make a sizeable investment in their supply chain to implement risk management strategies and ensure the legal sourcing of their raw materials. Pursuing this option requires a large investment of time and resources. Firms which have determined that taking these steps will pay off in the long run have made the investment and are maintaining their relationships with regulated markets both to recoup their expenditure and to capitalize on these lucrative markets. However, other firms have decided that with sizeable consumer markets present in the Middle East, Southeast Asia and China which do not prioritize timber legality it is not necessary to obtain chain-of-custody certification and it may be more profitable to withhold making such an investment and redirecting their sales towards these rapidly expanding markets. Thus firms which are less aware of timber legality regulations are less likely to have obtained chain-of-custody certification and show a higher intent to shift away from regulated markets.

- **Wood processing firms are split into two groups, those which are pro-regulation and those which oppose regulations. Firms which perceive regulations to be effective tend to be larger and are focused on export markets while firms which view timber legality regulations as a trade barrier tend to be smaller, have a domestic focus and express an intention to move away from regulated markets.**

Based on the results of the factor analysis and multivariate analysis, a clear divide is present in wood processing firms' perceptions of timber legality regulations. In the pro-regulation camp we observed that firms which support the statement 'timber legality regulations are an effective way to reduce illegal logging' also tended to believe illegal logging to be a major environmental problem and were planning to increase their use of chain-of-custody certification in order to comply with regulations (**Table 13**). These pro-regulation and eco-minded firms tended to be larger (**Figure 85**), have a more international focus (**Figure 84**) and appear to be pro-actively increasing use of chain-of-custody certification to maintain or expand their relationship with consumers in regulated markets.

On the other hand, firms which agreed that 'timber legality regulations are a trade barrier designed to protect foreign manufacturers' were more likely to express an intention to decrease sales to regulated markets and an intent to increase sales to unregulated and domestic markets (**Table 13**). This anti-regulation group tends to be comprised of smaller firms with a strong domestic focus (**Figure 84 and 85**). These anti-regulation firms tend to have a high percent of domestic sales, suggesting that they have less experience with international markets and as a result it is more straightforward for them to focus on local and unregulated consumers. Expending time and energy to become aware of regulations or obtain chain-of-custody certification may be a poor investment for this group as they may not have established relationships with regulated markets. With the high amount of competition present in the Asian wood products industry such an investment may pose a financial risk to these firms and it may be simpler to ignore issues of timber legality and focus on unregulated markets.

- **The results suggest a distinct intention to shift away from regulated markets particularly among Chinese firms. This supports recent reports of leakage in the wood products supply chain which may reduce the impact of timber legality regulations and their effectiveness at reducing illegal logging.**

The respondents from China reported higher awareness of regulations (**Figure 42**) and greater use of chain-of-custody certification (**Figure 33**), characteristics which should indicate a pro-regulation position. However, Chinese firms actually showed a much more anti-regulatory stance, with over half of Chinese firms expressing an intent to shift sales away from regulated countries and towards unregulated and domestic markets (**Figure 65**). Vietnamese firms on the other hand were smaller and showed lower awareness of regulations, but only a small proportion of Vietnamese firms received a positive ‘intend to shift’ score. This ‘intention to shift’ also manifests itself in different ways across the two countries, with Chinese firms reporting an intention to shift sales towards the rapidly expanding Chinese domestic market for wood products (**Table 18**). Vietnamese firms which intended to shift did not report any notable increases to unregulated markets, but instead reported a pullback in sales from the United States.

This intention to shift among Chinese firms is likely due to the presence of the large Chinese domestic market which is becoming more affluent and increasing its demand for wood products. Vietnamese firms on the other hand have a smaller and less affluent domestic market and these companies are much more reliant on consumer markets such as the U.S., EU and Japan which capture 80% of Vietnam’s wood exports (EFI 2011). Another distinct difference between the two countries relates to the composition of firms which displayed an intent to shift. Chinese respondents showed a distinct divide across business types with 64% furniture firms displaying a significantly intent to shift. In addition Chinese firms were divided based on firm size, with 71% of firms with annual sales revenue less than \$1.5 million expressing an intent to shift away from regulated markets. Vietnamese responses were more clearly defined by firm size, as firms with annual sales revenues less than \$1.5 million reported that 63% of their sales were from the domestic market and 44% of firms indicated an intent to shift away from regulated markets.

The segmenting of the Chinese market and to a lesser extent the Vietnamese market suggests that there may be a redistribution of wood products taking place within processing countries, with legal wood products being sold to regulated markets and suspect products diverted towards domestic and unregulated markets. These results supports the idea that regulatory leakage is taking place, wherein sales of wood products from suspicious sources are shifting towards unregulated markets which are experiencing rapid increases in demand for wood products (Lawson and MacFaul 2010; Prestemon 2014; Martin and Ghazali 2015). A growing number of reports have detailed how skyrocketing Chinese demand for rare wood species is driving illegal logging in neighboring countries. These reports include evidence of Chinese firms sourcing prohibited species and smuggling logs to China from Laos (EIA 2011), Mozambique (EIA 2013a), Indonesia, Myanmar and the Russian Far East (EIA 2012). Not only is there significant evidence of Chinese firms illegally sourcing timber, but Chinese firms are actively involved in illegal harvesting in neighboring countries. A report by the Economist details the exploitation of forests claimed by indigenous residents and logging in excess permits by Chinese firms in Cambodia (The Economist 2007). More recently, a report by the Center for International Forestry Research documented the illegal harvesting and export of logs from Mozambique by Chinese timber companies (Ekman et al. 2013). Just last month the government of

Myanmar sentenced 153 Chinese nationals to life in prison after convicting them of illegal logging and violation of a log export ban (Reuters 2015).

While major consumer countries may reduce their consumption of suspicious wood products, leakage due to increased consumption within unregulated markets offsets reductions in demand for illegal wood, undermining the overall efficacy of these policies. This pattern of leakage is troubling and it may allow illegally harvested wood to maintain its position within the global wood products supply chain. As markets which are less concerned over timber legality, such as China, India and the Middle East experience increasing purchasing power, the overall consumption of illegal timber could actually rise in spite of these policies.

Short-Run Policy Implications

The results of the analysis indicate that in the short time since timber legality regulations were enacted, larger firms which have an international focus have become more aware of timber legality regulations, are more likely to have obtained chain-of-custody certification and are less likely to shift to unregulated markets. From a policy standpoint, it appears that timber legality regulations have been effective at reaching the ‘low hanging fruit’ represented by these large, export oriented firms. However, the results of this study also suggest that small and medium sized firms are less aware of regulations, have a more negative perception of these policies, are less likely to adopt chain-of-custody certification and are more likely to shift to unregulated markets. Our research suggests that these small and medium firms make up a large component of the wood processing industry and may have a significant impact on the consumption of illegal wood products. In order for timber legality regulations to be effective, illegal logging policies need to extend beyond just the largest firms and impact the business practices across firms of all sizes.

Policymakers attempting to address the behavior of small and medium sized firms will face serious challenges, particularly with regard to the Chinese market. Not only is the ‘intention to shift’ stronger among Chinese firms, but the large subset of Chinese firms focused on the growing domestic market will be less responsive to foreign regulations on timber legality. Given the strong growth in demand for wood products domestically, regardless of legality, it will be challenging to influence Chinese manufacturers through international policies. Influencing these manufacturers will likely require action by the Chinese government, either through government programs or the establishment of a Chinese timber legality policy, although neither of these options are currently being discussed widely.

Chinese survey respondents noted that their main sources for information on timber regulations were through government agencies and industry associations (see **Figure 60**). However, a recent report found that access to information was lacking for Chinese wood products manufacturers, and small firms in particular have difficulty communicating with state agencies and that industry associations are in their nascence (Xinjian and Qian 2015). While efforts have been made recently to increase the capacity of Chinese forestry agencies and trade associations, these projects are still in their early stages and with such large demand from the domestic market it may be difficult to incentivize Chinese firms to change their behavior.

While the Chinese market may present relatively few options for policymakers to impact the illegal logging supply chain in the short term, the Vietnamese market presents an interesting opportunity. The results of the multivariate analysis indicate that while Vietnamese firms are less aware of regulations they seem to be predisposed to a pro-regulation mindset (**Figure 83**). It may be possible that through outreach and education Vietnamese firms' level of awareness could be increased, shifting these firms towards a position which is both pro-regulation and highly aware. This research suggests that if Vietnamese firms could be influenced in such a manner, this would increase demand for chain-of-custody certification and potentially reduce their overall consumption of suspicious wood products.

The lack of a strong domestic market in Vietnam, as well as their strong reliance on exports to the United States may allow the Vietnamese wood products industry to be significantly impacted by foreign regulations and industry groups. The results of our analysis showed a positive correlation between firm size, familiarity with timber legality regulations, sales and sourcing of wood products from the U.S. and adoption of certification. It appears that timber legality regulations, and particularly the U.S. Lacey Act may be influencing a 'virtuous cycle' of effects within the Vietnamese wood products industry. Larger Vietnamese firms have higher awareness of timber legality regulations, have a higher rate of chain-of-custody adoption and are significantly increasing exports of wood products to the United States while taking steps to eliminate illegal products from their supply chain, in part by increasing purchases of U.S. wood raw materials.

From a strategic perspective, our results suggest that U.S. wood products exporters should be able to take advantage of this 'virtuous circle' to expand demand for their products in Vietnam. It may be possible to target export promotion activities towards larger furniture and flooring manufacturers who are already familiar with the U.S. Lacey Act. Vietnamese respondents as a whole indicated that they would be most likely to source information on timber regulations from government agencies and industry associations. This presents an opportunity to build upon current awareness by large Vietnamese firms. Working in conjunction with government agencies and establishing partnerships between U.S. forest products associations and Vietnamese industry groups it may be possible to increase Vietnamese furniture and flooring manufacturers' awareness of the U.S. Lacey Act.

However, smaller Vietnamese firms which do not sell wood products to highly regulated markets are generally unaware of timber legality regulations, are much less likely to adopt CoC certification, and are more likely to shift to less regulated markets. With smaller and less scrupulous firms continuing to use illegally harvested wood products while directing their sales to less environmentally sensitive markets such as China, it is very likely that smaller Vietnamese furniture and flooring firms will continue to exacerbate the problem of illegal logging in the Southeast Asian region and particularly within neighboring countries (e.g., Cambodia and Laos). Therefore, it is critical to specifically target this subset of firms in an effort to impact the demand for illegal timber. Firms with sales revenue less than \$1.5 million reported that they would obtain information on timber legality regulations from government and industry associations and also showed a notably higher reliance on trade publications compared to larger firms. It may be possible through a concerted campaign of education and outreach to increase the awareness of timber legality regulations among small Vietnamese firms, counteract the issue of regulatory leakage and impact the illegal logging supply chain.

Any effective partnership with Chinese and Vietnamese industry associations will require a concerted effort by U.S. government agencies, non-profit organizations and industry groups working together to increase awareness of the U.S. Lacey Act. At present, outreach by the U.S. government regarding the Lacey Act Amendment and its implications for foreign manufacturers is carried out by the U.S. Department of State, the U.S. Agency for International Development and the U.S. Forest Service International Programs. Together these agencies provide policy advice, training and technical assistance to forestry agencies and business associations in producer and processor countries. In order to raise the awareness of manufacturers and increase the impact of the Lacey Act Amendment, these agencies will need to extend their outreach programs and expand them to reach a broader audience. Such an endeavor could start small through distribution of translated brochures at tradeshows to increase manufacturers' awareness and notify firms of how they can obtain more information. Further steps could include the organization of training sessions at tradeshows and regional manufacturing hubs by USAID and USFS-International Programs staff to provide more in-depth explanations of timber legality policies and how firms can best respond to these regulations. Eventually these U.S. agencies will need to take the time to establish programs with the Chinese State Forestry Administration and the Vietnamese Ministry of Agriculture and Rural Development to better disseminate information on compliance to Chinese and Vietnamese firms.

The United States government has made significant efforts to partner with private organizations to increase the impacts and awareness of the U.S. Lacey Act Amendment. These include partnerships with a coalition of non-profit organizations which pushed for the passage of the Lacey Act Amendment and have worked to ensure its success. USAID in partnership with the World Resources Institute and the Environmental Investigations Agency developed the Forest Legality Alliance, a multi-stakeholder initiative aimed at reducing illegal logging through supporting the supply of legal forest products (EIA 2015a; WRI 2015). These efforts have increased awareness of timber legality and supported highly publicized investigations of the illegal logging supply chain.

Although strong partnerships have been made with NGOs, a major opportunity still exists for the U.S. government to partner with industry associations in order to more effectively target wood products manufacturers. Chinese and Vietnamese firms both reported that industry associations are an important source of information on regulations. USAID and the US Forest Service International Programs need to take the time to establish relationships with major Chinese and Vietnamese industry associations and work to educate association managers regarding timber legality regulations so that they can in turn advise their members on how to best comply with these policies. In China, major industry associations include the Chinese National Forest Product Industry Association, the China Timber and Wood Products Distribution Association and the Shanghai Timber Association, while in Vietnam the major trade associations include the Vietnam Timber & Forest Product Association and the Handicraft and Wood Industry Association of Ho Chi Minh City.

Anecdotal evidence from conversations at the tradeshows revealed that Chinese and Vietnamese firms largely chose to increase use of chain-of-custody certification in response to pressure from buyers in the U.S. and EU which were demanding products that had FSC or PEFC chain-of-custody certification. Further outreach by U.S. industry associations may significantly increase demand by U.S. companies for products whose supply chains are certified as a strategy to manage risk and more easily comply with regulations. In addition, industry associations such as the Softwood Export Council (SEC) and American Hardwood Export Council (AHEC) have established

relationships with international manufacturers and already have resources in place to meet with Chinese and Vietnamese manufacturers either at their international offices or at the tradeshows which they currently attend. This could take the form of informational materials, workshops, and one-on-one meetings with association representatives and the managers of major processing firms.

However, a major hurdle exists which needs to be addressed in order for these associations to take an active role in addressing timber legality. While it may be in the interest of trade associations to promote awareness of timber legality regulations, in order to boost demand for legal U.S. wood products, funding for such outreach is limited. Resources will need to be made available to fund U.S. industry associations so that they can reach out to manufacturers and establish partnerships with associations in China and Vietnam. The provision of grants by U.S. agencies would allow for U.S. industry associations to devote personnel and resources to outreach efforts which would build upon their already established networks, allowing for increased awareness and further expanding the impact of the Lacey Act throughout the wood products supply chain.

Broad Policy Recommendations

The findings of this study suggest that regulatory leakage may be occurring as a result of timber legality regulations. If the wood products market splits into regulated and unregulated markets, this will limit the efficacy of timber legality regulations and impede the aims of policymakers to reduce the practice of illegal logging worldwide. In order to address this problem, a multi-pronged approach must be taken to address the entire wood supply chain. Such an approach will require changes to current timber legality policies to increase their efficacy, the implementation of national level regulations by producer and processor countries as well as long-term support for outreach programs to educate firms throughout the wood products industry on timber legality regulations and the options available for firms to monitor and control their supply-chain.

In recent years, developed consumer markets have implemented regulations to limit the import of illegal timber. However, these regulation need to be strengthened and expanded so as to further limit demand for illegal timber while providing incentives for wood producers and processors to use certified timber. The EU Timber Regulation has led the way in establishing clear regulatory standards which are backed up by rigorous enforcement as well as a partnership system which incentivizes producer countries to reform their regulations and implement strategies to combat illegal logging. Although there have been a few problems regarding availability of licensed timber and uneven enforcement, it is expected that with time the EU TR will have a significant positive impact on the illegal logging supply chain.

The Japanese ‘Goho-wood’ policy on the other hand only affects government procurement and has done little to reduce high-risk imports of wood products since 2010 (Momii 2014a). The Japanese, who have the highest per capita use of illegal wood (Lawson and MacFaul 2010), need to take steps to expand legality regulations to cover imports of all wood products and implement programs to increase awareness of the problem of illegal timber among Japanese consumers so as to reduce demand for such products.

Considering that the Australian Illegal Logging Prohibition Act was only implemented in November 2014, it is difficult to judge if steps need to be made to strengthen the Act. However, considering the results of the trade flow analysis, Indonesia is one of Australia's largest suppliers of wood products, particularly flooring. This strong trade relationship as well as their geographic proximity presents an opportunity for the Australian government to effect changes in the Indonesian timber industry.

The U.S. Lacey Act has only been enforced against three companies which limits public awareness of the policy and reduces its impact. In order to increase the efficacy of the regulation, more funding needs to be devoted to investigation, prosecution of violators and outreach to businesses in order to increase firms' awareness of the policy and highlight the financial and reputational impacts of the Lacey Act. There are significant impediments limiting the investigation of timber legality cases which include a lack of tools for monitoring wood products at their point of entry. Training customs agents to effectively identify potentially mislabeled wood products is time consuming and costly and with limited resources it is a challenge to effectively identify wood species and their country of origin. With reduction of costs and miniaturization of genetic testing equipment it may be possible for DNA timber tests to become an effective tool in investigations of illegal logging (Reuters 2012). In addition, breakthroughs in machine vision technologies may soon be available as a field deployable tool using a wood imaging device and image analysis software to identify wood species rapidly and with greater accuracy than trained law enforcement personnel (USDA 2014). Greater investment in these technologies could result in dramatic increases in the efficacy of investigators which would play an important role in combatting illegal logging.

However, it is not enough for the U.S. to simply carry out more investigations and prosecutions. In order to increase its effect on the problem of illegal logging, the U.S. needs to take steps to build upon the Lacey Act Amendment's current achievements. In addition to penalties against non-compliant firms, the U.S. government should support improved enforcement of natural resource laws in tropical countries by providing funding for enforcement and developing the capacity for participatory forest management. In addition to technical support, the U.S. should support partnerships aimed at developing the capacity of sustainably managed forests globally so that these sustainable products can serve as a substitute for illegally harvested products and meet global demand for wood products.

The U.S. should also take steps to support the Voluntary Partnership Agreement system established by the EU. The VPA system uses collaborative partnerships to incentivize producer countries to increase their monitoring and enforcement of timber legality. Penalties for violation of a VPA agreement can include the partner country's exclusion from the European market, which places considerable pressure on producer country governments to implement reforms. Instead of the U.S. establishing its own collaborative program, which would involve a considerable investment of time and resources, the U.S. should consider accepting VPA status as a method of legality verification. At present, there are six countries which have signed VPAs with the EU and are in the processes of establishing Timber Legality Assurance Systems (TLAS) which will identify and license legally-produced timber. As the largest importer of wood products in the world, if the U.S. were to accept TLAS licensed timber as a means to verify legality, this would add considerable weight to the VPA program. This would encourage U.S. buyers to increase sourcing of wood products from VPA countries, while at the same time motivating producer countries to join the VPA program and

implement more effective forest governance. Such a move would only require minimal investment by the U.S. but could have a considerable impact on the governance of timber legality throughout the wood products supply chain.

Although expanded efforts by developed consumer markets should have some positive effects, the leakage effects suggested by this study indicate that any significant impact on the illegal logging supply chain will require major efforts on the part of developing countries. Only by shrinking markets for illegal timber across both developed and developing countries will it be feasible to shrink overall demand for illegally harvested wood. With its dual role as an expanding processor and consumer market, it is critical for China to play an active role in addressing this problem. Either on its own, or as a result of international pressure, the Chinese government must take steps to reduce the use of illegally harvested wood in the Chinese wood manufacturing sector. It is critical that the Chinese government take action to implement binding regulations and strengthen monitoring on their imports and exports of wood products. However, to push producer and processor countries to implement these reforms may require dramatic international pressure. Agreements such as the ‘Bali Declaration’ and the ‘Gleneagles Communiqué’ have previously been adopted which recognize the problem of illegal logging. The broad adoption of timber legality regulations across developed and developing countries would require a similarly high profile global accord with national signatories and such a change in global governance would require considerable political support. In addition to pushing for stricter legal controls internationally, another priority for the U.S. government should be long-term support for training and outreach to wood products manufacturers to increase awareness of legality requirements either through government programs or indirectly through partnerships with industry associations.

In order for efforts to address the problem of illegal logging to be effective, it is critical that producer countries take steps to strengthen forest governance. In recent years there have been a number of examples where direct efforts in producer countries have led to declines in illegal logging. Such efforts include awareness-raising campaigns and improved governance in Indonesia, independent monitoring and private sector initiatives in Cameroon, and improved regulations and enforcement in Brazil (Lawson and MacFaul 2010). Major consumer countries should pressure timber producer countries to implement measures to reduce illegal logging and promote sustainable forest management. Only through a concerted effort by countries along the entire timber supply chain will it be possible to meaningfully counter the problem of illegal logging and achieve long-term reductions in the sourcing of illegal timber at the global scale.

Limitations of the Analysis

It is important to note that the timber legality regulations on which this research focuses have only been effect for a short time. The Japanese ‘Goho-wood’ policy is the oldest of the regulations and is still less than 10 years old, while the European Union and Australian policies were implemented in March 2013 and November of 2014 respectively. The administration of the surveys spanned from March 2013 to March 2014, overlapping implementation of the EUTR and preceding the Australian policy. While these regulations have been in planning for several years, it is unlikely that the survey responses of the firms completely incorporate the effects of these policies, and it is highly improbable that the effects of these policies have been realized fully throughout the wood products supply chain.

Due to the difficulty in evaluating the impacts of regulations across the whole of the illegal timber supply chain, this study only focuses on a subset of the major suspicious processing countries. While China and Vietnam were selected to represent a mature and emerging market, this narrow focus may not adequately represent the diverse manufacturers across other major wood processing countries such as India, Thailand and Indonesia.

In addition, administration of the survey employed a convenience sampling method, wherein readily available members of the target population were surveyed. Trade shows were targeted so as to gain access to as many firms as possible and the specific shows were selected so as to represent a wide array of business types in the wood products industry. This methodology allows researchers to minimize the cost of travelling to individual firms and was preferred to using an online survey because electronic contact information is not readily available for Chinese and Vietnamese firms and it would be very difficult to effectively screen the target population with an online survey.

One of the main downsides of this sampling methodology is that the respondents of the survey may not adequately represent the population as a whole. It is likely that firms which attend trade shows are different from those which do not attend. Firms which attend trade shows are generally larger, more willing to invest their time participating in industry events and thus have greater access to information on timber legality. In addition, convenience sampling is a non-probability technique and thus firms make the choice whether or not to complete the survey. As such, it is possible that firms which deferred from responding may have been concerned that their supply chain included illegal products and that responding to a survey could somehow put them at risk. Therefore it is likely that this survey population is comprised of firms which are larger than the population as a whole, and have a lower level of illegal products in their supply chain. It is likely that the survey results are somewhat skewed from the actual population, and that in reality wood processors are smaller, less aware and have a less positive perception of regulations than the survey results indicate. However, the research team was aware of the biases associated with this sampling method and the responses are still considered the best available data to evaluate the study’s research questions.

Implications for Future Research

As mentioned earlier, the timber legality regulations evaluated by this study are still in their early stages. Therefore, it is challenging to evaluate the impacts of these policies before their effects have been fully realized. In order to better evaluate the effects of these policies it would be valuable to perform a similar research study after a period of five or ten years. This will give time for the EU Timber Regulation and Australian ILPA to be fully implemented and allow for any subsequent policy amendments to be made. A follow-up analysis will give firms time to respond to these regulations and adjust their business practices accordingly.

The results of this study suggest that small wood processing firms which sell to the domestic market may be the primary users of suspicious wood products and in turn may be the main drivers of illegally logging practices worldwide. As such, these small processing firms are deserving of closer scrutiny. Future research is necessary to evaluate the volume of products affected by these firms and investigate the organizations, personnel and resources involved in their supply chains. With greater information it may be possible to tailor regulations to target these groups and apply pressure to influence their business practices and thus mitigate their impacts.

This study only assesses wood product manufacturers in China and Vietnam, and a large proportion of firms were located in Shanghai, China and Ho Chi Minh, Vietnam. It would be valuable to expand this research study within China and Vietnam to gain a better representation of regional variation. In particular, it would be worthwhile to gather data from the Red River Delta in Vietnam, specifically Hanoi, as this is a regional hub in Vietnam and very few of the current study's respondents were located in this region. Also, as clear differences were shown between Chinese and Vietnamese respondents, it is likely that other major wood processing countries such as India, Thailand and Indonesia would also show significant variation which could be targeted by further research. In addition, as Vietnam represented an emerging market for wood processing which has shown strong growth for over a decade, it might be valuable to expand the study to target even less developed wood processing markets such as Indonesia and Thailand. This would allow researchers to represent a wider diversity of processing markets, and gain more insight into the business decisions of smaller and less mature manufacturers.

Acknowledgements

I would like to thank my parents Charles Roe and Charlotte Jones-Roe and my brother Andrew L'Roe. Thank you for supporting me throughout this work. Without your love and encouragement this would not have been possible.

This study would not have been possible without the ongoing support of Dr. Ivan Eastin and Dr. Indroneil Ganguly at the Center for International Trade in Forest Resources (CINTRAFOR). Your advice and guidance has been incredible over the last three years and I owe you both my sincere gratitude. I would also like to thank Dr. David Layton at the Evans School of Public Affairs for the time and energy he devoted to me as a member of my committee.

Many thanks to Ziyi Lu and Cindy Xiaoning Chen for their assistance in administering surveys in China, as well as their help with coding the data into SPSS. I would also like to express my thanks to the entire CINTRAFOR family: Clarence Smith, Cody Sifford, Daisuke Sasatani, Tait Bowers, Francesca Pierobon, Ziyi Lu, Cindy Chen, Burdette Birdinground, and Ike Nwaneshiudu.

I would like to give special thanks to Dr. Daisuke Sasatani, who has been an incredible colleague and mentor over the last several months. His constant support and willingness to answer any and all of my questions regarding statistics, trade and economics truly made this project possible. I do not think I would have been able to complete this project without Daisuke's considerable help.

This material is based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture through the National Needs Fellowship program under award number 2012-38920-30196. We gratefully acknowledge the support of the USDA Federal State Marketing Improvement Program (FSMIP), award no. 12-25-G-1519 and the McIntire-Stennis Formula Fund, award no. 2013-32100-06092 for providing financial support to this study. We also thank the Softwood Export Council for providing international travel funding and the American Hardwood Export Council for their help with the data collection.

References

- Abdi, H. 2003. Factor Rotations in Factor Analyses. *Encycl. Res. Methods Soc. Sci.* Available online at: <http://www.utdallas.edu/~herve/Abdi-rotations-pretty.pdf>.
- Alexander, K. 2014. *The Lacey Act: Protecting the Environment by Restricting Trade*. Congressional Research Service. Available online at: <http://fas.org/sgp/crs/misc/R42067.pdf>.
- APHIS. 2009. *Facts about the Amended U.S. Lacey Act*. USDA: Animal and Plant Health Inspection Service. Available online at: www.aphis.usda.gov/publications/plant_health/content/printable_version/fs_laceyact.pdf.
- Australian Government. 2014a. *Department of Agriculture illegal logging position paper*. Australian Government, Department of Agriculture. Available online at: <http://daff.gov.au/illegallogging>.
- Australian Government. 2014b. *Due Diligence – Use of Timber Legality Frameworks*. Australian Government, Department of Agriculture. Available online at: <http://www.agriculture.gov.au/forestry/policies/illegal-logging/faqs>.
- Australian Government. 2013. *Illegal Logging Prohibition Amendment Regulation 2013*. Available online at: <http://www.comlaw.gov.au/Details/F2013L00883>.
- Australian Government. 2014c. *Illegal Logging Prohibition Regulation Amendment*. Available online at: <http://www.comlaw.gov.au/Details/F2014C01294>.
- Barber, C. V., and J. Schweithelm. 2000. *Trial by fire forest fires and forestry policy in Indonesia's era of crisis and reform*. World Resources Institute, Forest Frontiers Initiative, Washington, D.C.
- Blundell, A. G., and B. D. Rodan. 2003. Mahogany and CITES: Moving beyond the veneer of legality. *Oryx*. 37(1):85–90.
- Bosello, F., R. Parrado, and R. Rosa. 2013. The economic and environmental effects of an EU ban on illegal logging imports. Insights from a CGE assessment. *Environ. Dev. Econ.* 18(02):184–206.
- Bowers, T. 2012. Forest certification in Asia: The changing marketplace for value-added wood product manufacturers in China and Vietnam. *For. Chron.* 88(5):578–584.
- Brack, D. 2013. Combating Illegal Logging: Interaction with WTO Rules. *Chatham House Brief. Pap. Chatham House Lond.*
- Brack, D. 2002. *Controlling the International Trade in Illegally Logged Timber and Wood Products*. Royal Institute of International Affairs: Sustainable Development Programme.
- Brack, D. 2014a. *Trade in Illegal Timber: The Response in the Netherlands*. Chatham House, London, UK. Available online at: <http://www.chathamhouse.org/node/16286>.
- Brack, D. 2014b. *Trade in Illegal Timber: The Response in the United Kingdom*. Chatham House, London, UK. Available online at: <http://www.chathamhouse.org/node/16284>.
- Bridegam, P., and I. Eastin. 2014. The effects of the 2008 Lacey Act amendment on international trade in forest products. *For. Chron.* 90(5):643–650.
- Buckland, S. 1997. Model selection: An integral part of inference. *Biometrics*. 53:603–618.
- Bush, G. W. 2002. *President Announces Clear Skies & Global Climate Change Initiatives*. The White House: Office of the Press Secretary, Washington, D.C.
- CIE. 2010. *A Final Report to inform a Regulation Impact Statement for the proposed new policy on illegally logged timber*. Centre for International Economics, Canberra & Sydney, Australia.

- CIFF. 2014. *Report of the 33rd China International Furniture Fair*. China Foreign Trade Guangzhou Exhibition General Corp., Guangzhou, China.
- CITES. 2005. *CITES World: Official Newsletter of the Parties*. Convention on International Trade in Endangered Species of Wild Fauna and Flora.
- CITES. 2012. *How CITES Works*. Convention on International Trade in Endangered Species of Wild Fauna and Flora. Available online at: <http://www.cites.org/eng/disc/how.php>.
- Clarke, K., and R. Gorley. 2005. *Getting started with Plymouth Routines in Multivariate Ecological Research (PRIMER)*.
- Clarke, K. R. 1993. Non-parametric multivariate analyses of changes in community structure. *Aust. J. Ecol.* 18(1):117–143.
- ClientEarth. 2015. *EUTR Latest News: March 2015*. ClientEarth. Available online at: <http://www.clientearth.org/reports/EUTR-news-March-2015.pdf>.
- Cohen, J., and J. Cohen. 2003. *Applied multiple regression/correlation analysis for the behavioral sciences*. L. Erlbaum Associates, Mahwah, N.J.
- Contreras-Hermosilla, A. 2007. *Forest Law Enforcement and Governance Program: Review of Implementation*. The World Bank, Washington, D.C.
- van Dam, J., and H. Savenije. 2011. *Enhancing the trade of legally produced timber : a guide to initiatives*. Tropenbos International, Wageningen.
- Digby, P. G. N., and R. A. Kempton. 1987. *Multivariate Analysis of Ecological Communities*. Chapman and Hall. 224 p.
- Dillman, D. A. 2000. *Mail and internet surveys: the tailored design method*. Wiley, New York.
- EFI. 2011. *Vietnam: Overview of Forest Governance and Trade, Baseline Study 3*. European Forest Institute.
- EFI. 2015. *Voluntary Partnership Agreements*. EU FLEGT Facility: European Forest Institute. Available online at: <http://www.euflegt.efi.int/vpa>.
- EFI. 2009. *What is a Voluntary Partnership Agreement? EFI Policy Brief 3*. European Forest Institute.
- EIA. 2012. *Appetite for Destruction: China's trade in illegal timber*. Environmental Investigation Agency. Available online at: <https://eia-international.org/report/appetite-for-destruction-chinas-trade-in-illegal-timber>.
- EIA. 2011. Crossroads: The Illicit Timber Trade Between Laos and Vietnam. *Environ. Investig. Agency*.
- EIA. 2013a. *First Class Connections: Log Smuggling, Illegal Logging, and Corruption in Mozambique*. Environmental Investigation Agency. Available online at: <http://www.eia-international.org/wp-content/uploads/EIA-First-Class-Connections.pdf>.
- EIA. 2015a. *Forests for the World: U.S. Lacey Act*. Environmental Investigation Agency. Available online at: <http://eia-global.org/campaigns/forests-campaign/u.s.-lacey-act/>.
- EIA. 2013b. Liquidating the Forests: Hardwood Flooring, Organized Crime and the World's Last Siberian Tigers. *Environ. Investig. Agency*.
- EIA. 2015b. *Russian Supplier to Lumber Liquidators Convicted of Organized Crime*. Environmental Investigation Agency. Available online at: <http://eia-global.org/blog/russian-supplier-to-lumber-liquidators-convicted-of-organized-crime>.
- EIA. 2010. *Setting the Story Straight, The U.S. Lacey Act: Separating Myth from Reality*. Environmental Investigation Agency.
- EIA. 2013c. *The Open Door: Japan's Continuing Failure to Prevent Imports of Illegal Russian Timber*. Environmental Investigation Agency.

- EIA, and Telepak. 2008. *Borderlines: Vietnam's Booming Furniture Industry and Timber Smuggling in the Mekong Region*. *Environ. Investig. Agency Telepak*.
- Ekman, S., H. Wenbin, and E. Langa. 2013. *Chinese trade and investment in the Mozambican timber industry*. Center for International Forestry Research. Available online at: http://www.cifor.org/publications/pdf_files/WPapers/WP122Ekman.pdf.
- Elias, P. 2012. *Logging and the Law: How the U.S. Lacey Act Helps Reduce Illegal Logging in the Tropics*. Union of Concerned Scientists.
- ETTF. 2015. *Belgian Competent Authority releases Brazilian ipe at Anvers*. European Timber Trade Federation. Available online at: <http://www.ettf.info/node/159>.
- European Commission. 2013a. *EU Timber Regulation: Frequently Asked Questions*. European Commission. Available online at: http://ec.europa.eu/environment/eutr2013/faq/index_en.htm.
- European Commission. 2013b. *EU Timber Regulation: Who is affected?* European Commission. Available online at: http://ec.europa.eu/environment/eutr2013/who-is-affected/index_en.htm.
- European Commission. 2012. *Guidance Document for the EU Timber Regulation*. European Commission.
- European Commission. 2013c. *Guidance Document for the EU Timber Regulation*. European Commission. Available online at: <http://ec.europa.eu/environment/forests/pdf/Final%20Guidance%20document.pdf>.
- European Commission. 2007. *Impact Assessment: Report on additional options to combat illegal logging*. European Commission.
- European Commission. 2015. *State of implementation of EU Timber Regulation in 28 Member States*. European Commission.
- FAO. 2015a. FAOSTAT: Forest Products Statistics Database. Available online at: <http://www.fao.org/forestry/statistics/84922/en/>.
- FAO. 2015b. *Forest Products Definitions*. FAOSTAT-Forestry: Available online at: http://faostat.fao.org/Portals/_Faostat/documents/pdf/FAOSTAT-Forestry-def-e.pdf.
- Field, A. P. 2005. *Discovering statistics using SPSS*. Sage Publications, London; Thousand Oaks, Calif.
- Forestry Agency of Japan. 2006. *Guideline for Verification on Legality and Sustainability of Wood and Wood Products*. Wood Products Division.
- Fowler, F. J. 2009. *Survey research methods*. SAGE Publications, Los Angeles.
- FSC. 2014a. *FSC: 2014 Facts and Figures*. Forest Stewardship Council. Available online at: <https://ic.fsc.org/facts-figures.839.htm>.
- FSC. 2015a. *FSC and the Australian Illegal Logging Prohibition Act*. Forest Stewardship Council. Available online at: <https://ic.fsc.org/download.fsc-and-the-australian-illegal-logging-prohibition-act-2012.701.htm>.
- FSC. 2013a. *FSC: Annual Report 2012*. Forest Stewardship Council. Available online at: <https://ic.fsc.org/annual-reports.341.htm>.
- FSC. 2015b. *Illegal Logging: Choosing The Right Approach*. Forest Stewardship Council. Available online at: <https://au.fsc.org/illegal-logging.277.htm>.
- FSC. 2014b. *Questions and Answers about FSC and the EU Timber Regulation Revised November 2014*. Forest Stewardship Council. Available online at: <https://ic.fsc.org/eu-timber-regulation.46.htm>.

- FSC. 2012. *The Lacey Act and FSC*. Forest Stewardship Council. Available online at: <https://us.fsc.org/newsroom.239.526.htm>.
- FSC. 2013b. USA Forest Products Legality Legislation and FSC. *For. Steward. Council*. Available online at: <https://ic.fsc.org/national-news.328.306.htm>.
- G8 Summit. 2005. *Gleneagles Plan of Action: Climate Change, Clean Energy and Sustainable Development*.
- GATT. 1986. *Text of the General Agreement*. General Agreement on Tariffs and Trade, Geneva, Switzerland. Available online at: https://www.wto.org/English/docs_e/legal_e/gatt47_e.pdf.
- Global Environmental Forum. 2013. *Summary of the Survey Results Regarding the Legality Verification of Wood Products*. Available online at: https://www.fairwood.jp/news/pr_ev/2014/gohosei_question_result201405.pdf.
- Global Witness. 2013. *An Industry Unchecked: Japan's extensive business with companies involved in illegal and destructive logging in the last rainforests of Malaysia*. Global Witness Limited, London.
- Global Witness. 1999. *Made in Vietnam, Cut in Cambodia*. Global Witness Ltd, London, UK. Available online at: <https://www.globalwitness.org/library/made-vietnam-cut-cambodia>.
- Greenpeace. 2000. *Against the Law: The G8 and the illegal timber trade*. Greenpeace International.
- GTF. 2015. *German importers' appeals on EUTR wenge seizures rejected*. Global Timber Forum.
- GTIS. 2015a. Global Trade Atlas: Online Trade Data System. *Glob. Trade Inf. Serv.* Available online at: www.gtis.com/gta.
- GTIS. 2014. Global Trade Atlas: Online Trade Data System. *Glob. Trade Inf. Serv.* Available online at: www.gtis.com/gta.
- GTIS. 2015b. Global Trade Information Services: Frequently Asked Questions. Available online at: http://www.gtis.com/english/GTIS_FAQ.html.
- Guha, R. 2000. *Environmentalism: a global history*. Longman, New York.
- Hanson, C. 2010. Declarations and Due Care: Insights from Another Lacey Case. *World Resour. Inst.*
- Harris, N. L., S. Brown, S. C. Hagen, S. S. Saatchi, and S. Petrova. 2012. Baseline Map of Carbon Emissions from Deforestation in Tropical Regions. *Science*. 336(6088):1573–1576.
- Heckman, J. 1979. Sample Selection Bias as a Specification Error. *Econometrica*. 47(1):153–161.
- Hoare, A. 2015a. *Illegal Logging and Related Trade: The Response in Cameroon*. Chatham House, London, UK.
- Hoare, A. 2014a. *Illegal Logging and Related Trade: The Response in Ghana*. Chatham House, London, UK.
- Hoare, A. 2014b. *Illegal Logging and Related Trade: The Response in Indonesia*. Chatham House, London, UK.
- Hoare, A. 2015b. *Illegal Logging and Related Trade: The Response in Malaysia*. Chatham House, London, UK.
- Hoare, A. 2014c. *Methodology for Estimating Levels of Illegal Timber- and Paper-sector Imports: Estimates for China, France, Japan, the Netherlands, the UK, the US and Vietnam*. Chatham House, London, UK.

- Honnold, V. 2009. *Developments in the Sourcing of Raw Materials for the Production of Paper*. DIANE Publishing.
- Indufor. 2008. *Assessment of the Impact of Potential Further Measures to Prevent the Importation or Placing on the Market of Illegally Harvested Timber or Products Derived from Such Timber*. Indufor Oy, Helsinki, Finland.
- INTERPOL/World Bank. 2009. *Chainsaw Project: An INTERPOL perspective on law enforcement in illegal logging*. INTERPOL General Secretariat.
- ITTO. 2013. *May 2013 Market Information Service*. International Tropical Timber Organization. Available online at: http://www.itto.int/mis_detail/id=3480.
- Japanese Ministry of Environment. 2007. *Japan's Green Purchasing Policy: Tackling Illegal Logging*. Japanese Ministry of Environment. Available online at: <http://goho-wood.jp/ihou/view.pdf>.
- Japan Federation of Wood Industry Associations. 2006. "Goho-wood" *Japan's measures against illegal logging*. Council for Tackling Illegal Logging and Promotion of Goho-wood. Available online at: <https://www.goho-wood.jp/world/outline/>.
- Kruskal, J., and M. Wish. 1978. *Multidimensional Scaling*. Sage Publications, Sage University.
- Larson, R., and E. Farber. 2012. *Elementary statistics: picturing the world*. Pearson Prentice Hall, Boston.
- Lattin, J. 2003. *Analyzing multivariate data*. Thomson Brooks/Cole, Pacific Grove, CA.
- Lawson, S., and L. MacFaul. 2010. *Illegal Logging and Related Trade: Indicators of the Global Response*. Chatham House. Available online at: <http://www.illegal-logging.info/sites/default/files/uploads/CHillegalloggingpaperwebready1.pdf>.
- Legendre, P., and L. F. J. Legendre. 1998. *Numerical Ecology*. Elsevier. 872 p.
- Li, R., J. Buongiorno, J. Turner, S. Zhu, and J. Prestemon. 2008. Long-term effects of eliminating illegal logging on the world forest industries, trade, and inventory. *For. Policy Econ.* 10(7/8).
- Ludwig, J. 2012. *Illegal Logging Prohibition Bill 2012: Revised Explanatory Memorandum*.
- Lumber Liquidators. 2013. Lumber Liquidators Responds to Action By Federal Authorities. *Bloom. Bus.* Available online at: <http://www.bloomberg.com/article/2013-09-27/a5zXVDST7LGA.html>.
- Lumber Liquidators Inc. 2015. *Form 10-K 2015: Annual Report to the SEC*. Securities and Exchange Commission, EDGAR website. Available online at: http://www.sec.gov/Archives/edgar/data/1396033/000114420415011792/v400728_10k.htm.
- Lu, Z., I. Ganguly, and I. Eastin. 2014. Changes in Chinese wood-based exports to the U.S.: Post Lacey Act amendment. *For. Chron.* 90(05):660–665.
- Martin, R., and B. Ghazali. 2015. The impact of timber procurement policies. *Int. Trop. Timber Organ.* :pg. 3–7.
- McCune, B., and J. Grace. 2002. *Analysis of Ecological Communities*. Mjmm Software Design, Gleneden Beach, OR. 300 p.
- Milligan, G. W., and M. C. Cooper. 1985. An examination of procedures for determining the number of clusters in a data set. *Psychometrika.* 50(2):159–179.
- Moiseyev, A. 2010. Modeling the impacts of policy measures to prevent import of illegal wood and wood products. *For. Policy Econ.* 12(1):24–30.
- Momii, M. 2014a. *Trade in Illegal Timber: The Response in Japan*. Chatham House: Energy, Environment and Resources Department. Available online at:

- http://www.chathamhouse.org/sites/files/chathamhouse/field/field_document/20141125III_egalLoggingJapanMomii.pdf.
- Momii, M. 2014b. *Trade in Illegal Timber: The Response in Japan*. Chatham House, London, UK. Available online at: <http://www.chathamhouse.org/node/16276>.
- Momii, M. 2014c. *Trade in Illegal Timber: The Response in the United States*. Chatham House, London, UK. Available online at: <http://www.chathamhouse.org/node/16285>.
- Monteiro, A., and C. Souza. 2006. *Satellite Images for Evaluating Forest Management Plans*. Imazon. Available online at: http://imazon.org.br/PDFimazon/Ingles/the_state_of_amazon/satelites-images.pdf.
- Nellemann, C. 2012. *Green Carbon, Black Trade: Illegal Logging, Tax Fraud and Laundering in the World's Tropical Forests*. INTERPOL Environmental Crime Programme, UNEP. Available online at: http://www.unep.org/pdf/RRALogging_english_scr.pdf.
- Nellemann, C., L. Miles, B. P. Kaltenborn, M. Virtue, and H. Ahlenius. 2007. *The Last Stand of the Orangutan: State of Emergency : Illegal Logging, Fire and Palm Oil in Indonesia's National Parks*. UNEP and UNESCO. 52 p.
- NEPCon. 2015a. *Australian Illegal Logging Prohibition Act*. NEPCon. Available online at: <http://www.nepcon.net/australian-illegal-logging-prohibition-act>.
- NEPCon. 2014. *Australia tightens its grip on illegal timber*. NEPCon. Available online at: <http://www.nepcon.net/newsroom/australia-tightens-its-grip-illegal-timber>.
- NEPCon. 2013a. *EUTR lesson: beware of dubious documentation*. NEPCon. Available online at: <http://www.nepcon.net/newsroom/eutr-lesson-beware-dubious-documentation>.
- NEPCon. 2015b. *Investigation finds major EUTR risk issues with Chinese plywood imports to the UK*. NEPCon. Available online at: <http://www.nepcon.net/newsroom/investigation-finds-major-eutr-risk-issues-chinese-plywood-imports-uk>.
- NEPCon. 2013b. *The EUTR: getting into gear or off track?* NEPCon. Available online at: <http://www.nepcon.net/newsroom/eutr-getting-gear-or-track>.
- NEPCon. 2015c. *Two years with the EUTR: rooting for enforcement*. NEPCon. Available online at: <http://www.nepcon.net/newsroom/two-years-eutr-rooting-enforcement>.
- Newman, J., A. Ruwindrijarto, and D. Curry. 2000. *The Final Cut Illegal Logging in Indonesia's Orangutan Parks*. Environmental Investigation Agency and Telepak Indonesia, Jakarta, Indonesia.
- Nussbaum, R., and M. Simula. 2005. *The Forest Certification Handbook*. Earthscan, London; Sterling, VA.
- Park, M. 2010. A Final Report to inform a Regulation Impact Statement for the proposed new policy on illegally logged timber. *Cent. Int. Econ.*
- PEFC. 2014a. Japan Becomes Fourth Asian Country to Join as a PEFC National Member - News. Available online at: <http://pefc.org/news-a-media/general-sfm-news/1706-japan-becomes-fourth-asian-country-to-join-as-a-pefc-national-member>.
- PEFC. 2014b. *New Australian Illegal Logging Regulation recognizes PEFC*. Programme for the Endorsement of Forest Certification. Available online at: <http://www.pefc.org/news-a-media/general-sfm-news/1759-new-australian-illegal-logging-regulations-recognizes-pefc>.
- PEFC. 2014c. *PEFC Annual Review 2013 - Building on Momentum*. Programme for the Endorsement of Forest Certification. Available online at: http://pefc.org/images/documents/annual_review/PEFC_2013_annual_review.pdf.

- Pfeil, E. 2007. *FLEGT – Combating illegal logging as a contribution towards sustainable development*. Federal Ministry for Economic Cooperation and Development.
- Prestemon, J. P. ; 2014. *The impacts of the Lacey Act Amendment of 2008 on US hardwood lumber and plywood imports*. Forest Policy and Economics. Available online at: <http://www.treesearch.fs.fed.us/pubs/47185>.
- Ravenel, R. M., and I. M. E. Granoff. 2004. Illegal Logging in the Tropics. *J. Sustain. For.* 19(1-3):351–371.
- Ravenel, R. M., I. M. E. Granoff, and C. A. Magee. 2005. *Illegal Logging in the Tropics: Strategies for Cutting Crime*. 1 edition. CRC Press. 393 p.
- R Core Team. 2015. *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing, Vienna, Austria. Available online at: <http://www.R-project.org>.
- Reuters. 2015. Burma sentences 153 Chinese workers to life imprisonment for illegal logging. *The Guardian*. Available online at: <http://www.theguardian.com/world/2015/jul/23/burma-chinese-workers-life-imprisonment-illegal-logging>.
- Reuters. 2012. DNA tests tell trees from the wood. Available online at: <http://www.reuters.com/article/2012/08/19/us-timber-idUSBRE87I09D20120819>.
- Russian Federation. 2014. *Regional Prosecutor’s Office: Criminal Sentencing of Illegal Logging Operation*. Attorney General’s Office: Russian Federation. Available online at: <http://genproc.gov.ru/smi/news/archive/news-514064>.
- Saltzman, R. 2010. Establishing a “Due Care” Standard Under the Lacey Act Amendments of 2008. *Mich. Law Rev.* 109(1) Available online at: http://uwashington.worldcat.org/oclc/4565305591&referer=brief_results.
- Saunders, J. 2014. *Trade in Illegal Timber: The Response in Vietnam*. Chatham House, London, UK. Available online at: <http://www.chathamhouse.org/node/16451>.
- Schaumburg-Müller, H., and P. H. Chuong. 2010. *The New Asian Dragon: Internationalization of Firms in Vietnam*. Copenhagen Business School Press DK. 260 p.
- Schroeder-Wildberg, E., and A. Carius. 2005. *Illegal Logging, Conflict and the Business Sector in Indonesia*. Capacity Building International. Available online at: <http://www.illegal-logging.info/sites/default/files/uploads/LoggingconflictIndonesia.pdf>.
- Seneca Creek Associates. 2004. Illegal Logging and Global Wood Markets: The competitive impacts on the US wood products industry. *Prep. Am. For. Pap. Assoc. Seneca Creek Assoc. Wood Resour. Int.*
- SFI. 2013. *Addressing EUTR Requirements Through SFI Certification*. Sustainable Forestry Initiative & PEFC. Available online at: <http://www.sfi-program.org/files/pdf/sfi-eutr/>.
- Sheikh, P. A. 2007. Illegal logging: Background and Issues. in Congressional Research Service. Available online at: <http://openocrs.com/document/RL33932/2007-03-19/download/1005/>.
- Sheikh, P. A. 2012. *The Lacey Act: Compliance Issues Related to Importing Plants and Plant Products*. Congressional Research Service. Available online at: <http://fas.org/sgp/crs/misc/R42119.pdf>.
- Shelley, W. R. 2012. Setting the Tone: The Lacey Act’s Attempt to Combat the International Trade of Illegally Obtained Plant and Wildlife and Its Effect on Musical Instrument Manufacturing. *Environ. Law.* 42.
- Shepard, R. N. 1974. Representation of structure in similarity data: Problems and prospects. *Psychometrika.* 39(4):373–421.

- Simeone, J. 2013. Russia's Forest Sector and International Trade in Forest Products. *Vestn. J. Russ. Asian Stud.* Available online at: http://www.sras.org/russia_forest_sector_wto.
- Song, S. 2014. *Myanmar Imposes Export Ban To Stop Its Timber From Foreign Exploitation.* International Business Times.
- SUHAKAM. 2007. *Suhakam's Report on Penan In Ulu Belagan: Right to Land and Socio-Economic Development.* Human Rights Commission of Malaysia. Available online at: <http://www.suhakam.org.my/wp-content/uploads/2013/12/Report-On-Penan-In-Ulu-Belaga.pdf>.
- Sun, X., and K. Canby. 2011. *CHINA: Overview of Forest Governance, Markets and Trade.* Forest Trends. Available online at: http://www.forest-trends.org/publication_details.php?publicationID=2878.
- SWEECC. 2013. *Furniture Manufacturing & Supply China 2013 Event Profile.* Shanghai World Expo Exhibition & Convention Center. Available online at: www.chinaexhibition.com.
- Tacconi, L. 2007. *Illegal logging: law enforcement, livelihoods and the timber trade.* Center for International Forestry Research.
- The Economist. 2007. *Can we help you? How China is wooing a poor neighbor.* The Economist. Available online at: <http://www.economist.com/node/8880871>.
- The World Bank. 2010. *Socialist Republic of Vietnam: Forest Law Enforcement and Governance.* East Asia and Pacific Region Sustainable Development Department.
- The World Bank. 2006a. *Strengthening forest law enforcement and governance : addressing a systemic constraint to sustainable development.* The World Bank.
- The World Bank. 2006b. *Sustaining economic growth, rural livelihoods, and environmental benefits: Strategic options for forest assistance in Indonesia.* The World Bank.
- Thomson, J., and R. Kanaan. 2003. *Conflict Timber: Dimensions of the Problem in Asia and Africa.* United States Agency for International Development, ARD Inc.
- Tibbets, A. 2011. *Implications of the 2008 Lacey Act amendments insights from the wood products industry.* Oregon State University, Corvallis, Oregon. Available online at: <http://hdl.handle.net/1957/26108>.
- Tollefson, C., F. P. Gale, and D. Haley. 2008. *Setting the standard: certification, governance, and the Forest Stewardship Council.* UBC Press, Vancouver.
- Turner, J., A. Katz, and J. Buongiorno. 2007. *Implications for the New Zealand Wood Products Sector of Trade Distortions due to Illegal Logging.* Available online at: <http://www.illegal-logging.info/sites/files/chlogging/uploads/sus731scion.pdf>.
- URS. 2013. *Legal Forest Products Assurance: Supplementary report on selected timber legality assurance frameworks.* URS Australia, Prepared for Department of Agriculture, Fisheries and Forestry, Canberra, Australia.
- US Congress. 2008. *Food, Conservation, and Energy Act of 2008.* 110th United States Congress. Available online at: <http://www.gpo.gov/fdsys/pkg/PLAW-110publ246/pdf/PLAW-110publ246.pdf>.
- US Congress. 2012. *House Report 112-604 - RELIEF Act.* 112th US Congress. Available online at: <https://www.congress.gov/congressional-report/112th-congress/house-report/604/1>.
- USDA. 2014. *The Xylotron: A Field-Deployable Machine-Vision Wood Identification System.* Available online at: http://www.fs.fed.us/research/highlights/highlights_display.php?in_high_id=585.

- USDA/APHIS. 2012. *Lacey Act Amendment. Complete List of Questions and Answers*. United States Department of Agriculture: Animal and Plant Health Inspection Service. Available online at: http://www.aphis.usda.gov/plant_health/lacey_act/downloads/faq.pdf.
- USDOJ. 2010. *U.S. Department of the Interior v. Three pallets of tropical hardwood, Harlan Crouch, Claimant*. United States Department of Interior: Office of the Solicitor.
- USDOJ. 2012. *Gibson Guitar Corp. Agrees to Resolve Investigation into Lacey Act Violations*. US Department of Justice. Available online at: <http://www.justice.gov/opa/pr/gibson-guitar-corp-agrees-resolve-investigation-lacey-act-violations>.
- U.S. Embassy. 2013. *The U.S.-Vietnam Bilateral Trade Agreement (BTA) - Resources for Understanding*. Embassy of the United States to Hanoi. Available online at: <http://vietnam.usembassy.gov/econ12.html>.
- US House of Representatives. 2013. *2008 Lacey Amendments: Unintended Consequences are Raising Costs, Threatening Jobs and Small Business*. US House of Representatives: Committee on Natural Resources.
- VietnamWood. 2013. *VietnamWood 2013 Show Report*. Chan Chao International Co., Ltd. Available online at: www.vietnamwoodexpo.com.
- VIFA-Expo. 2014. *Post Show Report: VIFA Expo 2014*. Available online at: <http://www.vifafair.com/home/press-conference/>.
- VNU Exhibitions Asia. 2013. *Domotex Asia/China Floor 2013 Event Profile*. Available online at: www.chinaexhibition.com.
- Wellesley, L. 2014a. *Illegal Logging and Related Trade: The Response in Brazil*. Chatham House, London, UK. Available online at: <http://www.chathamhouse.org/node/16130>.
- Wellesley, L. 2014b. *Trade in Illegal Timber: The Response in China*. Chatham House, London, UK. Available online at: <http://www.chathamhouse.org/node/16448>.
- Wellesley, L. 2014c. *Trade in Illegal Timber: The Response in France*. Chatham House, London, UK. Available online at: <http://www.chathamhouse.org/node/16283>.
- Wendorf, C. A. 2004. Primer on Multiple Regression Coding: Common Forms and the Additional Case of Repeated Contrasts. *Underst. Stat.* 3(1):47–57.
- World Customs Organization. 2015. What is the Harmonized System? Available online at: <http://www.wcoomd.org/en/topics/nomenclature/overview/what-is-the-harmonized-system.aspx>.
- WRI. 2009. *Fact Sheet: Are You Ready for the Lacey Act?* World Resources Institute. Available online at: <http://www.wri.org/blog/2009/12/fact-sheet-are-you-ready-lacey-act>.
- WRI. 2015. *Forest Legality Alliance*. World Resources Institute. Available online at: <http://www.wri.org/our-work/project/forest-legality-alliance>.
- WRI. 2003. *World resources 2002-2004: decisions for the earth : balance, voice and power*. World Resources Institute and the United Nations Development Programme, Washington, D.C. Available online at: <http://www.wri.org/publication/world-resources-2002-2004>.
- WTO. 2015. *Understanding the WTO*. World Trade Organization: Information and External Relations Division, Geneva, Switzerland. Available online at: https://www.wto.org/english/thewto_e/whatis_e/tif_e/understanding_e.pdf.
- Xinjian, L., and M. Qian. 2015. Procuring legal and sustainable tropical timber in China. *Int. Trop. Timber Organ.* :pg. 17–20.
- Zar, J. H. 2010. *Biostatistical Analysis*. Prentice Hall. 966 p.

Appendices

Appendix A. Survey in English

1. Please specify your main business type: (check all that apply) :

- Wood Outdoor Furniture Manufacturer Importer of Wood Products
 Wood Indoor Furniture Manufacturer Exporter of Wood Products
 Wood Flooring Manufacturer Other (Please Specify): _____

2. Please indicate which of the following chain-of-custody programs your company has obtained:

- Forest Stewardship Council (FSC) Program for the Endorsement of Forest Certification (PEFC)
 We do not have chain-of-custody certification Other wood product certification (Please Specify): _____

3. What percentage of your wood raw materials/wood products exports were tropical hardwoods in 2012?

_____ %

4. What percentage of your wood raw materials/wood products exports had chain-of-custody certification in 2012?

_____ %

5. Approximately what percentage of your sales revenue was derived from the following markets?

	Vietnam	Direct Export	Indirect Export	TOTAL
2012	%	%	%	100%

6. How have your SALES of wood products changed over the past five years? (select one option for each choice)

	Increased	Remained same	Decreased	Don't sell to this region
United States	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
European Union (EU)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Japan	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Middle East	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Australia	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Southeast Asia	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Russia	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vietnam	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

7. Only manufacturers: How have your sources of wood raw materials changed over the past five years? (select one option for each choice)

	Increased	Remained same	Decreased	Don't import from this region
Russia	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
United States	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Canada	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Southeast Asia	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Africa	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
European Union (EU)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Latin America	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vietnam	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Continue to back side. ☺

8. Do you agree or disagree with the following statements:

<i>Statement</i>	<i>Agree</i>	<i>Disagree</i>
Legality regulations are an effective way to reduce illegal timber	<input type="checkbox"/>	<input type="checkbox"/>
I intend to increase my exports to countries that do not have timber legality regulations	<input type="checkbox"/>	<input type="checkbox"/>
Timber legality regulations cause timber prices to increase	<input type="checkbox"/>	<input type="checkbox"/>
Timber legality regulations increase the cost of exporting	<input type="checkbox"/>	<input type="checkbox"/>
I intend to decrease my exports to countries that have timber legality regulations	<input type="checkbox"/>	<input type="checkbox"/>
I plan to increase my use of certified wood to help me comply with legality legislation	<input type="checkbox"/>	<input type="checkbox"/>
Timber legality regulations are a trade barrier designed to protect foreign manufacturers	<input type="checkbox"/>	<input type="checkbox"/>
I intend to sell more products within Vietnam because of timber legality regulations	<input type="checkbox"/>	<input type="checkbox"/>
Illegal logging is a major environmental problem	<input type="checkbox"/>	<input type="checkbox"/>

9. Please indicate your level of familiarity with the following timber legality regulations.

	<i>Have not heard about it</i>	<i>Have heard about it but am not sure of the details of this regulation</i>	<i>Am very familiar with this regulation</i>
US Lacey Act	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
EU Timber Regulation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Japanese Public Procurement Policy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Australia Illegal Logging Prohibition Act	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

10. Based on your perception/experience of the Lacey Act please respond to the following questions. (Skip to question 11 if you are not aware of Lacey Act)

a. Do you agree or disagree with the following statements

<i>Statement</i>	<i>Agree</i>	<i>Disagree</i>
I acquired chain-of-custody certification to help me comply with the Lacey Act	<input type="checkbox"/>	<input type="checkbox"/>
I will increase my use of wood from the US to help my company comply with the Lacey Act	<input type="checkbox"/>	<input type="checkbox"/>
The Lacey Act will cause me to reduce my exports of wood products to the US	<input type="checkbox"/>	<input type="checkbox"/>
The Lacey Act has made me more careful about sourcing logs/lumber	<input type="checkbox"/>	<input type="checkbox"/>
It is easy to comply with the Lacey Act	<input type="checkbox"/>	<input type="checkbox"/>

b. Has compliance with the Lacey Act has increased the cost of exporting to the US? YES NO
(if yes specify ____%)

11. Please select the category that best describes your company's sale revenue in 2012

- Less than ¥10,000,000
 ¥10,000,000 to ¥40,000,000
 ¥40,000,001 to ¥70,000,000
 ¥70,000,001 to ¥100,000,000
 ¥100,000,000 to ¥200,000,000
 more than ¥200,000,000

12. How many full time workers does your company employ: _____

13. Within which province is your company located? _____

14. Please indicate where you would be most likely to go to get information about timber legality regulations

- Government Agencies
 Industry Associations
 Other Exporters
 My foreign customers
 Trade Publications
 Internet websites
 Other: Please specify: _____

Thank you for your cooperation!

8. 请根据贵公司的情况评价下列陈述（同意或者不同意）：

	同意	不同意
木材合法性法规是遏制非法采伐的有效途径	<input type="checkbox"/>	<input type="checkbox"/>
我倾向于对不执行木材合法性法规的国家增加出口	<input type="checkbox"/>	<input type="checkbox"/>
木材合法性法规导致世界木材价格升高	<input type="checkbox"/>	<input type="checkbox"/>
木材合法性法规导致出口成本升高	<input type="checkbox"/>	<input type="checkbox"/>
我倾向于对执行木材合法性法规的国家减少出口	<input type="checkbox"/>	<input type="checkbox"/>
我计划更多地使用通过认证的木材原料，以遵守木材合法性法规	<input type="checkbox"/>	<input type="checkbox"/>
木材合法性法规是一个贸易壁垒，目的是保护本国的生产厂商	<input type="checkbox"/>	<input type="checkbox"/>
由于原出口地的木材合法性法规，我倾向于在中国国内市场扩大销售	<input type="checkbox"/>	<input type="checkbox"/>
非法采伐是一个严重的全球性环境问题	<input type="checkbox"/>	<input type="checkbox"/>

9. 您对以下木材合法性法规的熟悉程度：

	未听说过	听说过，但是不熟悉	非常熟悉
美国·雷斯法案（修正案）	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
欧盟·新木材法案	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
日本·政府木材绿色采购政策	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
澳大利亚·非法采伐禁令	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

10. 如果贵公司听说过雷斯法案（修正案）

a. 请根据贵公司的情况评价下列陈述（同意或者不同意）：

	同意	不同意
我公司已取得绿色标签（林产品产销监管链认证），以遵守雷斯法案	<input type="checkbox"/>	<input type="checkbox"/>
我公司将增加对产自美国的木材原材料的使用，以遵守雷斯法案	<input type="checkbox"/>	<input type="checkbox"/>
雷斯法案将导致我公司木质产品向美国的出口减少	<input type="checkbox"/>	<input type="checkbox"/>
雷斯法案已使我公司更加注重木材原料的甄选环节	<input type="checkbox"/>	<input type="checkbox"/>
我公司遵守雷斯法案的难度不大	<input type="checkbox"/>	<input type="checkbox"/>

b. 为遵守雷斯法案，贵公司向美国的出口成本是否上升 上升 上升幅度 ____% 未上升

11. 2012年，贵公司的销售收入（人民币）：

- 1000万元以下
 1000万元~4000万元（含4000万元）
 4000万元~7000万元（含7000万元）
 7000万元~1亿元
 1亿元~2亿元
 2亿元以上

12. 贵公司的全职员工数量 _____

13. 贵公司所在地（省份） _____

14. 您最有可能从哪些渠道获悉木材合法性法规的相关信息：

- 政府机构
 行业协会
 同行
 海外客户
 贸易相关出版物
 网站
 其他（请说明） _____

Appendix C. Survey in Vietnamese

Bản nghiên cứu về mức độ ảnh hưởng của những quy định hợp pháp hoá về gỗ

1. Xác định hình thức kinh doanh chính của công ty bạn (đánh dấu tất cả các câu trả lời đúng):

- Nhà máy sản xuất đồ gỗ ngoài trời Nhà nhập khẩu các sản phẩm gỗ
 Nhà máy sản xuất đồ gỗ nội thất Nhà xuất khẩu các sản phẩm gỗ
 Nhà máy sản xuất gỗ lát sàn Hình thức khác (ghi cụ thể): _____

2. Chỉ ra một trong những chương trình Chuỗi Hành Trình Sản Phẩm- Chain of Custody (COC) dưới đây đang hiện hành trong công ty bạn:

- Hội đồng quản trị rừng Chương trình chứng chỉ rừng Châu Âu
 Các chứng chỉ về gỗ khác (ghi cụ thể): Chúng tôi không có chứng chỉ nào

3. Gỗ cứng nhiệt đới chiếm bao nhiêu phần trăm trong sản lượng xuất khẩu gỗ thô và các sản phẩm gỗ của công ty bạn trong năm 2012? _____%

4. Trong sản lượng gỗ thô và các sản phẩm gỗ xuất khẩu năm 2012 của công ty bạn, bao nhiêu phần trăm có chứng chỉ COC? _____%

5. Khoảng chừng bao nhiêu phần trăm doanh thu của công ty bạn đến từ những thị trường sau đây:

	<i>Việt Nam</i>	<i>Xuất khẩu trực tiếp</i>	<i>Xuất khẩu gián tiếp</i>	<i>Tổng số</i>
2012	%	%	%	100%

6. Doanh thu từ các sản phẩm gỗ của công ty bạn thay đổi như thế nào trong vòng 5 năm trở lại đây? (Chỉ chọn một đáp án cho mỗi ý)

	<i>Tăng</i>	<i>Giữ nguyên</i>	<i>Giảm</i>	<i>Không bán ở khu vực này</i>
Hoa Kỳ	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Liên minh Châu Âu (EU)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nhật Bản	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Trung Đông	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Úc	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Đông Nam Á	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Liên Bang Nga	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Việt Nam	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

7. Câu hỏi chỉ dành cho các nhà sản xuất: Nguồn cung cấp nguyên liệu gỗ thô cho công ty bạn thay đổi như thế nào trong vòng 5 năm trở lại đây? (Chỉ chọn một đáp án cho mỗi ý)

	<i>Tăng</i>	<i>Giữ nguyên</i>	<i>Giảm</i>	<i>Không nhập khẩu từ khu vực này</i>
Liên Bang Nga	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hoa Kỳ	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Canada	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Đông Nam Á	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Châu Phi	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Liên minh Châu Âu (EU)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Các nước Mỹ La-tinh	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Việt Nam	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

8. Bạn đồng ý hay không đồng ý với những nhận định sau đây?

<i>Nhận định</i>	<i>Đồng ý</i>	<i>Không đồng ý</i>
Các qui định hợp pháp hoá là một cách hiệu quả để giảm thiểu gỗ lậu	<input type="checkbox"/>	<input type="checkbox"/>
Tôi có ý định gia tăng xuất khẩu đến các nước không có các qui định hợp pháp hoá về gỗ	<input type="checkbox"/>	<input type="checkbox"/>
Sự hợp pháp hoá về gỗ làm tăng giá gỗ	<input type="checkbox"/>	<input type="checkbox"/>
Sự hợp pháp hoá về gỗ làm tăng giá xuất khẩu	<input type="checkbox"/>	<input type="checkbox"/>
Tôi có ý định giảm thiểu xuất khẩu tới những quốc gia có các qui định hợp pháp hoá về gỗ	<input type="checkbox"/>	<input type="checkbox"/>
Tôi có kế hoạch sử dụng gỗ có chứng nhận để giúp tôi tuân thủ theo luật	<input type="checkbox"/>	<input type="checkbox"/>
Các qui định hợp pháp hoá gỗ là những rào cản thương mại bảo vệ các nhà sản xuất nước ngoài	<input type="checkbox"/>	<input type="checkbox"/>
Tôi có ý định bán nhiều sản phẩm ở Việt Nam hơn bởi vì các qui định hợp pháp hoá về gỗ	<input type="checkbox"/>	<input type="checkbox"/>
Đốn gỗ bất hợp pháp là một vấn đề môi trường lớn	<input type="checkbox"/>	<input type="checkbox"/>

9. Xác định sự mức độ quen thuộc của bạn với những qui định hợp pháp hoá gỗ sau đây.

	<i>Chưa từng nghe qua</i>	<i>Đã từng nghe tới nhưng không chắc về chi tiết của luật này</i>	<i>Rất quen thuộc với luật này</i>
Đạo Luật Lacey của Hoa Kỳ	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Qui định về gỗ của liên minh châu Âu	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Chính sách đấu thầu Nhật Bản	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Đạo luật nghiêm cấm đốn gỗ lậu của Úc	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

10. Dựa vào quan điểm/kinh nghiệm của bạn về Luật Lacey, hãy trả lời những câu hỏi dưới đây. (Bỏ qua câu hỏi này nếu bạn không biết Luật Lacey)

a. Bạn đồng ý hay không đồng ý với những nhận định sau đây?

<i>Nhận định</i>	<i>Đồng ý</i>	<i>Không đồng ý</i>
Tôi lấy chứng chỉ COC để giúp tôi tuân thủ theo đạo luật Lacey	<input type="checkbox"/>	<input type="checkbox"/>
Tôi sẽ gia tăng sử dụng gỗ từ Hoa Kỳ để giúp công ty tôi tuân thủ theo đạo luật Lacey	<input type="checkbox"/>	<input type="checkbox"/>
Đạo luật Lacey sẽ khiến tôi giảm lượng xuất khẩu các sản phẩm gỗ qua Mỹ	<input type="checkbox"/>	<input type="checkbox"/>
Đạo luật Lacey đã khiến tôi cẩn thận hơn trong việc cung ứng đốn gỗ	<input type="checkbox"/>	<input type="checkbox"/>
Tuân thủ theo đạo luật Lacey rất dễ	<input type="checkbox"/>	<input type="checkbox"/>

b. Việc tuân thủ đạo luật Lacey có làm tăng giá xuất khẩu sang Hoa Kỳ không? Có Không
(Nếu có, bao nhiêu phần trăm: _____%)

11. Hãy chọn câu trả lời miêu tả đúng nhất về doanh thu của công ty bạn trong năm 2012

- Dưới 35 tỷ đồng Từ 35 tỷ đồng đến 135 đồng Từ 135 tỷ đồng đến 250 tỷ đồng
 Từ 250 tỷ đồng đến 350 tỷ đồng Từ 350 tỷ đồng đến 700 tỷ đồng Hơn 700 tỷ đồng

12. Công ty bạn thuê bao nhiêu công nhân toàn thời gian: _____

13. Công ty bạn được đặt ở thành phố/tỉnh nào _____

14. Hãy chỉ ra nơi khả thi nhất mà bạn sẽ đến để lấy thông tin về các qui định hợp pháp hoá gỗ

- Văn phòng Chính phủ Các hiệp hội công nghiệp Nhà xuất khẩu khác Khách hàng nước ngoài
 Tạp chí thương mại Các trang web Khác: Ghi cụ thể: _____

Cảm ơn sự hợp tác của quý bạn!