C I N T R A F O R

Working Paper

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Trends in the Japanese Market for Forest Products: Implications for Alaska

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Center for International Trade in Forest Products
College of Forest Resources
University of Washington
Box 352100
Seattle, WA 98195-2100

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Executive Summary

With the U.S. housing market at a seventeen year low, it is becoming increasingly important to find global markets for U.S. forest products. One market that values Alaska forest products and offers tremendous opportunity is Japan. However, due to a previously strong U.S. Dollar, increased competition from Europe, and other factors, Alaska forest products have lost significant market share in Japan. The purpose of this research project was to examine recent trends that affect Japan's forest products market and present potential opportunities for Alaska forest products. Data was collected from government and industry organizations and industry experts were interviewed. The research identified five major trends affecting Japan's forest products market:

- Changing Building Regulations – The Building Standards Law was revised in 2007 requiring certification of the structural integrity of new residential buildings by qualified architects or structural engineers. This revision was in response to a recent building scandal where some architects falsified structural strength documents required by the Japanese government. As a result, a number of buildings in the Tokyo area were declared unable to withstand a moderate earthquake and condemned.
- Changing Timber Supply – Overall, Japan's lumber and log imports from North America have decreased. In contrast, lumber and log supplies from Europe, Russia, China, and within Japan have increased. However, several recent occurrences are constricting Japan's timber supply including a Russian log export tariff and increased demand from other regions. Many of the industry experts interviewed pointed out that mills are looking for new suppliers to hedge against disruptions in their traditional timber supply.
- Increasing Green Building and Green Procurement Policies – Japan has developed a green building certification program called the Comprehensive Assessment System for Building Environmental Efficiency (CASBEE). This system consists of various green building criteria. Additionally, the Japanese government has announced a public procurement program that requires all forest products purchased by the government to come from legally harvested timber.
- Changing Exchange Rates – The U.S. Dollar has depreciated approximately 6 percent against the Japanese Yen in the past two years. This makes Alaska and other U.S. forest products more price competitive in the Japanese market.
- Changing Demographics – Two of the most important demographic segments in Japan are the Baby Boomers and the children of the baby boomers or Eco Baby Boomers. The Baby Boomers are retiring and many are looking to improve their houses. Eco Baby Boomers are having families of their own and many are choosing to purchase value priced houses rather than condominiums or renting apartments.

Based on the analysis of Japan's forest products market, the researchers offered the following recommendations:

- Identify Alaska forest products companies interested in exporting to Japan. The first step to promote Alaska forest products in Japan is to identify companies interested in and qualified to export to Japan. These companies need to have the production capacity to do container load volumes and the commitment of management to pursue the Japanese market. Once these companies are identified, a directory should be created in Japanese to distribute to Japanese forest products buyers. These companies should also be encouraged to participate in the Japan Home Show and trade mission described below.
- Utilize trade organizations to increase awareness of Alaska forest products. Alaska's presence in

the Japanese market has dwindled and needs to be rebuilt. This can be done at a relatively low cost through utilizing resources that are already in place. There are two organizations that the authors recommend Alaska's forest products industry utilize in Japan. The first is the Softwood Export Council headquartered in Portland, OR and with a Japan office in Tokyo. The University of Alaska is active with the Softwood Export Council and can assist with making connections. The second is the State of Alaska's Japan Office located in Tokyo. Both of these organizations participate in forest products events held in Japan. The Alaska forest products industry should work closely with both these organizations. The contact information for these organizations is provided in Appendix A.

- Promote WWPA Alaska forest products' labels in Japan. A coordinated marketing effort should be organized to promote the three WWPA registered labels in Japan: Alaska Hem, Alaska Yellow Cedar, and Alaska Spruce. Each of these should be promoted as a brand with unique attributes. The goal should be to build brand recognition for Alaska species in Japan by promoting these species and their unique attributes. Literature should be developed in Japanese explaining each species, their unique attributes, and the end usage for which they are suitable. It would also be beneficial to include contact information for Alaska forest products companies that can supply each of these species.
- Promote the structural values of Alaska lumber in Japan. The revised Building Standards Law requires builders to certify the structural integrity of their buildings by approved architects. In order to do this, architects will need access to the structural values of members used for structural support. Therefore, the results of the in grade testing program conducted by the Ketchikan Wood Technology Center should be translated into Japanese. Japanese architects responsible for certifying building plans will need access to modulus of elasticity and bending strength calculations for Alaska yellow cedar, hemlock, and Sitka spruce.
- Target the glulam beam industry. One expected outcome of the revision to the Building Standards Law is an increase in market share for glulam beams. Mr. Miyazawa (Miyazawa 2007), of the Japan Housing Newspaper, emphasized the revision to the Building Standards Law will favor glulam beams over solid sawn lumber because the exact structural values are written on each glulam beam. The opportunity for Alaska forest products manufacturers is to target the glulam beam industry with lamstock. Japan's glulam beam industry has shown strong growth and there are opportunities for Alaska yellow cedar, hemlock, and Sitka spruce (CINTRAFOR 2008).
- Develop a certificate of harvest origin program for Alaska forest products. The Japanese government is starting to require all forest products purchased by government agencies to provide proof that the wood originated from legally harvested timber. This procurement program is still in the initial stages but what is clear is that some documentation will be required. As of now, the Japanese government is being very flexible with the documentation. At the GOHO Wood (Legal Wood) Conference in Japan, the Japanese official explained that companies can develop their own certificate and attach supporting documents such as timber sale receipts. Exporters should work closely with their Japanese customers and make sure that proper documentation is provided.
- Create an Alaska forest products display for the Japan Home Show held annually in November. One of the main conclusions to be drawn from this research is that Japan's forest products manufacturers are becoming very concerned with the stability of their raw materials supply. Their concern centers on what will happen in the future to Russian and European supply and so Japanese buyers are looking for new suppliers. However, in order for this to benefit Alaska forest products companies, Japanese companies need to be informed of what products exist and how to get them. An excellent venue to meet Japanese buyers and educate them about Alaska forest products is the Japan Home Show. The Japan Home Show is held in November in Tokyo. The Softwood Export Council has a booth each year and allows members to display products. An Alaska forest products

display should be designed to display product samples, product literature, and copies of the Alaska Forest Products Directory.

- Organize a Japan Trade Mission for Alaska forest products companies. As a follow up to the Japan Home show, a Japan trade mission should be organized for Alaska forest products companies interested in the Japanese market. The primary purpose of this trade mission would be to introduce Alaska forest products companies to potential Japanese buyers. The secondary purpose of the mission would be to educate Alaska forest products companies about the Japanese market and the types of forest products used in the market. This trade mission should include Japanese mill visits, a seminar given by an Alaska representative explaining to potential Japanese buyers about Alaska forest products, and a reception to bring Alaska companies together with potential Japanese buyers. The visit should also include a visit to pre-cut lumber mills, laminators, and post and beam construction sites. This trade mission should be organized in cooperation with the Alaska Department of Trade, the University of Alaska, and the Softwood Export Council.
- Invite potential Japanese customers to Alaska for an Alaska mill tour. This would be a way to introduce Alaska mill owners to Japanese forest products buyers. Additionally, it would allow the Japanese forest product buyers to educate Alaska mills about what products the Japanese market demands and their product specifications

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1. Introduction

Since the closure of the Sitka Pulp Mill in 1993 and the Ketchikan Pulp Corporation in 1997, the Alaska forest products industry has been in transition. According to a report by the McDowell group (McDowell 1998), a majority of the lumber used in Alaska construction was imported from the lower forty eight states rather than being manufactured in Alaska. One problem has been the lack of kilns to dry lumber to the moisture content the market demanded. As of 2000, Alaska only had an installed base of 94 thousand board feet of kiln dry capacity (Nicholls and Kilborn 2001). This hindered Alaska's ability to supply lumber to Alaska and other markets, which required kiln dry lumber. In order to assist Alaska mills in setting up kiln dry facilities, a federal grant program was initiated and, as of 2004, Alaska had an estimated 220 thousand board feet of kiln drying capacity (Nicholls et al. 2006). According to a recent sawmill processing capacity study, Alaska's forest products industry was estimated to be utilizing approximately 8.4 percent of Southeast Alaska's mill capacity, which was estimated to be 370,350 thousand board feet (Brackley et al. 2006). This excess capacity reflects both supply constraints and changing demand for Alaska forest products.

One key development for Alaska's forest products industry was the establishment of the Ketchikan Wood Technology Center in Ketchikan. The Ketchikan Wood Technology Center conducted in-grade testing of Alaska species that showed higher strength values for some Alaska species compared with similar species growing in the lower 48 states. The result of this in-grade testing program was three WWPA registered grade marks for Alaska species: Alaska Hem, Alaska Yellow Cedar, and Alaska Spruce (WWPA 2005). These registered trademarks have allowed Alaska lumber to be differentiated from other species on the basis of strength.

The ability to produce kiln dried lumber and the differentiation provided by registered grade marks has not only opened up markets in the U.S. but also Japan (Sasatani et al. 2005). As with the U.S., Japan's residential construction market has shifted from green lumber to kiln dried lumber and engineered wood products (Eastin et al. 2003). The primary region to benefit from the Japanese shift to kiln dried lumber and engineered wood products has been Europe. During the early 1990's European kiln dry lumber and engineered wood began to enter the Japanese market and by 2005 European lumber and glue laminated lumber held a dominant position.

The purpose of this research project was to examine recent trends that affect Japan's forest products market and provide potential opportunities for Alaska forest products. Data was collected from government and industry organizations and through interviews with industry experts. This qualitative research identified five major trends that will be discussed in this paper:

1. **Changing Building Regulations** – The Japanese government revised its Building Standards Law in 2007. This revision applies more stringent standards to the structural certification of building plans.
2. **Changing Timber Supply** – Overall, Japan's lumber and log supply from North America has decreased. In contrast, lumber and log supply from Europe, Russia, and within Japan has increased. However, many recent occurrences are constricting Japan's timber supply including a Russian log export tariff and increased demand for timber from other regions.
3. **Increasing Green Building and Green Procurement Policies** – Japan has developed a green building certification program called the Comprehensive Assessment System for Building Environmental Efficiency (CASBEE). This system applies to both commercial and residential buildings and consists of various green building criteria. Additionally, the Japanese government has announced a program to require all forest products purchased for use in government projects to originate from legally harvested timber.
4. **Changing Exchange Rates** – The U.S. Dollar has depreciated approximately six percent against the Japanese Yen in the past two years. During this same period, the Euro and Canadian Dollar

appreciated against the Japanese Yen making U.S. forest products more price competitive in the Japanese market.

5. **Changing Demographics** – Two of the most important demographic segments in Japan are the Baby Boomers and the children of the baby boomers or Eco Baby Boomers. The Baby Boomers are retiring and have the disposable income that allows them to improve their houses and their quality of life. Eco Baby Boomers are beginning to have families of their own and many are choosing to purchase value priced homes rather than condominiums or renting apartments.

2. Changing Building Regulations

In June 2007, the Japanese government enacted a revised Building Standards Law. This revision follows the Housing Quality Assurance Act (HQAA) of 2000. The HQAA had four objectives: (1) improve the quality, durability, and performance of residential homes, (2) provide homebuyers with a mechanism for resolving disputes with building contractors, (3) establish a housing completion guarantee system, and (4) establish a system of "Housing Performance Indication Standards" against which individual houses can be compared (Eastin 2003). The HQAA was enacted in April of 2000 to improve the quality of Japanese residential construction.

The revised Building Standards Law of 2007 was enacted in response to a 2005 building scandal in which a rogue architect, Hidetsugu Aneha, falsified the structural strength calculations required by the Japanese government. As a result, fourteen condominium buildings in the Tokyo area were declared unsafe and unable to withstand a moderate earthquake. Many of the associated companies declared bankruptcy, leaving the building and condominium unit owners with little recourse to recoup their investment. In an effort to avoid similar problems in the future, the revised Building Standards Law requires certification of the structural integrity of new residential construction buildings by qualified architects and structural engineers.

One of the major goals of the revision was to restore public trust in the structural safety of buildings. The major component of the revision requires a structural calculation review for reinforced concrete and steel reinforced concrete buildings over 20 meters in height and all residential buildings over 13 meters in height or 9 meters in height at the eves. Generally, these buildings are three stories or higher. The building owner must submit architectural drawings and structural data calculations certified by a qualified architect or structural engineer to the government. After the documents are then reviewed and approved, an interim building inspection and a final building inspection are required before the final approval is granted.

Most of the large builders in Japan have qualified architects on staff or possess the financial resources to hire architects to calculate the structural values required by the revised law. However, it is harder for small contractors to find qualified architects that they can afford to calculate structural values required for new condominiums and houses. In an effort to mitigate the effect of the revised building standards law on the construction industry, the Japanese government expanded loan guarantees for small and midsize builders and related industries (Bloomberg News 2007). The temporary relief program went into effect in November 2007 and continued through March of 2008.

This Building Standards Law will again be revised in December 2008 to include one and two story buildings. This change will affect the non-condominium residential construction market and is expected to strongly favor large residential construction builders who have the financial resources to hire qualified architects. One unanticipated result of the revision of the Building Standards Law could be a substantial consolidation of the residential construction industry.

Another unanticipated result of the Building Standards Law revision could be an increase in the market share for glulam beams. Mr. Miyazawa (2007), of the Japan Housing Newspaper, emphasized that the revision to the Building Standards Law will favor glulam beams over solid sawn lumber because the exact structural values are displayed on each glulam beam. Mr. Miyazawa predicts that architects, responsible for certifying the structural integrity of buildings, will favor glulam beams because of the greater ease of performance structural calculations.

2.1 The Impact of the Revised Building Code on Housing Starts

Japanese annual housing starts have averaged around 1.2 million units since 1998 (Figure 2.1). However, in 2007 housing starts dropped to 1.08 million units, which can partially be attributed to the revision of the Building Standards Law. This revision caused a bottleneck in the permitting process arising from a shortage of staff in the Ministry of Land, Infrastructure, and Transportation (MLIT) to process these building certification applications. Another factor was a shortage of qualified architects to calculate the structural strength of the condominiums. The revision was enacted in June of 2007 and housing starts dropped immediately.

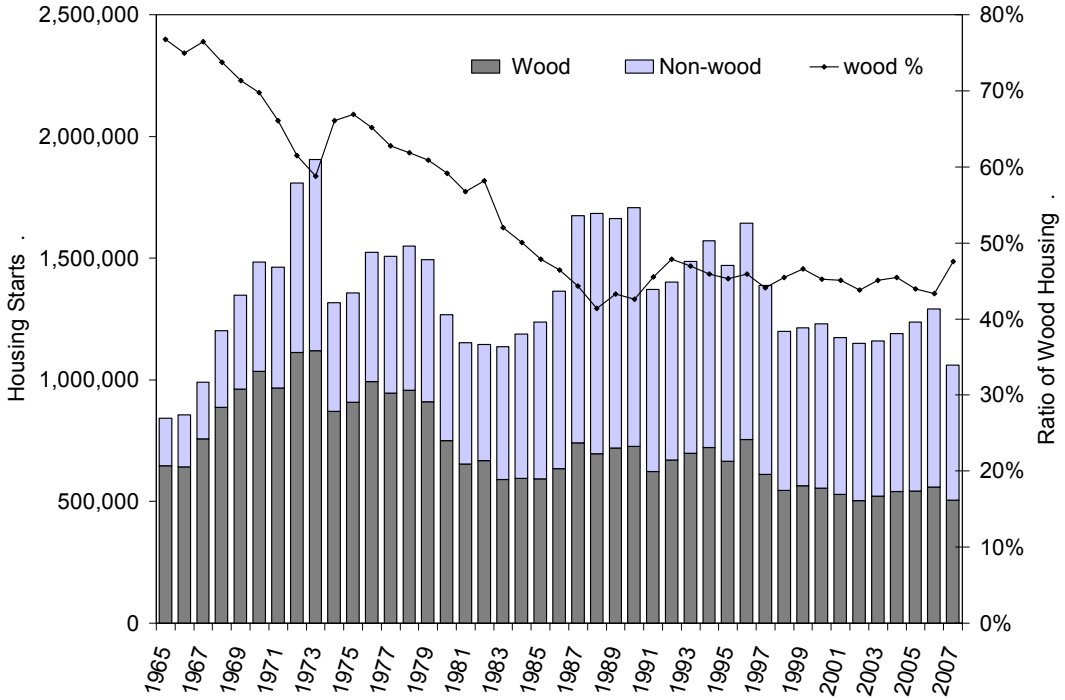

Figure 2.1: Annual Housing Starts in Japan
Source: MLIT 2008

In 2007, July housing starts were down 23.4 percent, August starts were down 43.3 percent, September starts were down 44 percent, and October starts were down 35 percent. Total housing starts are comprised of four categories: custom houses, spec houses, apartments, and condominiums. Since the revision to the Building Standards Law was targeted at buildings above two stories, apartment buildings and condominiums were the most adversely affected. For example, in September 2007, condominium starts were down 75 percent from the previous year and apartment starts were down 51 percent (Figure 2.2).

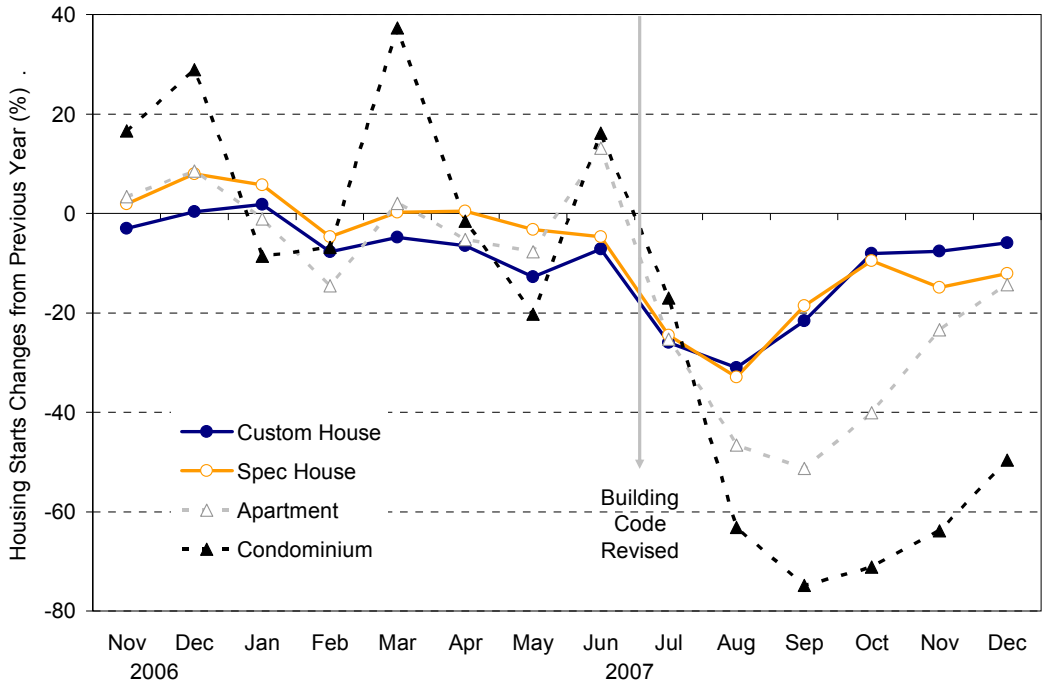

Figure 2.2: Monthly Housing Start Percentage Change from the Previous Year
Source: MLIT

In contrast to condominiums and apartment buildings, which are generally built using steel and concrete construction, approximately 90 percent of detached housing starts are wooden construction. The three primary types of wooden housing in Japan are traditional post and beam houses, 2x4 houses, and prefabricated houses (Figure 2.3). Post and beam comprised 77 percent, 2x4 comprised 20 percent, and prefab comprised 3 percent of 2007 wood housing starts. As noted above, the Building Standards law will further be revised in December 2008 to include one and two-story buildings. Since the current revision was targeted at buildings above two stories and not residential detached houses, wood housing starts were not as adversely affected as apartments and condominiums. However, this could change substantially with the implementation of the new provision to the Building Standards Law in December 2008.

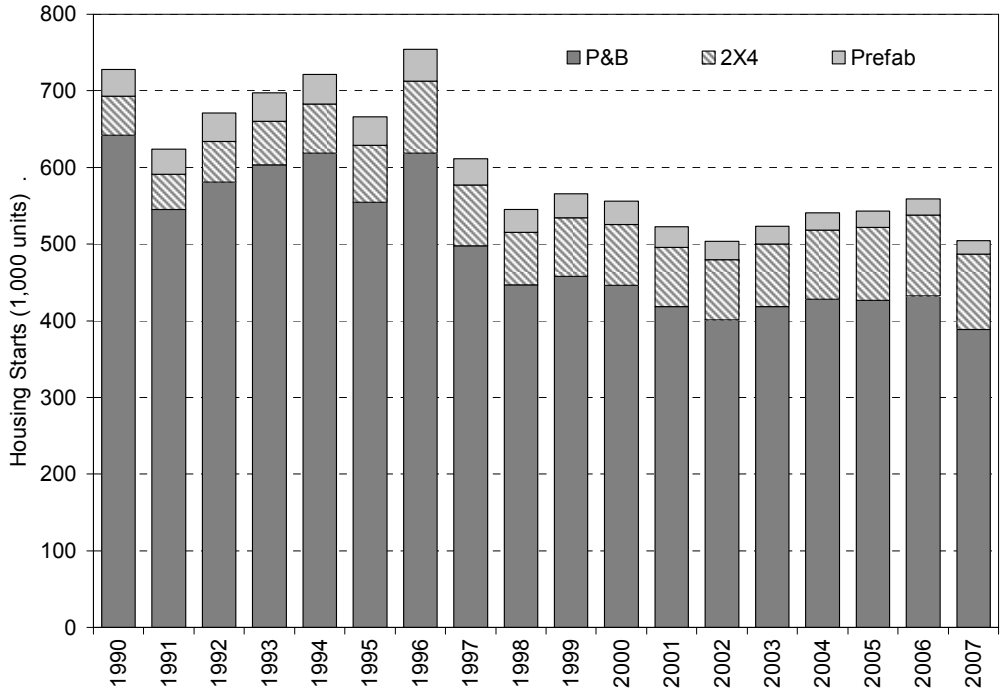

Figure 2.3: Annual Wooden Housing Starts by Construction Method
Source: MLIT

3. Changing Timber Supply

Japan's timber supply has changed dramatically since the early 1990's and several factors have contributed to this change. North America timber suppliers have lost significant market share to European and Russian timber suppliers, Japanese government policies have encouraged the use of domestic timber, and China's timber demand has increased significantly and all these factors have impacted Japan's demand for imported timber. Figure 3.1 illustrates that Japan is relying less on North America and South Sea log supplies and more on Russia log supplies. Lumber exports to Japan show a similar trend, with Japan relying less on North American supplies and more on European supplies (Figure 3.2).

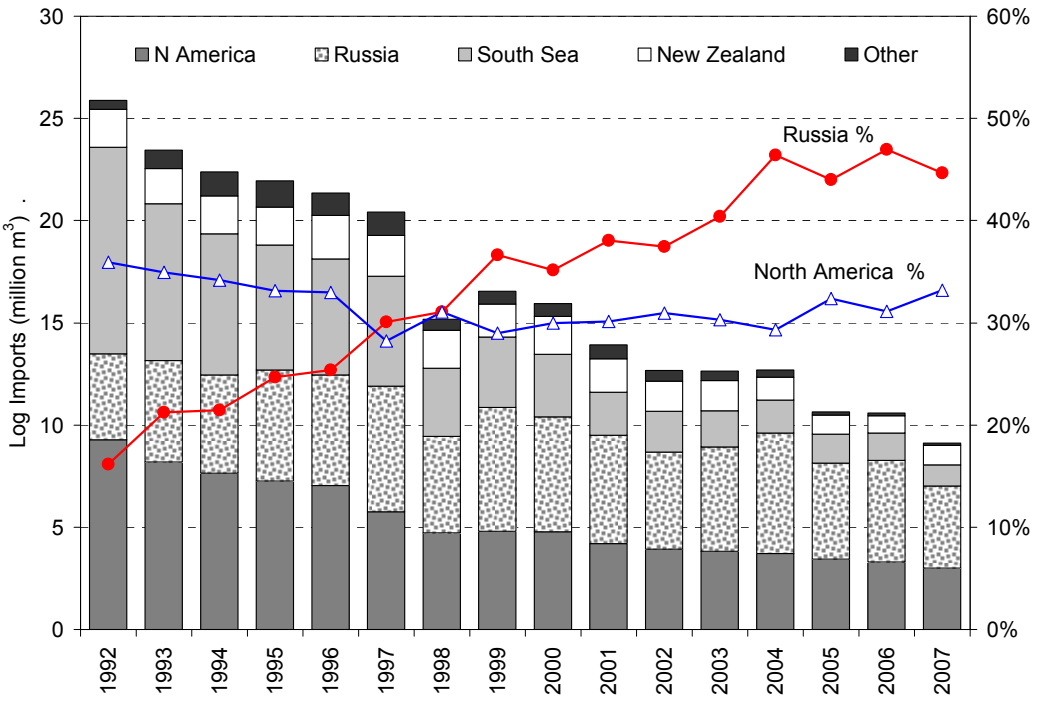

Figure 3.1: Log Imports to Japan by Region

Source: Japan Ministry of Finance and Customs

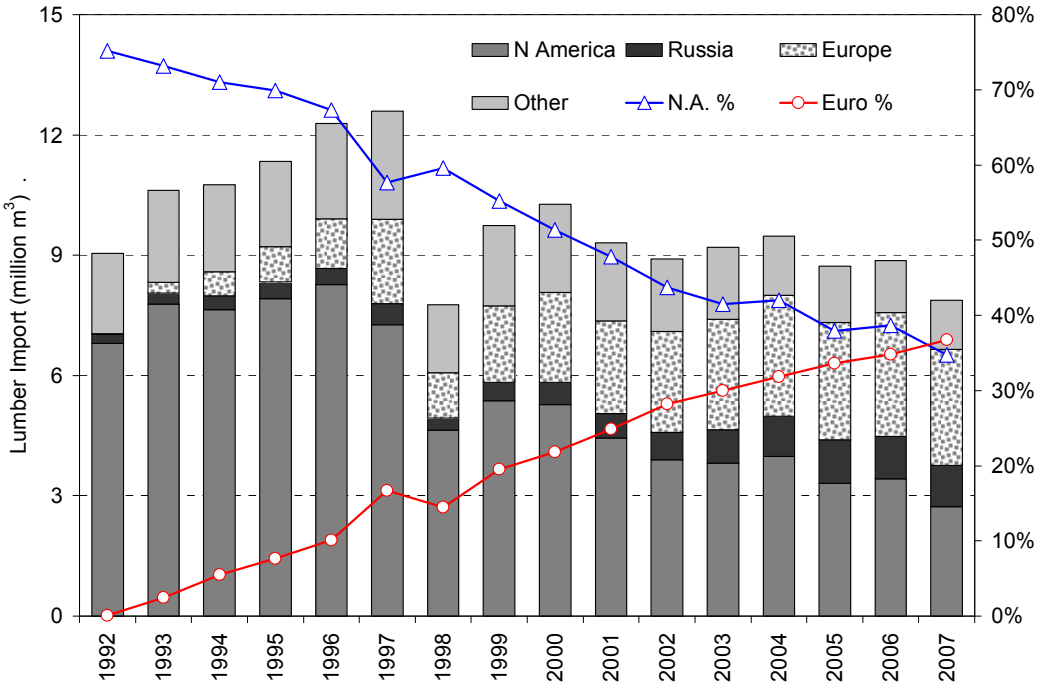

Figure 3.2: Lumber Imports to Japan by Region
Source: Japan Ministry of Finance and Customs

3.1 North American Log and Lumber Supply

North America has lost market share in Japan's forest products market due to a number of factors. First, the listing of the Northern spotted owl as an endangered species in 1990 constrained timber supply and resulted in substantial price volatility. Second, strong U.S. housing starts between 1996 and 2006 absorbed much of the U.S. supply and kept prices firm. Third, during the 1990's, the U.S. economy experienced strong economic growth, while the Japanese economy stagnated. This disparity in economic performance pushed the U.S. Dollar up against the Japanese yen making U.S. forest products relatively more expensive than those from other countries with weaker currencies (e.g. Canada and the E.U.). Fourth, European and Russian forest product's companies took advantage of the reduced competitiveness of U.S. wood products and increased their market share. The Europeans have been especially successful at defining the needs of the Japanese market and providing products that meet these needs (Sasatani et al. 2005). The following discussion examines various timber species and the change in their export volumes to Japan. The Japanese harmonized code categories for lumber were changed in 1997 making time series data comparisons before and after 1997 difficult. The three species affected by this change were Douglas-fir, SPF, and hemlock. Therefore, for these three species, estimates were used for the period before 1997 and these estimates are represented by dashed lines in the graphs below.

Sitka Spruce Imports from North America

Sitka spruce log and lumber exports to Japan have both decreased. As with some of the other species listed below, this decline can partially be attributed to the increased use of European whitewood. The U.S. exported 899,533 cubic meters of Sitka spruce logs to Japan in 1990 and this volume declined by 91 percent to 83,164 cubic meters by 2007 (Figure 3.3). Canada exported 85,972 cubic meters of Sitka spruce logs to Japan in 1990 and this volume declined by 41 percent to 50,832 cubic meters by 2007. However, total 2007 Sitka spruce log export volumes were slightly above the 2006 level of 38, 853 cubic meters. Although the U.S. exports more Sitka spruce logs than Canada, Canada has been increasing their

relative market share. In 1990, Canada exported 8.7 percent of the total North American Sitka spruce log exports to Japan and by 2007 this has increased to 38 percent.

The U.S. exported 23,685 cubic meters of Sitka spruce lumber to Japan in 1997 and this declined by 99 percent to 279 cubic meters by 2007 (Figure 3.4). Canada exported 164,640 cubic meters of Sitka spruce lumber to Japan in 1997 and this figure decreased by 82 percent to 29,546 cubic meters by 2007.

Sitka spruce logs from Alaska are highly valued in Japan for their narrow growth rings and straight grain with few defects. While Sitka spruce wood is often used in the production of musical instruments, its major use in Japan is in a wide range of products intended for appearance end-uses in traditional tatami rooms in post and beam houses. Over the past decade, a combination of changing homeowner preferences and the slow economy have reduced the demand for traditional tatami rooms and therefore reduced the demand for Sitka spruce logs and lumber. However, a larger concern in Japan has been concern over the reliability of the Sitka spruce log supply in Alaska. Fundamentally, the reduced supply from the Tongass National Forest in SE Alaska has had an adverse effect on demand in Japan. In response to these perceived supply uncertainties, the Japanese have increased their imports of Chinese cedar and Russian larch although both of these species are viewed as being lower in quality that Sitka spruce from SE Alaska.

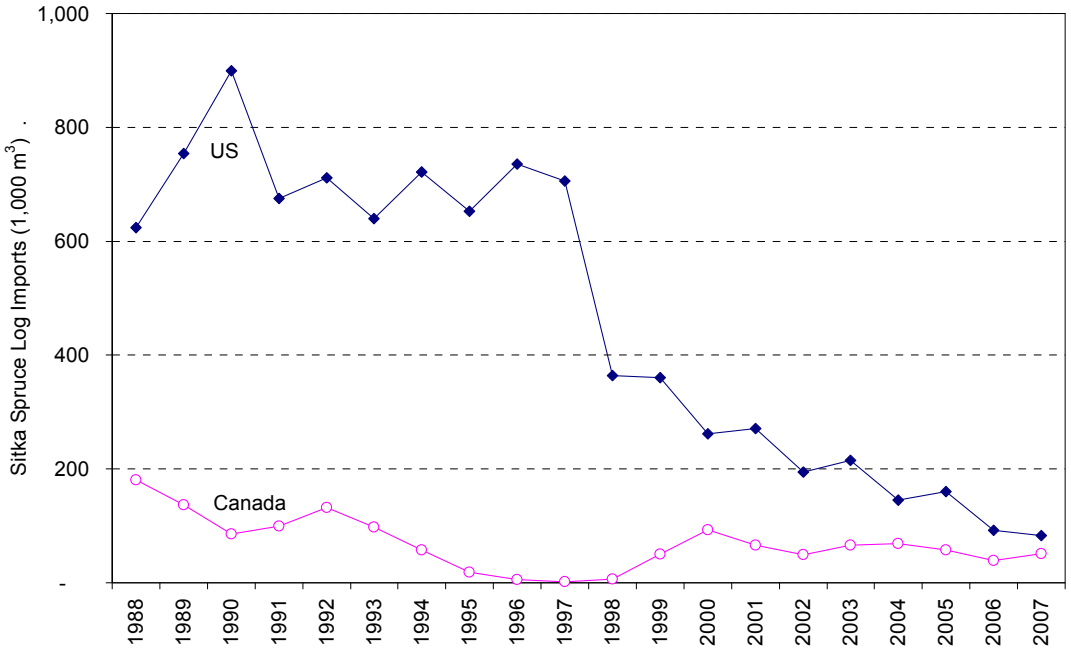

Figure 3.3: Sitka Spruce Log Imports from North America
Source: Japan Ministry of Finance and Customs

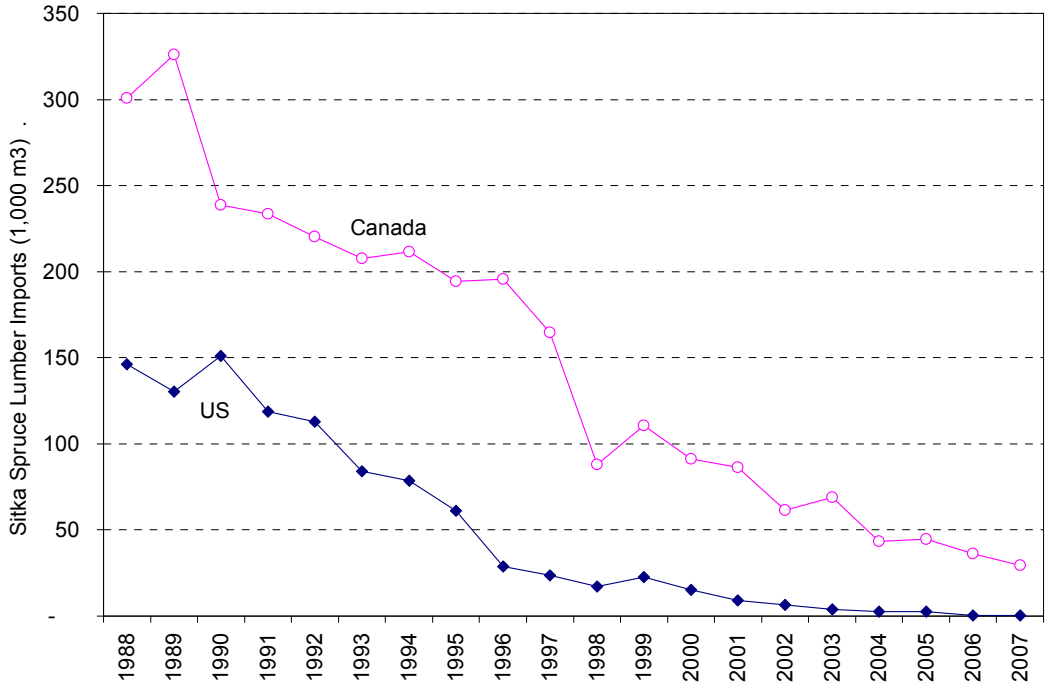

Figure 3.4: Sitka Spruce Lumber Imports from North America
Source: Japan Ministry of Finance and Customs

Hemlock Imports from North America

Hemlock log and lumber exports to Japan from North America have also declined dramatically. As hemlock volumes have decreased, Japanese sugi and Japanese hinoki and European whitewood volumes have increased. The U.S. exported 2.2 million cubic meters of hemlock logs to Japan in 1990 and this volume declined by 98 percent to 47,435 cubic meters by 2007 (Figure 3.5). Canada exported 180,027 cubic meters of hemlock logs to Japan in 1990 and this volume declined by 17 percent to 157,539 by 2007.

As with logs, hemlock lumber volumes have also declined. The U.S. exported 492,751 cubic meters of hemlock lumber to Japan in 1997 and this declined by 98 percent to 9,198 cubic meters by 2007 (Figure 3.6). Canada exported 2.1 million cubic meters of hemlock lumber in 1997 and this figure decreased by 73 percent to 578,675 cubic meters by 2007.

Hemlock has been traditionally used in post (hashira) applications in Japanese post and beam construction. However, following the devastating Kobe earthquake in 1995, the post and beam industry increasingly shifted towards the use of pre-cut structural components. Because of the requirements of the pre-cutting equipment and the exacting size tolerances for lumber used within the pre-cut industry, the demand for post material shifted from green lumber to kiln dried lumber. This shift placed hemlock at a significant competitive disadvantage to other materials because of the fact that hemlock lumber has an uneven distribution of moisture in the green lumber caused by the occurrence of wet pockets. These wet pockets make drying hemlock lumber extremely time consuming and expensive and contribute to substantial product degrade and uneven moisture distributions within the lumber (even after the lumber has been kiln dried). At the same time, European kiln dried whitewood (primarily spruce) glulam post began to enter the market and the combination of stable moisture content, exacting size tolerances, low prices and the willingness of European suppliers to provide three month forward pricing caused pre-cut manufacturers to favor European whitewood over hemlock. The result of this regulatory change and the

resultant shift in end-user preferences shift in the market was the loss of significant market share for hemlock suppliers in North America (Figures 3.5 and 3.6).

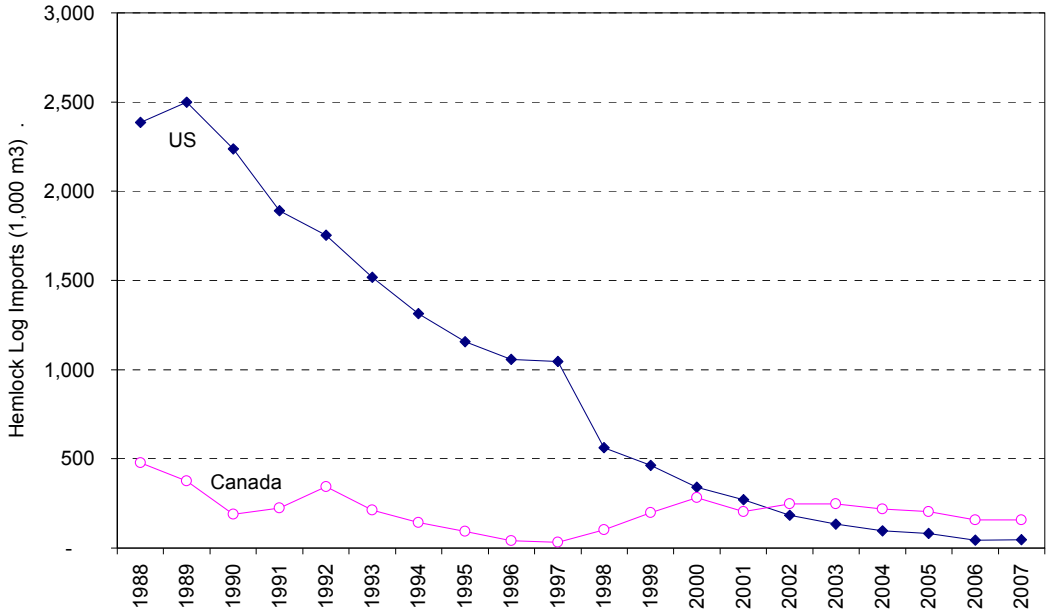

Figure 3.5: Hemlock Log Imports from North America
Source: Japan Ministry of Finance and Customs

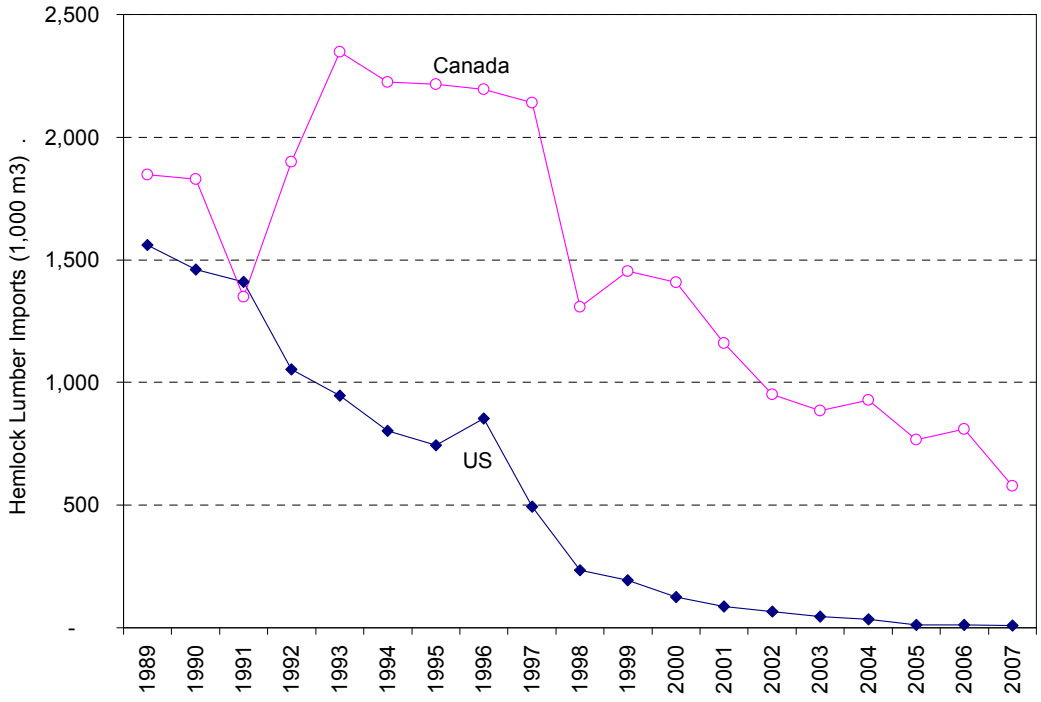

Figure 3.6: Hemlock Lumber Imports from North America
The dotted lines are estimated figures
Source: Japan Ministry of Finance and Customs

Yellow and White-Cedar Imports from North America

The Japanese trade statistics combine both yellow and white cedar log and lumber imports into a single category, making it difficult to identify individual trends for each species. However, the Japan Lumber Importers Association does break out yellow cedar in their summary trade statistics. The 2007 JLIA data suggests that as much as 90% of the US and virtually all of the Canadian exports of yellow and white cedar exports are comprised of yellow cedar. As a result, this section will focus its discussion on yellow cedar. Overall, yellow cedar volumes have declined. Yellow cedar is a naturally durable species and one of the reasons for its decline was the increase in popularity of treated lumber such as larch. The U.S. exported over 160,000 cubic meters of yellow cedar logs to Japan in 1990 and this declined to just over 20,000 cubic meters by 2007 (Figure 3.7). While U.S. yellow cedar log export volumes to Japan declined, Canada log export volumes have increased. Canada exported over 9,000 cubic meters of yellow cedar logs to Japan in 1990 and over 20,000 cubic meters in 2007.

As with log exports, lumber exports of yellow cedar to Japan declined dramatically. The U.S. exported 3,150 cubic meters of yellow cedar lumber to Japan in 1997 and this declined to just 360 cubic meters in 2007 (Figure 3.8). Similarly, Canada exported over 227,000 cubic meters of lumber to Japan in 1997 and this figure decreased by half to just 111,857 cubic meters by 2007.

Yellow cedar is a naturally decay resistant timber species that is often used in ground contact applications in post and beam construction such as ground sills (dodai), floor posts (tsuka), girders (obiki) and floor joists (neda). It is also used as ground sills in 2x4 construction in Japan as well. Yellow cedar is frequently used produce lamina for the manufacture of glued laminated posts (hashira) as well as dodai. Higher grades of yellow cedar are often used to produce specialty moulding products for use in tatami room in traditional post and beam houses. However, this usage is shrinking as many younger Japanese home buyers increasingly show a preference for western designs and architectural styles that do not include a tatami room.

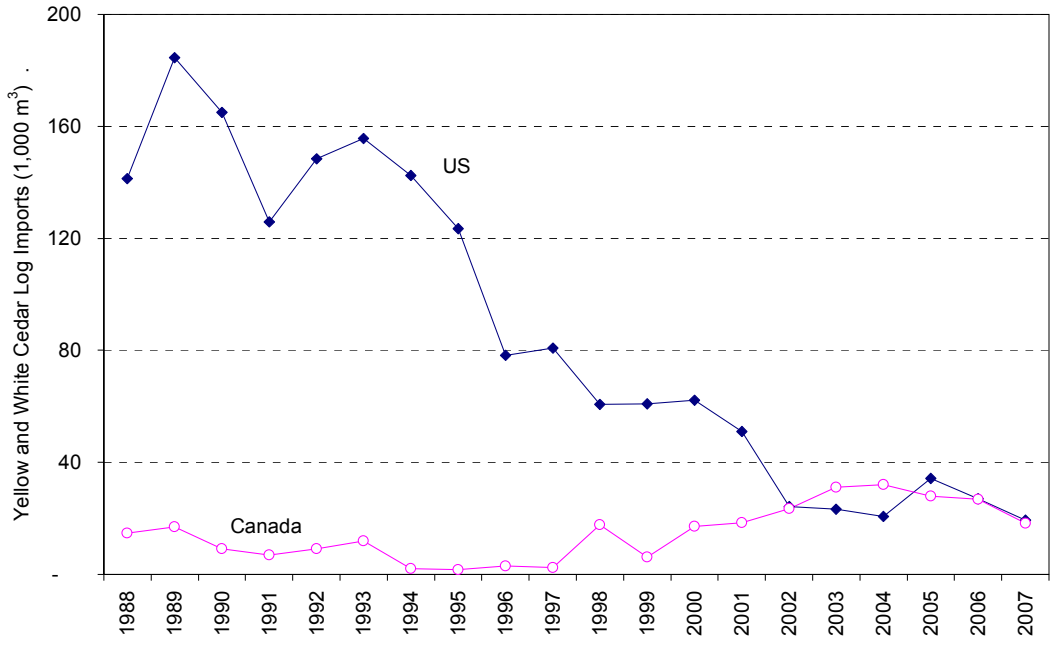

Figure 3.7: Yellow and White-Cedar Log Imports from North America

Source: Japan Ministry of Finance and Customs

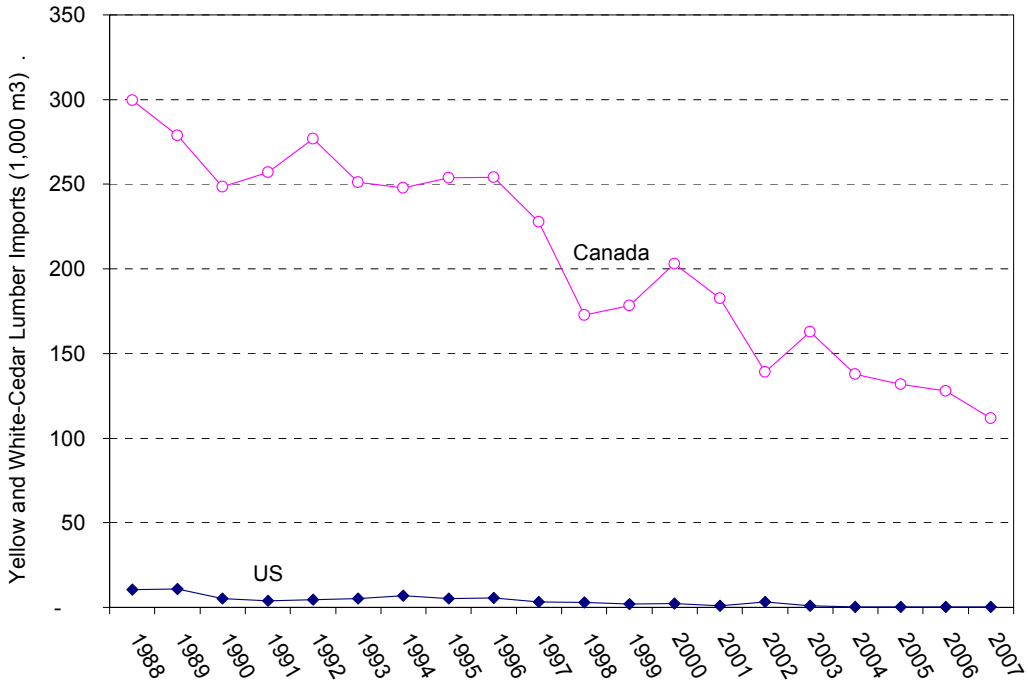

Figure 3.8: Yellow and White-Cedar Lumber Imports from North America
Source: Japan Ministry of Finance and Customs

Spruce, Pine, and Fir (SPF) Imports from North America

A majority of the SPF logs and lumber imported from North America is used within the 2x4 housing sector. Over the past thirty years, 2x4 housing starts have steadily increased their share of total housing starts and this has mostly benefitted SPF lumber exports from Canada. As shown in the tables below, most SPF is exported to Japan as dimension lumber from Canada rather than in the form of logs.

The U.S. exported 581,157 cubic meters of spruce and fir logs to Japan in 1990 and this declined by 94 percent to 32,035 cubic meters by 2007 (Figure 3.9). Canada exported 163,667 cubic meters of spruce and fir logs to Japan in 1990 and this volume declined by 30 percent to 115,017 by 2007.

Canada exported 1.65 million cubic meters of SPF lumber to Japan in 1997 and this figure declined slightly to 1.42 million cubic meters in 2007. In contrast to Canada, the U.S. exports only a small amount of SPF lumber. The U.S. exported 41,486 cubic meters of SPF lumber to Japan in 1997 and this declined by 65 percent to 14,322 cubic meters by 2007 (Figure 3.10).

The SPF species mix is primarily used within the Japan 2x4 residential construction industries. The 2x4 construction industry has been one of the bright spots in the residential construction industry. Since its introduction into Japan in the early 1970's, 2x4 housing starts have increased steadily from 168 in 1974 to 998,555 in 2007. By 2007, 2x4 housing starts represented 19.5% of wood housing starts in Japan. Historically, this has been a market segment that the Canadians have dominated, partly because of the traditional strength of the US dollar and partly because of the willingness of Canadian mills to provide high quality J grade dimension lumber. As a result, US exports of SPF logs have declined precipitously since 1989. In contrast, Canadian SPF log exports have increased modestly to exceed 100,000 cubic meters for the first time since 1994. Canadian exports of SPF lumber, the vast majority of which comes from sawmills in interior BC and Alberta, have increased rapidly from 440,000 cubic meters in 1988 to

1.62 million cubic meters in 2006. However, the strong Canadian dollar and the revision to the BSL adversely affected Canadian SPF lumber exports and they dropped to 1.41 million cubic meters in 2007. Interestingly, the strength of the 2x4 sector in Japan in conjunction with the strong performance of the US housing industry during the period 1991-2005 resulted in a large number of European sawmills gaining grade stamp approval to produce dimension lumber. This development resulted in substantial volumes of European dimension lumber finding its way not only into the US but also Japan, where it competed successfully against North American SPF dimension lumber. However, in the past two years the strength of the Euro has caused most of the European sawmills to discontinue exports of dimension lumber into both the US and Japan.

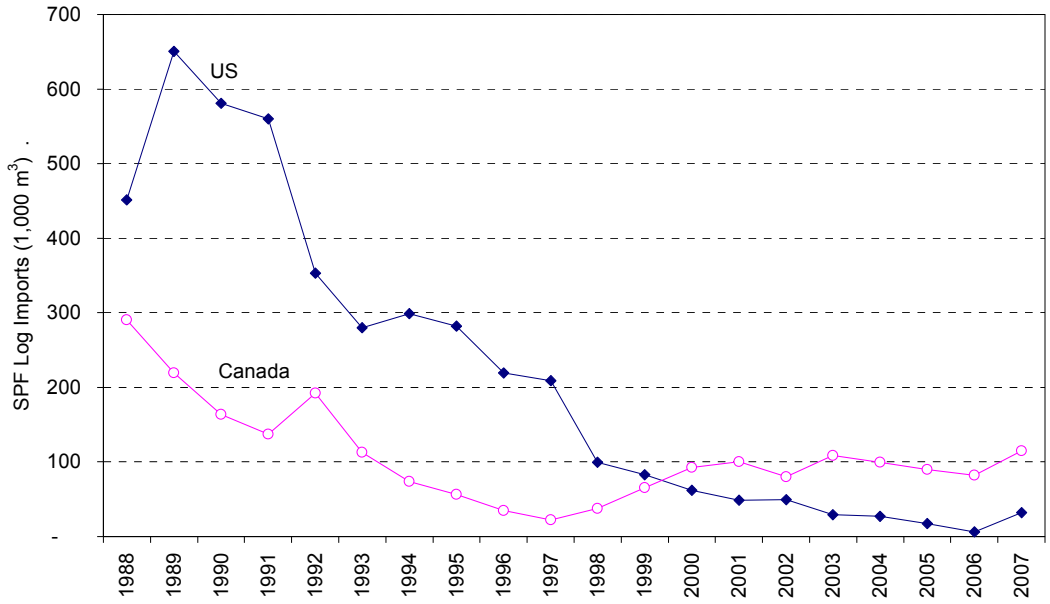

Figure 3.9: SPF Log Imports from North America

Source: Japan Ministry of Finance and Customs

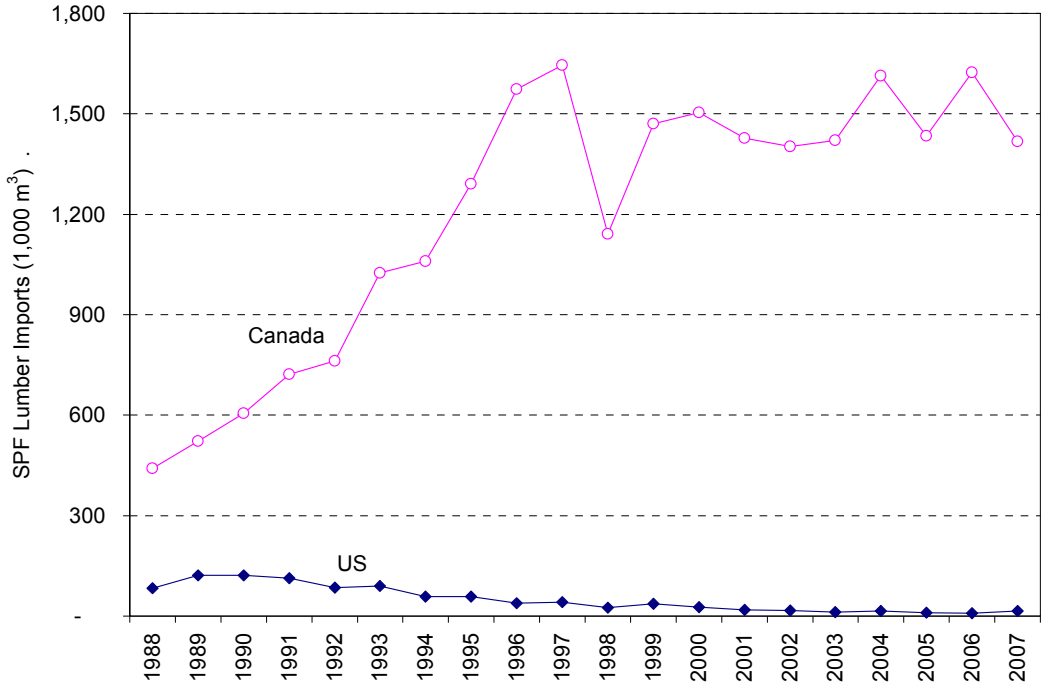

Figure 3.10: SPF Lumber Imports from North America
Source: Japan Ministry of Finance and Customs

Douglas-fir Log Imports from North America

Overall, Douglas-fir import volumes have been decreasing. Douglas-fir is normally used for structural beams in Japanese post and beam construction and part of its decline can be attributed to the increased usage of glulam beams instead of solid sawn beams. The U.S. exported 6.2 million cubic meters of Douglas-fir logs to Japan in 1990 and this declined by 69 percent to 1.9 million cubic meters by 2007 (Figure 3.11). Canada exported 43,525 cubic meters of Douglas fir logs to Japan in 1990 and this volume increased by approximately ten times to 458,217 cubic meters by 2007.

The U.S. exported 690,647 cubic meters of Douglas-fir lumber to Japan in 1997 and this declined by 84 percent to 112,334 cubic meters by 2007 (Figure 3.12). Canada exported 975,914 cubic meters of Douglas-fir lumber to Japan in 1997 and this figure decreased by 74 percent to 254,316 cubic meters by 2007. Part of this decrease in Douglas-fir can be explained by increased imports from Russia as explained below.

Douglas-fir logs are used in Japan to produce solid sawn hirakaku (beams) and other structural components for use in Japan's post and beam construction sector. Douglas-fir has traditionally been the preferred species for hirakaku. In the early 1990's because of its unique combination of strength, beauty and durability. In the early 1990's the combination of the strong US dollar, volatility in log and lumber export prices, and the spotted owl ruling caused many home builders and precutting manufacturers in Japan to perceive that there could be problems maintaining a reliable supply of Douglas-fir into the future. It is against this backdrop that the European glued laminated beam manufacturers targeted Japan as a strategic market opportunity. By 1993 European sawmills began to aggressively market whitewood laminated lumber for posts (hashira) into Japan. This product was hugely successful in Japan and it quickly undermined hemlock log and lumber exports from North America. However, whitewood laminated lumber was widely perceived as having poor durability and low strength. Thus most homebuilders and precutters were reluctant to use this product in beam applications. In response,

European sawmills began using red pine for glulam beams, and although red pine is not as strong as Douglas-fir, its red color makes it look similar to Douglas-fir. Similar to the case with European whitewood in the hemlock market, the combination of stable moisture content, exacting size tolerances, low prices and the willingness of European suppliers to provide three month forward pricing caused pre-cut manufacturers to begin to substitute European red pine beams for Douglas-fir. Over the course of the past ten years, European red pine beams have made significant inroads into Japan, although most of the red pine beams are smaller in cross-sectional size, with Douglas-fir still being the favored species for beams with large cross-sectional areas because of its superior strength characteristics. As the market situation deteriorated in Japan, most US Douglas-fir sawmills cutting metric sizes specifically for the Japanese market began to shut down their export operations in favor of producing dimension lumber for the rapidly expanding US housing sector.

In contrast, Douglas-fir logs exports continued to provide the raw material input for an important segment of the Japanese sawmills industry which produced hirakaku and other structural components for the post and beam industry in Japan. This segment of the sawmill industry, which is primarily located in the area around Hiroshima, remains a strong consumer of Douglas-fir logs today. Correspondingly, the increased use of glued laminated hirakaku within the post and beam industry provided an opportunity for these Japanese Douglas-fir sawmills to diversify into the production of lamina lumber as well as, in some cases, the production of laminated beams.

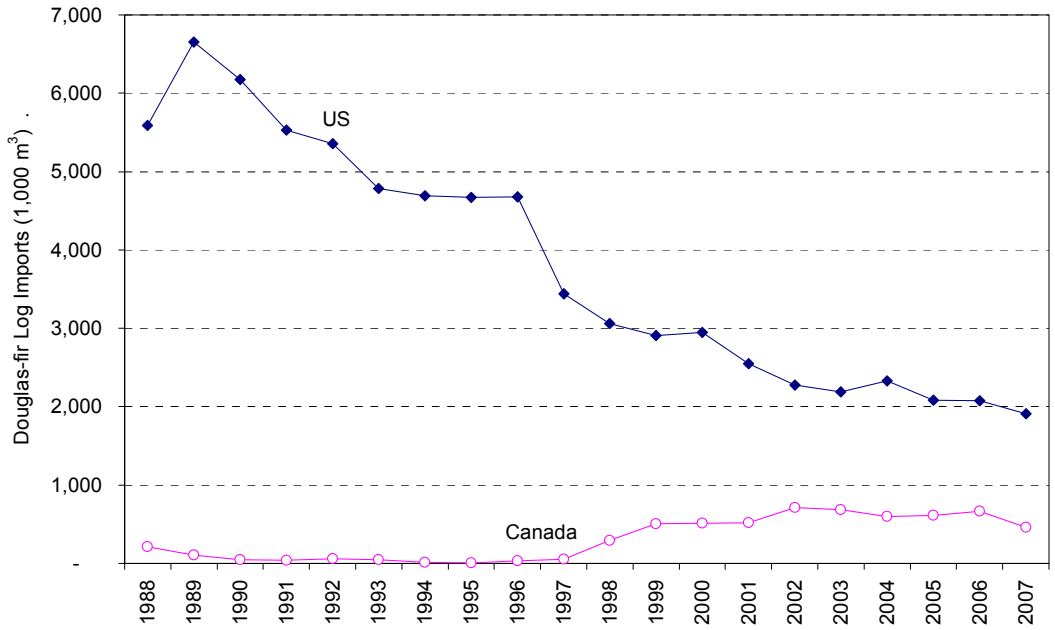

Figure 3.11: Douglas-fir Log Imports from North America
Source: Japan Ministry of Finance and Customs

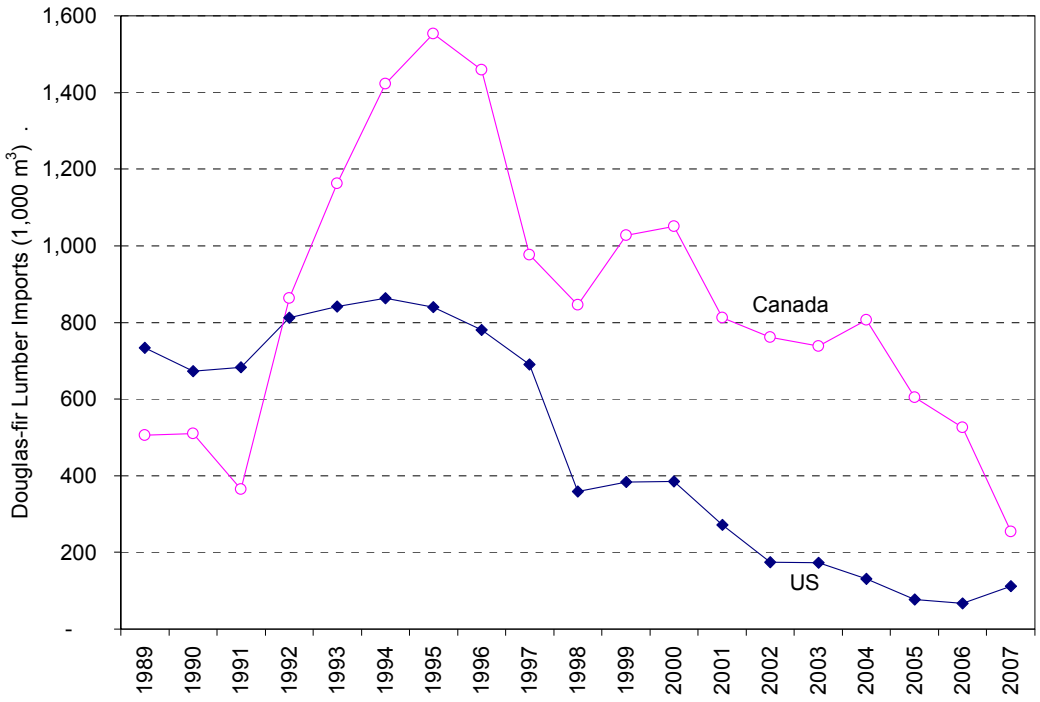

Figure 3.12: Douglas-fir Lumber Imports from North America

Source: Japan Ministry of Finance and Customs

3.2 Russian Log and Lumber supply

One problem confronting Japan's lumber and plywood mills is that Russia imposed a log export duty of 20 percent on January 1, 2007 and this increased to 25 percent April 1, 2008. This log export duty is in an attempt to increase value-added processing within Russia (Japan Lumber Journal 7/31/2007). The Russian government further announced that this log export duty will escalate to 80 percent on softwood logs 40 percent on hardwood logs by January 1, 2009 (Table 3.1). As Figure 3.13 shows, this has drastically increased the price of exported Russian softwood logs.

Table 3.1: Russia's Escalating Export Tariff Rate

Item	Jan/1/2007	Apr/1/2008	Jan/1/2009
Softwood Logs	20%	25%	80%
Hardwood Logs	20%	20%	40%
Poplar	10%	10%	80%
Semi finished products with bark. Thickness of 15cm or less	10%	15%	50%

Source: Japan Lumber Journal 2007

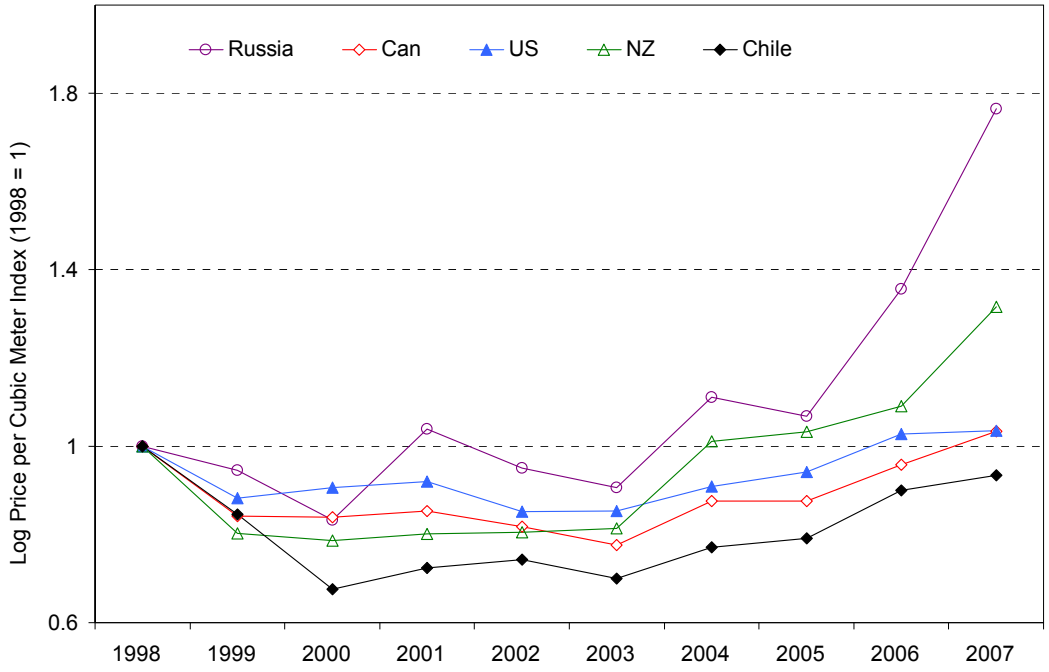

Figure 3.13: Index of Log Import Price by Country of Origin

Source: Japan Ministry of Finance and Customs

As a result of Russia's log export duty, China and Japan are searching to diversify their log supply so that they are less reliant on Russian logs. This not only affects Japan's Russian log supply, but also Japan's forest product imports from China. China manufactures Russian logs into finished products including lumber, laminated lumber, flooring, and furniture. The increased cost of Russian logs, caused by the log export duty, opens up opportunities for other regions to supply hardwood and softwood logs to Japan and China.

Log Imports from Russia

As Figure 3.14 shows, Russia's three main species of softwood log exports to Japan are larch, red pine and spruce/fir (spruce mixed with some fir). Although there was a slight decrease in overall volume from 1996 to 2007, the percentage of Russian log exports to Japan increased from 25.4 percent to 44.6 percent.

Russian logs have traditionally been used in the plywood and sawmill industries in Japan. High quality Russian larch logs are generally peeled to produce face veneer for structural plywood. Sawlogs are generally used to produce smaller structural components for post and beam housing (e.g., taruki, keta and mabashira). Russian larch is also being used to a smaller extent to produce lamina for laminated posts and beams.

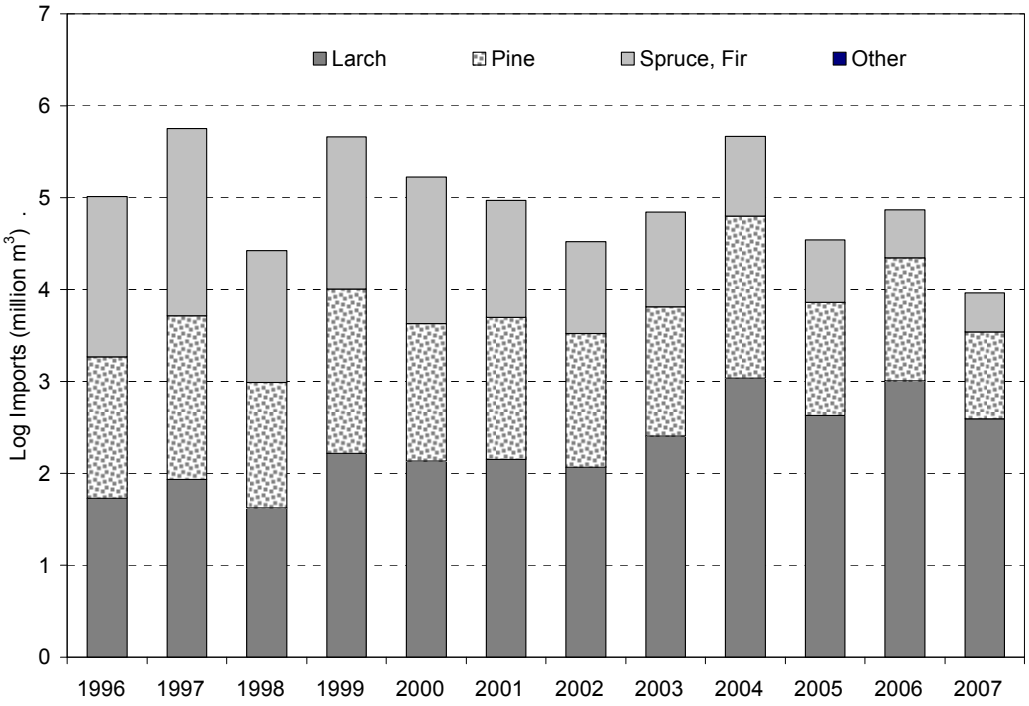

Figure 3.14: Japanese Softwood Log Imports from Russia
Source: Japan Ministry of Finance and Customs

Lumber Imports from Russia

As with logs, Russia's three main species of softwood lumber exports to Japan are spruce/fir, pine, and larch. From 1996 to 2007, Russian lumber exports have increased significantly from 405,693 cubic meters to slightly over 1 million cubic meters (Figure 3.15).

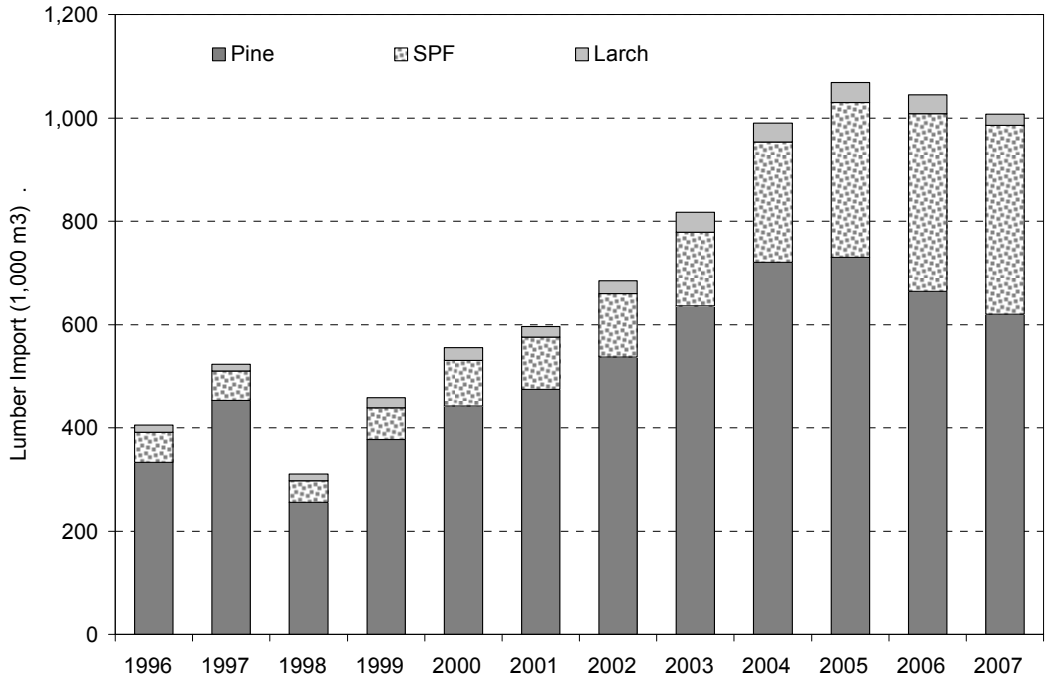

Figure 3.15: Softwood Lumber Imports from Russia
Source: Japan Ministry of Finance and Customs

In summary, Japan is affected by the Russian log export tariff in two ways. First, as explained above, the tariff increases the cost of logs imported directly from Russia. Second, the tariff increases the cost of secondary forest products manufactured in China from Russian logs and exported to Japan. As the Russian log export tariff escalates and the cost of Russian logs increases, two opportunities will arise for Alaska's forest products industry. First is the opportunity to export logs or cants from Alaska to Japan. This would help Japanese importers reduce their reliance on Russian logs. Second is the opportunity to export lumber products to Japan.

3.3 Japanese Domestic Log and Lumber Supply

Almost all of the industry experts interviewed in Japan expect the usage of domestic timber species to increase in the future. This is true despite the problems with Japanese *sugi* including its low strength values, difficulty with kiln drying, and high transportation costs to end-use markets. However, Ms. Kitagawa of the Japan Lumber Journal pointed out that many mills feel they must diversify their raw material resource base in the face of declining European and Russian timber supplies (Kitagawa 2007). These mills are very concerned about the future supply of Russian and European wood. Furthermore, local governments often offer incentives to encourage the use of domestic species in residential construction. Even though the use of *sugi* causes some problems, Ms. Kitagawa stated that the industry is figuring out ways to work around these problems such as developing improved drying methods and designing one-story houses that allow the use of lower strength sugi lumber.

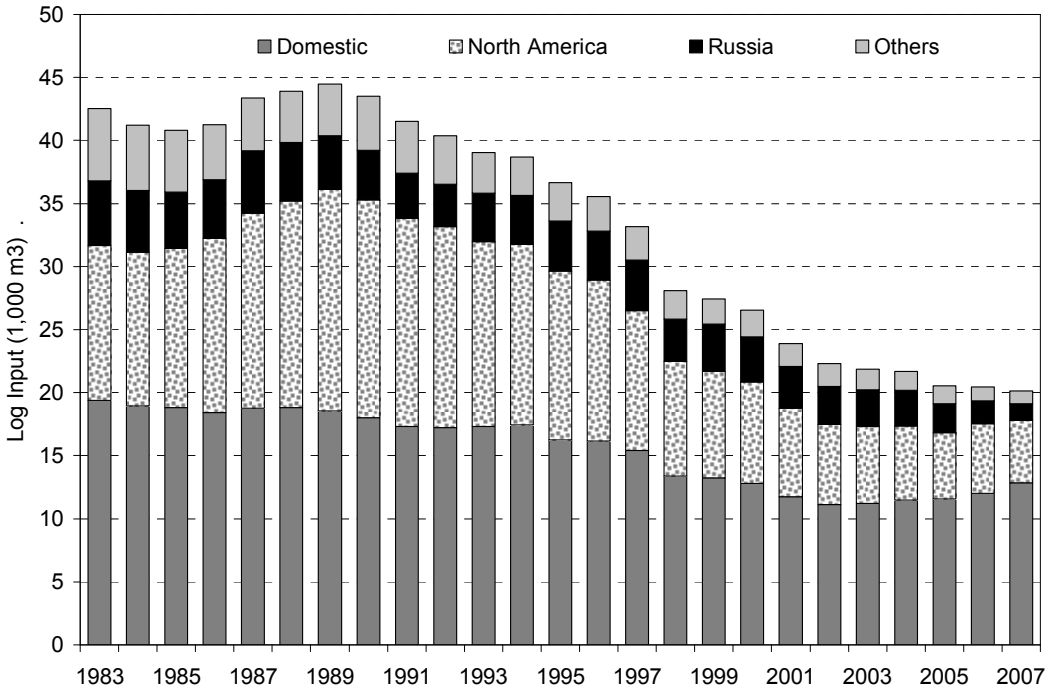

Figure 3.16: Quantity of Japan's Sawmill Log Usage by Region
Source: MAFF

In addition to industry experts, the data also shows an increased usage of domestic timber. Figure 3.16 shows the origin of logs utilized by Japan's sawmills. The volume of domestic logs used by Japanese sawmills has been steadily increasing since 2002. Figure 3.17 shows the percentage of North American logs and domestic logs being used by sawmills. From 1990 to 2006, the percentage of domestic logs used by sawmills increased from 41 percent to 61 percent. In contrast, the percentage of North American logs decreased from 40 percent to 23.6 percent.

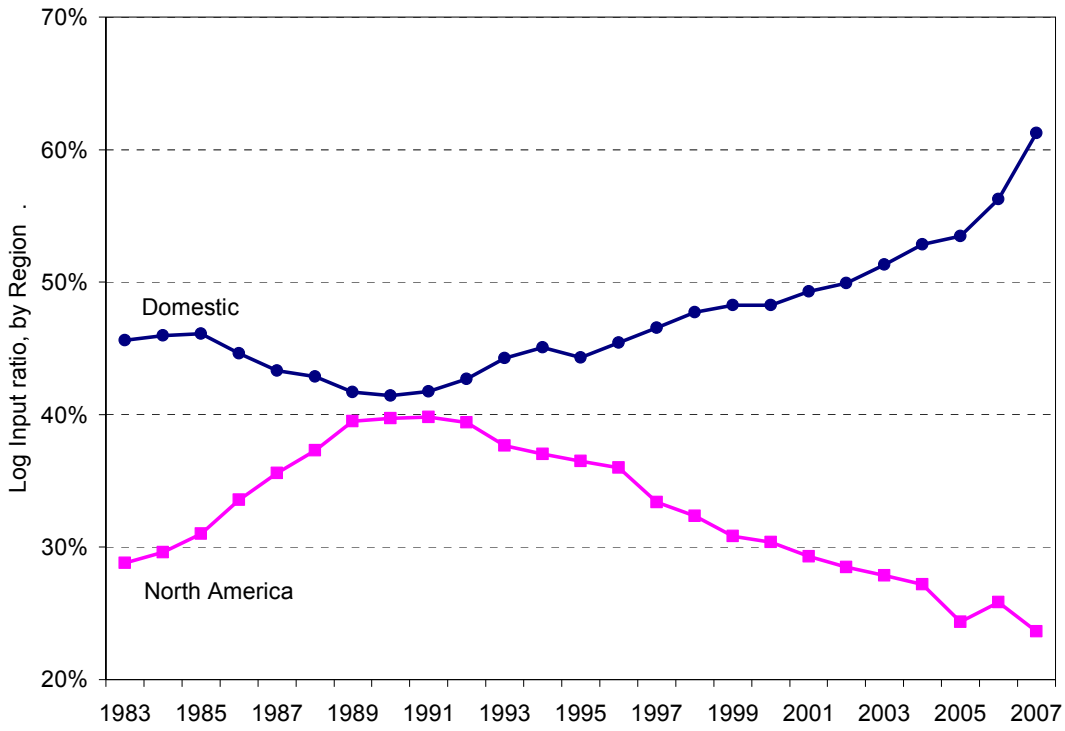

Figure 3.17: Percentage of Japan's Domestic Sawmill Log Usage by Region
Source: MAFF

Figure 3.18 shows a similar trend for lumber usage. The region is based on where the timber was originally sourced from rather than where it was milled. For example, if a log was imported from the U.S. and milled in Japan, it would show up on this graph as U.S. origin. In 1992, 34 percent of Japan's lumber consumption originated from U.S. timber and this declined to 11 percent by 2007. These figures illustrate how Japan has come to rely less on North American timber and more on Europe, Russia, and domestic timber supply. However, the Russian log export duty offers opportunity for Alaska forest products producers to increase their Japanese market share. Furthermore, as will be explained below, the weak U.S. Dollar has reduced the relative cost of U.S. forest products in the Japanese market.

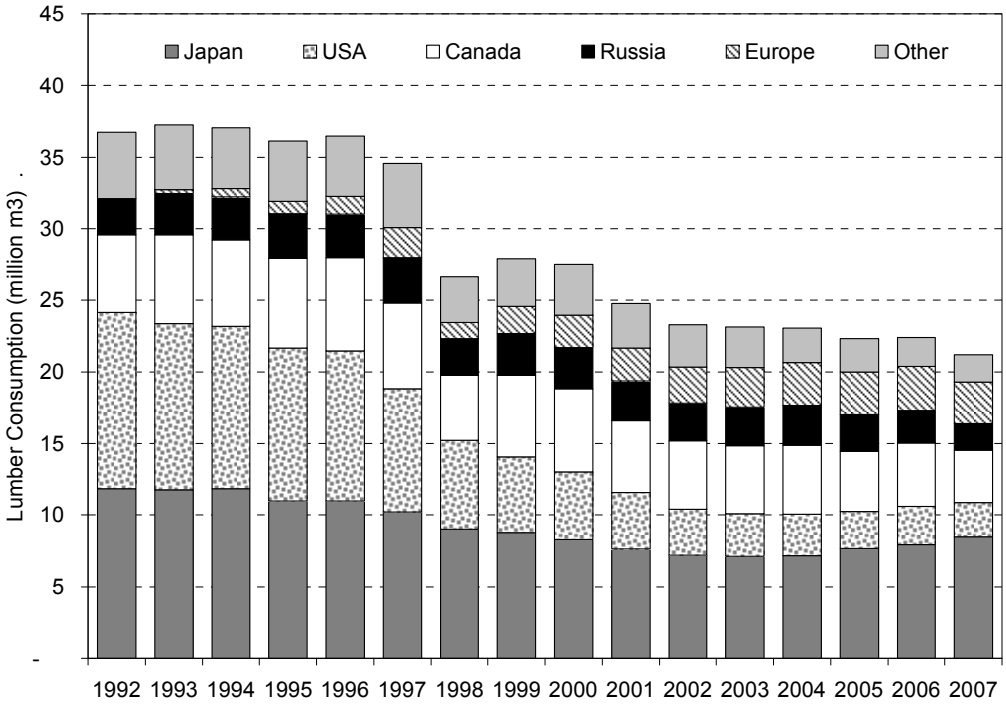

Figure 3.18: Estimate of Japan's Quantity of Lumber Consumption by Region of Origin
Source: MAFF

4. Increasing Green Building Awareness

Green building has been progressing in Japan through government procurement programs, green building certification, and regulations limiting the amount of formaldehyde in forest products.

4.1 CASBEE – Green Building Certification

Green building certification systems are gaining popularity globally. The United States has the Leadership in Energy and Environmental Design (LEEDS) and the National Association of Home Builders (NAHB) Green Building Program, the U.K. has the Building Research Establishment Environmental Assessment Method (BREEAM), and the European Commission has the Green Building Programme (GBP). Similar to these certification programs, Japan has developed the Comprehensive Assessment System for Building Environmental Efficiency (CASBEE). The certification standard's development and management of CASBEE fall under the jurisdiction of Japan's Sustainable Building Consortium, which was formulated in April 2001 (CASBEE 2004).

There are two CASBEE systems, one for commercial buildings and one for residential houses. The CASBEE framework for commercial buildings includes four basic certification areas: pre-design, new construction, existing building environmental management, and renovations. The ratings cover four basic areas: energy efficiency, resource efficiency, local outdoor environment, and indoor environment. The CASBEE scoring system is based on the building environmental quality (designated as "Q") and the performance and building environmental loadings (designated as "LR") (Table 4.1). The Q value is then divided by the L value to calculate the Building Environmental Efficiency (BEE) as follows:

BEE = Q/LR

The environmental quality component (Q) consists of indoor environment, quality of service, and outdoor environment (Table 4.1). These components are then further broken down as follows:

Indoor Environment

- Noise and Acoustics – This evaluates the background noise that affects the building occupants. Points are awarded for noise countermeasures such as quiet air conditioning, sound insulation, and sound absorption to stop sound reverberation in the rooms.
- Thermal Comfort - This evaluates the setting, control, and maintenance for building temperature, humidity, air conditioning, and other related equipment.
- Lighting – This evaluates the efficient use of natural lighting, direct sun light glare prevention measures, and other lighting factors related to the building environment.
- Air Quality – This evaluates the indoor air quality based on safe materials used within the building, the construction method, and ventilation.

Quality of Service

- Service Ability – This evaluates the ease of movement within the building and comfort of the building. The measurement criteria include floor area per occupant, ceiling height, technology compatibility, and availability of space to relax.
- Durability and Reliability – Evaluates the building structure and ability to maintain the building. This includes earthquake resistance, reliability of emergency systems, and the durability of interior and exterior finishes.
- Flexibility and Adaptability – Evaluates the long term ability of the structure to be adapted for new uses. For example, the ability of the current structure to adapt story height and floor layout for future building renewal projects.

Outdoor Environment on Site

- Preservation and Creation of the Biotope – This evaluates the efforts to conserve and create biotope for wild organisms. The purpose is to evaluate the potential habitat for plants and animals in the vicinity of the structure.
- Townscape and Landscape – Evaluates how well the urban context and the surrounding scenery have been considered.
- Local Characteristics and Outdoor Amenity – This evaluates how well the building fits in with the local topography, culture, and the general surrounding area. It also evaluates how well the building staff maintain relationships with the surrounding community.

Table 4.1: Q Value - Environmental Quality and Performance of the Building

Q-1. Indoor Environment	1. Noise & Acoustics	1.1 Noise
		1.2 Sound Insulation
		1.3 Sound Absorption
	2. Thermal Comfort	2.1 Room Temperature Control
		2.2 Humidity Control
		2.3 Type of Air Conditioning
	3. Lighting & Illumination	3.1 Natural Lighting
		3.2 Anti-Glare Measures
		3.3 Lighting Level
		3.4 Lighting Controllability
	4. Air Quality	4.1 Source Control
		4.2 Ventilation
		4.3 Operation Plan
Q-2. Quality of Service	1. Service Ability	1.1 Functionality & Usability
		1.2 Amenity
	2. Durability & Reliability	2.1 Earthquake Resistance
		2.2 Service Life of Components
		2.3 Reliability
	3. Flexibility & Adaptability	3.1 Spatial Margin
		3.2 Floor Load Margin
		3.3 Adaptability of Facilities
Q-3. Outdoor Environment on Site	1. Preservation of the Biotope	No further description
	2. Townscape & Landscape	No further description
	3. Local Characteristics & Outdoor Amenity	3.1 Attention to Local Character & Comfort Improvement
		3.2 Thermal Environment Improvement

The components of reducing environmental loadings of buildings (LR) consist of energy, resources and materials, and off-site environmental considerations. (Table 4.2). These are then further broken down as follows:

Energy

- Building Thermal Load – This evaluates values that are closely associated with air conditioning energy consumption.

- Natural Energy Utilization – This evaluates efforts to increase the direct use of natural energy (light, ventilation, etc) and converted use of renewable energy (solar energy generation, etc).
- Efficiency in Building Service Systems – This evaluates the level of efficiency improvements for air conditioning, ventilation, lighting, hot water supply and elevators.
- Efficient Operation – This evaluates the building operation and maintenance system and whether there is a building energy consumption monitoring system.

Resources and Materials

- Water Resources – This evaluates efforts to save water including use of rainwater and reuse of gray water.
- Materials of Low Environmental Load – This evaluates the building materials and equipment and their associated environmental loads. Consideration is given for use of recycled materials, reuse of structural members, wood materials harvested from sustainably managed forests, and avoidance of CFC's and halons.

Off-Site Environment

- Air Pollution – This evaluates efforts to restrict the quantity of atmospheric pollutants generated from within the building or on the building site.
- Noise, Vibration, and Odor – This evaluates the amount of noise, vibration and odor generated by the operation of the building.
- Wind Damage – This evaluates whether or not the building has been designed to minimize wind hazards caused by large scale buildings. It also evaluates measures taken to minimize sunlight obstruction of other buildings in the surrounding area.
- Light Pollution – This evaluates efforts to reduce building exterior lighting, lighted advertising displays, light leakage from building interiors, and solar glare reflected from the building.
- Heat Island Effect – This evaluates measures taken to alleviate the heat island effect outside the site. Consideration is given counter measures such as the planting of vegetation on and around the building.
- Load on Local Infrastructure

Table 4.2: LR Value – Reduction of Building Environmental Loadings

LR-1. Energy	1. Building Thermal Load	No further description
	2. Natural Energy Utilization	2.1 Direct Use Of Natural Energy
		2.2 Use of Renewable Energy
	3. Efficiency in Building Service system	3.1 HVAC System
		3.2 Ventilation System
		3.3 Lighting System
		3.4 Hot Water Supply System
		3.5 Elevators
		3.6 Equipment for Improving Energy Efficiency
	4. Efficient Operation	4.1 Monitoring
		4.2 Operational Management System
LR-2. Resources & Materials	1. Water Resources	1.1 Water Saving
		1.2 Rainwater & Gray Water
	2. Materials of Low Environmental Load	2.1 Recycled Materials
		2.2 Sustainable Forest Products Certification
		2.3 Materials with Low Health Risk
		2.4 Reuse of Existing Structure, etc
		2.5 Reuse of Components and Materials
		2.6 Use of CFCs and Halons
LR-3. Off-Site Environment	1. Air Pollution	No further description
	2. Noise, Vibration, & Odor	2.1 Noise & Vibration
		2.2 Odors
	3. Wind Damage & Sunlight Obstruction	No further description
	4. Light Pollution	No further description
	5. Heat Island Effect	No further description
	6. Load on Local Infrastructure	No further description

The above framework is for commercial buildings in Japan. As explained previously, there is a separate CASBEE rating system for housing construction called "CASBEE – Sumai" ("Sumai" means house in Japanese). The CASBEE Sumai program is still under development, but a draft was released in July 2007. This draft was developed with four principles in mind: 1) the application of market mechanisms, 2) minimize the role of government, 3) encourage change through the disclosure of information rather than government regulation, and 4) support the integration of building technologies to reduce the environmental footprint of a house (Eastin 2007). As with the green building certification system described above, points for CASBEE – Sumai are awarded for both environmental quality and performance "Q" and reduction of environmental loadings "LR". The 2007 draft of these criteria are listed in Table 4.3 and Table 4.4.

Table 4.3: Q Value - Environmental Quality and Performance of the Residential House

Q_H 1. Indoor Environment	1. Thermal Comfort/ HVAC (Heating, Ventilation, Air Conditioning)	1.1 Basic Performance
		1.2 Preventing Summer Heat
		1.3 Preventing Winter Coldness
	2. Health and Security	2.1 Reduction of Chemical Pollutant
		2.2 Adequate Air Ventilation Planning
		2.3 Anti-Theft
	3. Lighting	3.1 Utilizing Natural Light
		3.2 Anti-Glare Measures
	4. Quietness	No further description
Q_H 2. Durability	1. Basic Performance for Long-Life	1.1 Building Frame
		1.2 Exterior Wall
		1.3 Roofing and Deck-Roof Materials
		1.4 Durability for Natural Disaster
		1.5 Fire Proof
	2. Maintenance	2.1 Easy Maintenance
		2.2 Maintenance System
	3. Functionality	3.1 Space and Room Layout
		3.2 Barrier-Free for Elderly
Q_H 3. Urban Landscapes and Ecosystem	1. Preservation of Urban Landscape	No further description
	2. Preservation of the Biotope	2.1 Greening of Garden
		2.2 Preservation of Habitat
	3. Security for Neighborhood	No further description
	4. Utilization of Local Resources and Preserving Local Culture	No further description

Table 4.4: LR Value – Reduction of Residential House Environmental Loadings

LRH 1. Saving Energy and Water	1. Efficiency through Building Method	1.1 Decreasing Thermal Load
		1.2 Utilizing Natural Energy
	2. Energy Efficiency through Functional Equipment	2.1 Cooling and Heating Equipment
		2.2 Hot-Water Supply Equipment
		2.3 Lighting, Illuminating and Kitchen Equipment
		2.4 Air Ventilation Equipment
		2.5 Energy Efficient Vehicles
	3. Water Saving	3.1 Water Saving Equipment
		3.2 Utilizing Rain Water
	4. Efforts for Maintenance and Operation	4.1 Declaration of Efficient Lifestyle
		4.2 Reducing Energy Consumption
LRH 2. Saving Resources and Reducing Waste	1. Resource Saving and Adopting Material Which can Reduce Waste	1.1 Structural Frame (wood, concrete, etc)
		1.2 Groundwork and Foundation
		1.3 Exterior Finishing Material
		1.4 Interior Finishing Material
		1.5 Exterior Structural Material
	2. Reduction of Waste through Production and Construction	2.1 Production Period (Structural Materials)
		2.2 Production Period (Non-Structural Material)
		2.3 Construction Period
LRH 3. Caring for the International, Local, and Neighborhood Environments	1. Reduce Global Warming	No further description
	2. Caring Community Environment	2.1 Reduction Burden of Local Infrastructure
		2.2 Conserving Existing Natural Environment
	3. Caring Environment of Neighborhood	3.1 Reduction of Noise, Vibration, and Emission of Pollutants

If the final version of the regulations give points for locally harvested lumber, this could have an adverse affect on Alaska forest products. In a recent draft, points are distributed for using lumber that is harvested near where the home is built to reduce "wood miles" (Eastin 2007). If the final version of CASBEE – Sumai gives an advantage to locally harvested lumber, this could negatively impact Alaska's forest products exports to Japan. The industry should monitor this regulation and work with the US Trade Representatives Office to put pressure on the regulators not to punish forest products that are not harvested in Japan.

4.2 Japan's Green Wood Procurement Policy

The Japanese government has proposed a law for purchasing environmentally friendly products by government and other public entities in order to address global illegal logging. This law is titled the "Law Concerning the Promotion of Procurement of Eco-Friendly Goods and Services by the State and Other Entities". The purpose of this law is threefold: to encourage public entities to purchase environmentally friendly products, to provide information on environmentally friendly products and to stimulate demand

for environmentally friendly products. The GoHo Wood Conference in Yokohama addressed the problem of illegal logging and how to certify that wood used by the Japanese government is not derived from illegal logging (Council for Tackling Illegal Logging Issues, 2007).

The guideline for what the Japanese government considers legal wood within the confines of the green procurement law consisted of five areas: legality, sustainability, forest certification system, chain of custody certification system, and separate custody management. These are defined specifically within the guidelines as follows (GoHo Conference, 2007):

- Legality: The timber is harvested in a legal manner consistent with procedures in the forest laws of timber producing countries.
- Sustainability: The timber is procured from a forest under sustainable management
- Forest Certification Systems: Third party certification organizations recognized by the Japanese government that assess and certify the forest management level based on the standard settled by the independent forest certification institution.
- Chain of Custody Certification System: A system verified by a third party that assesses and certifies the separation system used to keep wood that originated from forests with sustainably managed certification separate from wood that has not originated from certified forests.
- Separate Custody Management: The method to manage wood and wood products verified with legality and sustainability from those that have not been verified in the distribution chain.

The Japanese government is currently being quite flexible with verification methods to accommodate wood suppliers. There are three allowable methods that can be used by companies supplying wood products to the Japanese government to verify the woods legality. First, companies can provide documentation from third party forest certification and chain of custody certification organizations. Second, companies can provide documentation from industry associations such as forest owners associations, timber and lumber associations, or wood products associations. This system is a voluntary code of conduct stating that the association's members wood originates from legal and sustainable sources. Third, large companies can self monitor their wood from harvesting to production and provide company documentation that states the wood is legal and sustainable. While the definitions of "legal" and "sustainable" are provided in the law and literature developed for wood suppliers, these are still vague. One of the major questions for wood suppliers is how do you certify that wood comes from "sustainably managed forests", when the forest in question has not been certified by a third party organization? This procurement policy is still in its infancy and many of the questions will be answered as the policy begins to be utilized. However, this policy should be monitored by the Alaska forest products industry so that proper documentation can be arranged to demonstrate that Alaska forest products originate from legally harvested timber.

4.3 Formaldehyde Regulations

The Ministry of Construction amended the Building Standards Law (BSL) by implementing the Sick House Regulations effective on July 1, 2003. The BSL Sick House regulations were specifically designed to address health problems caused by chlorpyrifos and formaldehyde emissions in residential construction. The Sick House regulations prohibit the use of building materials that emit chlorpyrifos in residential construction. The Sick House regulations also limit the amount of formaldehyde emissions from building materials, including wooden building materials. The Sick House regulations addressed formaldehyde emissions in residential housing by specifying three Countermeasures: 1) F**** rating of materials, 2) Mechanical ventilation requirements, and 3) Material use in attic spaces, etc.

The first Countermeasure imposes restrictions on interior finishing materials that emit formaldehyde and imposes surface area restrictions on building materials that receive a rating below F****. (Note that there are no restrictions on the use of wooden building materials that have received an F**** rating) (See Table 4.5). This Countermeasure generally applies to wooden building materials that are considered to be built-in (permanent), visible, and are used in a habitable room in a house. This group of products includes:

- kitchen cabinets,
- bathroom cabinets,
- finished wood flooring,
- engineered wood flooring,
- wooden doors,
- wall and ceiling paneling,
- fixed shelving in cabinets,
- wooden stair treads and risers,
- wooden countertops and
- edge-glued panels.

As a general rule, structural glulam and LVL do not fall under the sick house regulations. There has been a recent inclusion, however, that is referred to as the "1/10 Calculation". Linear glulam and linear LVL are subject to the Sick House regulations if the exposed area of the glulam or LVL member exceeds 1/10 of the surface area of the room (surface area is the sum of the wall area, floor area and ceiling area). Embedded glulam or LVL (i.e. Members hidden within a wall and not visible within the room) are included in the Attic, etc. section of the regulations and are exempted from the 1/10 Calculation.

There is a group of wooden building materials that are exempted from the Sick House regulations and whose use in a house is unrestricted. These products are either considered to be movable or of a small enough surface area that formaldehyde emissions would be low enough as not to pose a significant health risk to the buildings inhabitants. These unrestricted products include:

- lineal wood moulding and millwork,
- door and window casings,
- wooden windows,
- wooden furniture,
- removable wood shelving,
- wooden stair railings, banisters and stringers,
- unfinished solid wood flooring and
- finger-jointed lumber.

Any product that is movable within a room is exempted from the formaldehyde emission restrictions (for example, furniture and removable cabinet shelves). If a product is listed as an exempted product, then it is unaffected by the formaldehyde amendment to the BSL.

The second Countermeasure requires that ventilation equipment must be installed in new homes (with very few exceptions) to remove formaldehyde emissions from the indoor environment before they can build up to noxious levels. The third Countermeasure applies restrictions on building materials used in attic spaces, *etc.* This Countermeasure is designed to prevent the infiltration of formaldehyde from the attic into living spaces in the house. If an air barrier is installed in the attic (for example an impermeable plastic or vinyl sheet), then the building materials used in the attic and roof system are not subject to the Sick House regulations. This also applies if a ventilation system is installed in the attic area.

Table 4.5: Formaldehyde emission levels for the F* rating system.

Formaldehyde Emission Rating	Formaldehyde Emission Rate, X (mg/m^{2}h)
F*	X > .12
F**	.12 ≥ X > .02
F***	.02 ≥ X > .005
F****	X ≤ .005

In summary, there is increasing awareness of green building and procurement policies in Japan. When asked about new trends in the Japanese residential construction market, Ms, Kitagawa of the Japan Lumber Journal replied "Eco-Building" without hesitation. (Kitagawa 2007). Green building and procurement will be increasing in the future and a large part of this movement is "Goho Wood" or legally harvested wood. As explained above, it will be important for Alaska forest products producers to emphasize their wood as being legally harvested.

5. Exchange Rates

In order to examine the price competitiveness of U.S. forest products on the global market, one must examine the relative value of the U.S. Dollar to other currencies. As this section will illustrate, the value of the U.S. Dollar has declined against the Japanese Yen, Euro, and Canadian Dollar making U.S. forest products more competitive on the global market. Due to the declining value of the U.S. Dollar, Alaska yellow cedar, Alaska hemlock, and Alaska Sitka spruce have become much more price competitive in Japan.

5.1 Japan's GDP and CPI

In 1990, the bubble of an inflated Japanese economy burst resulting in a period characterized by slow economic growth, bad debt, and deflation. This period has been called Japan's "lost decade." However, since 2003, the economy has been improving, with real GDP hovering around 2 percent and the Consumer Price Index (CPI) steadily rising (Figure 5.1).

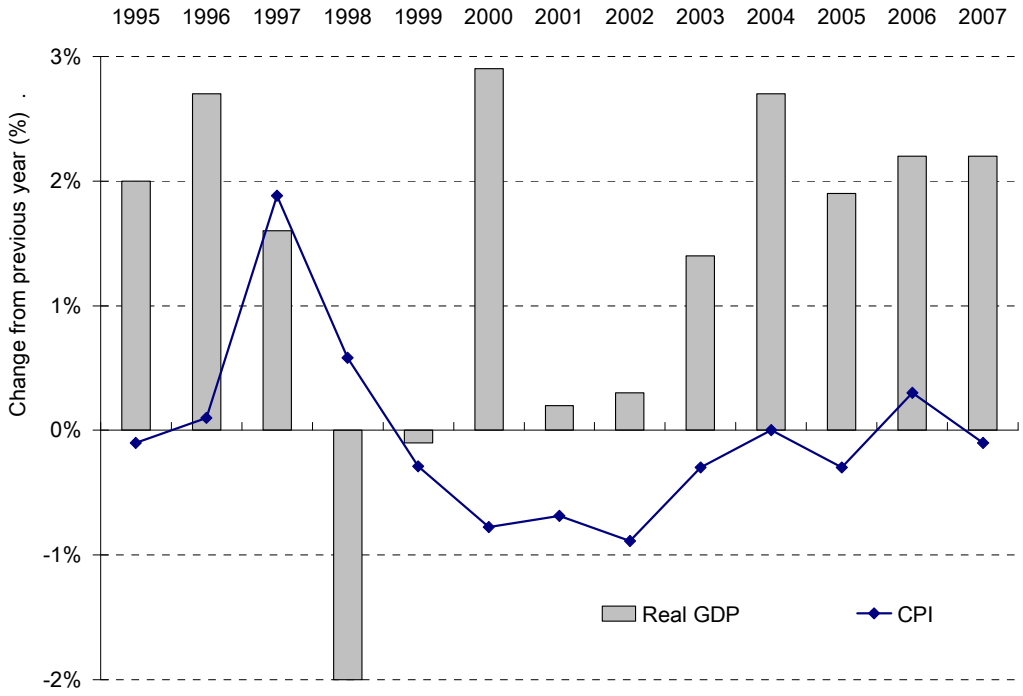

Figure 5.1: Japan's Real GDP Growth and CPI

Source: CAO

In contrast to the U.S. where economic growth is driven in a large part by domestic consumer spending, Japanese economic growth is driven primarily by exports. As shown in Figure 5.2, overall export growth has substantially exceeded domestic demand growth. There are many factors that have contributed to this, but two of the main causes are strong global demand for Japanese products and a relatively undervalued yen. Contrary to the strong export growth as a percentage of GDP, the growth of residential housing investment as a percentage of GDP has been stagnant.

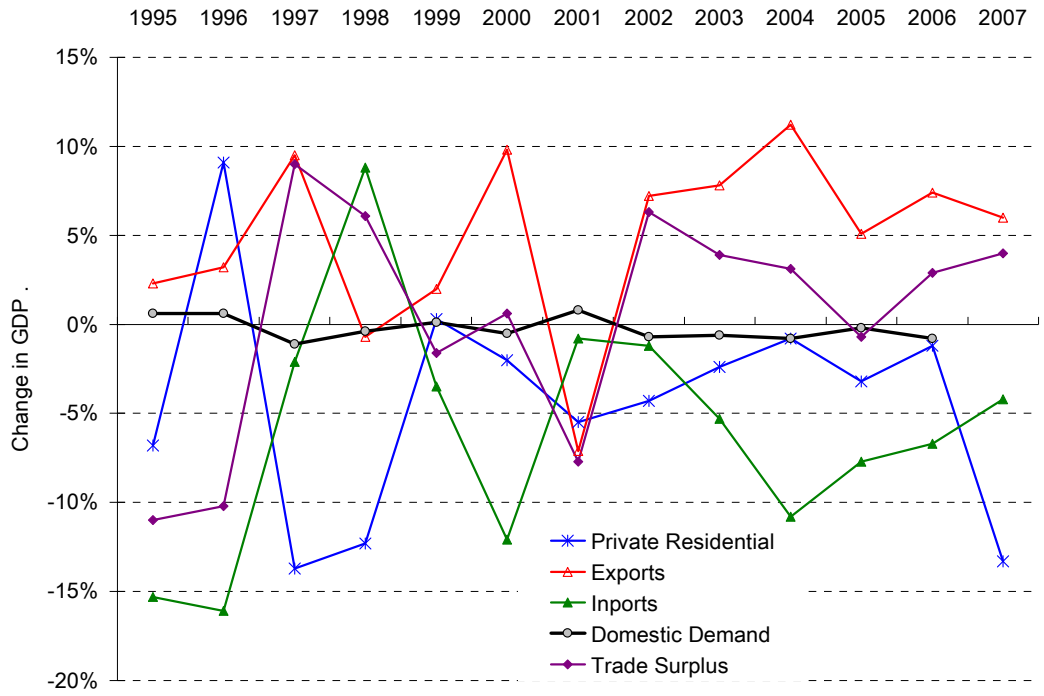

Figure 5.2: Japan's Real GDP growth Components by Categories
Source: CAO

Japan's economic growth is becoming increasingly dependent on its Asian trading partners. In 2006, Japan's biggest trade surplus was with the following regions: U.S. (+$77,580 million), Hong Kong (+$34,948 million), EU (+$29,536 million), Taiwan (+$23,807 million), South Korea (+$22,976 million) and Singapore (+$11,875 million). It important to note how important the four Asian Tiger countries are to Japan's economy. Combined, the trade surplus of Hong Kong, Taiwan, South Korea and Singapore was $93,606 million in 2005 and this exceeds the trade surplus with the U.S.

5.2 Interest Rates

In July of 2006, the Bank of Japan (BoJ) reacted to improved economic indicators by raising interest rates from near 0 to 0.25 percent. In February of 2007, the BoJ raised interest rates further to 0.5 percent and the BoJ governor Toshihiko Fukui stated that BoJ may raise interest rates further to a "normal" level. However, the BoJ hesitated with their plans to raise interest rates further as the global economy reacted to the subprime mortgage crisis and high oil prices. Additionally, Japan's domestic economy suffered from a sudden plunge in housing starts and political uncertainty strengthening the BoJ resolve not to raise interest rates.

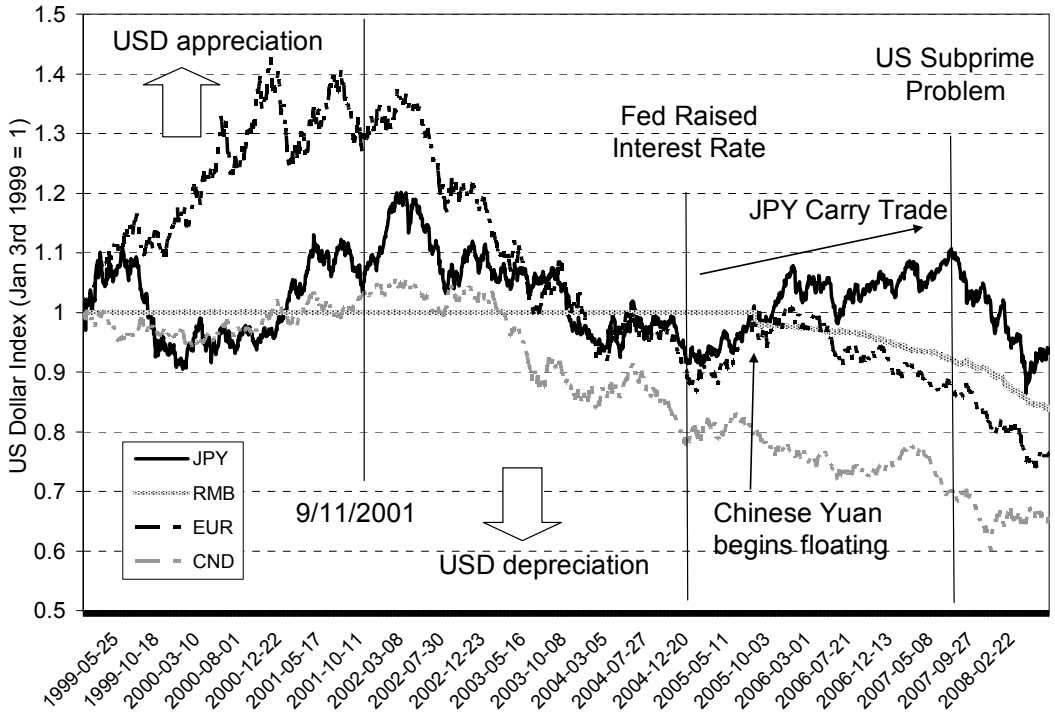

Figure 5.3: Yen Exchange Rate
Source: Federal Reserve

As of 8/25/2008, the Yen spot rate was 109 Yen to 1 U.S. Dollar and this was approximately a 6 percent increase in the value of the Yen compared to two years ago. One factor contributing to the increased value of the Yen is the Yen carry trade. Extremely low interest rates in Japan have lured aggressive global investors to borrow in Yen and invest in countries outside of Japan. This strategy is called the Yen carry trade and the goal is to borrow in Yen at low interest rates, convert the Yen to other currencies, and invest globally in high-yielding investments such as stocks, bonds, and real estate. The Yen carry trade was created by BoJ's virtually zero interest rate policy described above and has increased the volatility of the Yen. If global investors utilizing the carry trade start to get nervous, they convert their investments back to Yen and this increased Yen demand puts pressure on the Yen to rise. This appears to be happening as carry trade investors fear that the global economy may take a turn for the worse.

Two of the main competitors to U.S. forest products exports in Japan are Europe and Canada. The U.S. Dollar has weakened substantially against the Euro and Canadian Dollar giving U.S. forest products a price advantage (Figure 5.3). As of 8/25/2008, the Euro spot rate was 1 U.S. Dollar to 0.68 Euros and this was approximately a 13 percent increase compared to the rate of 2 years ago. As with the Euro, the value of the Canadian Dollar has appreciated against the U.S. Dollar, with 1 U.S. Dollar equaling 1.05 Canadian Dollars. This was approximately a 5 percent increase in the value of the Canadian Dollar compared to the rate of two years ago.

It is very difficult to predict where the value of the U.S. Dollar will go in the future. However, there are many factors that may cause the U.S. Dollar to devalue further in the short term. First, in the first half of 2008 the Fed Chairman Dr. Ben Bernanke aggressively lowered the Federal Funds Rate in an attempt to avoid a recession. If the Fed continues to lower interest rates, there is a strong chance the Dollar will fall further because there is almost no space left for the BoJ to cut interest rates. Second, fears of a U.S. recession could cause global investors to sell off their U.S. based investments and flee to other countries.

Third, the growing fiscal and trade deficits of the U.S. will continue to place devaluation pressure on the U.S. Dollar.

The weaker U.S. Dollar makes U.S. products more competitive abroad while reducing US imports of wood products, Figure 5.4. Between 2005 and 2006, US wood exports and imports increased by 14.3% and 14.7%, respectively. As a result, over the same time period the US trade deficit in wood products declined by 22%. In 2008, U.S. forest products priced in Yen are approximately 6 percent cheaper than two years earlier. This makes Alaska and other U.S. forest products much more price competitive than previously in the Japanese market and provides a good opportunity for Alaska producers to establish niche markets in Japan and be price competitive.

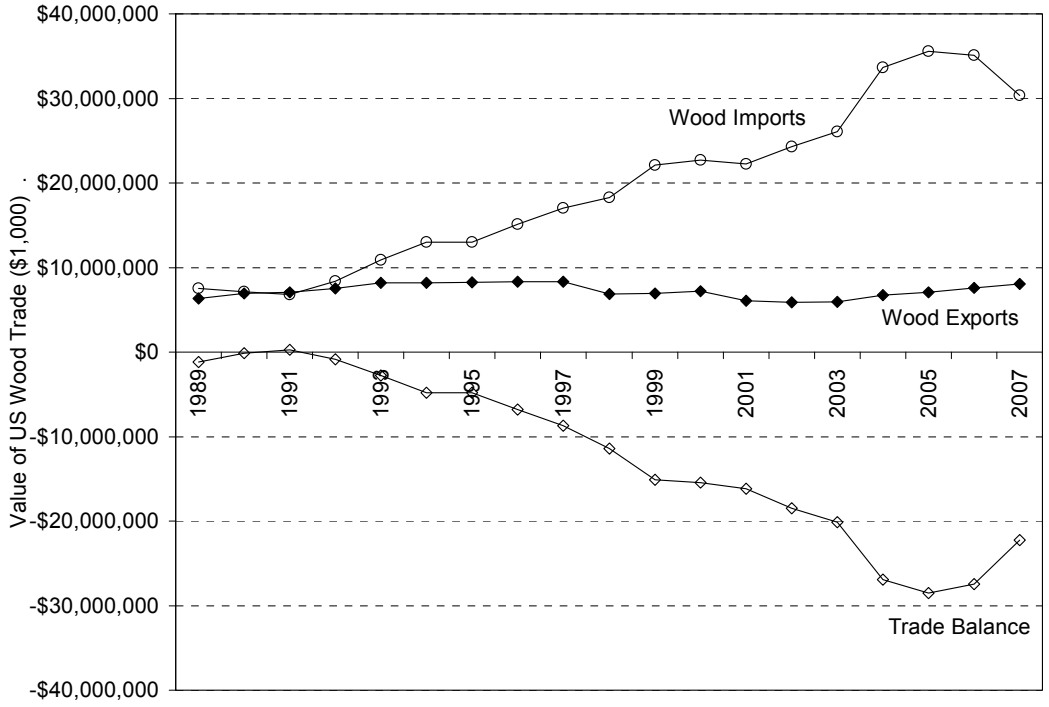

Figure 5.4: US trade balance for wood products
Source: USITC Trade Database 2008

6. Demographic Trends in Japan

Demographic trends provide the basis for predicting the future of Japan's residential construction market. Japan's Statistics Bureau estimates Japan's 2007 population to be approximately 128 million. Recently, Japan's population has been declining as both the mortality rate and the birth rate decline. In the first half of 2005, the number of deaths exceeded the number of births (MHLW 2005). Another factor contributing to Japan's declining population is a lack of immigrants. Japan has xenophobic tendencies, which are reflected in their strict immigration policies. Japan's immigration laws allow only a trickle of new immigrants each year. Japan's population is predicted to decline to approximately 100 million by 2050 (Figure 6.1). As Japan's population ages, there will be increasing burdens on Japan's welfare and government pension system. A large percentage of Japan's population is baby boomers and many in this group will soon retire (Figure 6.2).

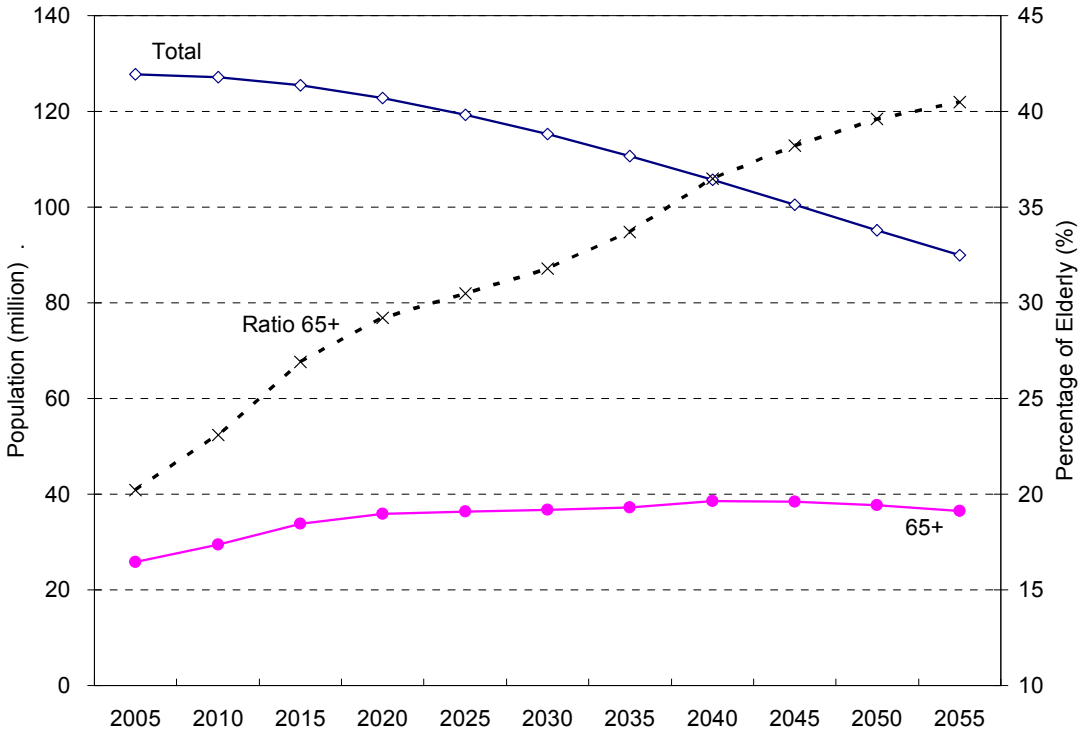

Figure 6.1: Japan's Total Population and Senior Population

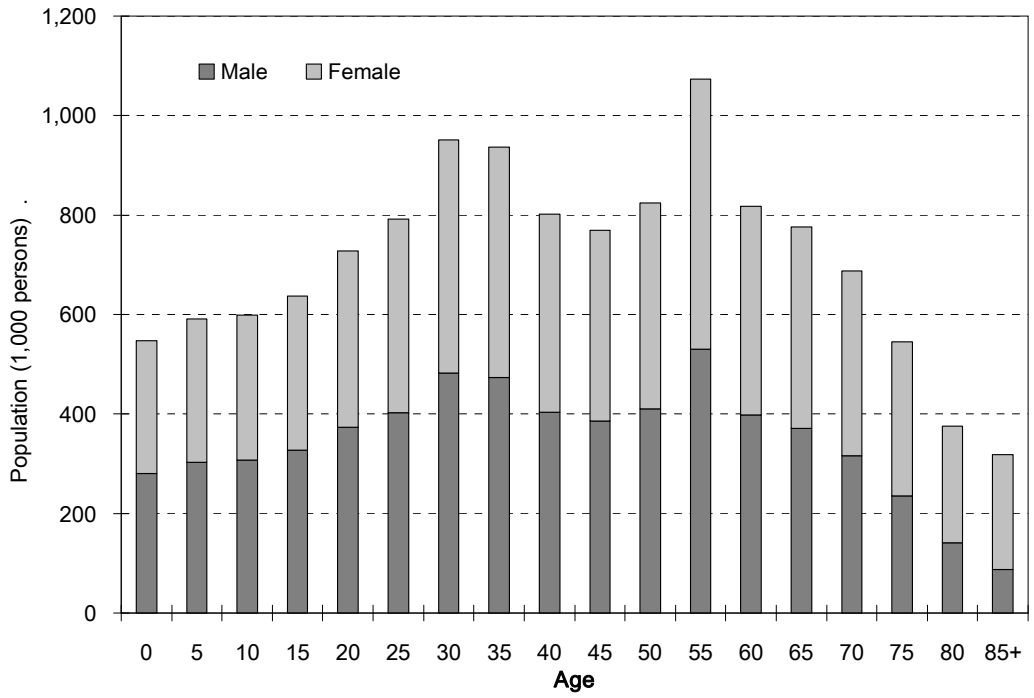

Figure 6.2: Japanese Population by Age

6.1 Population Trends

Japanese employees usually receive a lump sum pension payment when they reach retirement age, which is normally 60. The Bureau of Industry and Labor Affairs of Tokyo (2006) estimates that the approximate lump sum retirement payment for small to medium size companies in Tokyo to be about 11 million yen or US$104,761 (US$1 = ¥105) per employee. Large corporations often pay double or more that which small to medium size companies pay for lump sum retirement payments. These retirement lump sum payments will represent a large portion of Japan's future consumer spending and one area where retirees tend to spend money is to remodel and/or rebuild their homes.

The Cabinet Office of the Japanese Government conducted a survey of Japanese citizens 65 and over regarding their housing satisfaction level (Table 6.1). One important result showed that 8.1 percent of those living in single family detached houses and 9.8 percent of those living in condominiums had a desire to remodel their kitchen or bathroom.

Another result that stands out is that 16.1 percent of the respondents living in single detached houses felt their house was "old and damaged". These results should translate into increased spending for repairs and remodels as the number of elderly increases.

Table 6.1: Japanese Senior Citizens' Housing Satisfaction Level

	Single Family Detached House	Multi-family House (condo or apartment)
Sample (%)	1,659 (88.0%)	205 (12.0%)
Too small	4.9%	14.1%
Too few rooms	4.0%	10.2%
Too big	5.7%	0.0%
Desire to Remodel Kitchen or Bathroom	8.1%	9.8%
Unfriendly for elderly	11.3%	6.8%
Too old (damaged)	16.1%	13.2%
No problem so far	57.5%	50.2%

Source: Cabinet Office 2005

Another increasing demographic segment is the children of Baby Boomers or the "Echo Baby Boomers". Echo Baby Boomers tend to have a fewer number of people per household than their parents. Figure 6.3 shows that, although the number of households has substantially increased since the 1960's, the number of persons per household has decreased. Generally, these smaller households and younger families live in apartments or condominiums and the increase of smaller households has increased demand for condominiums and apartments. However, many young homebuyers have begun looking for reasonably priced single family detached homes rather than condominiums. This trend has supported the development of a new type of home builder called "power builders" who target younger buyers looking for value priced homes (Sasatani et al. 2008). The strategy of the power builders is to acquire sizable areas of land in suburban locations, divide the land into housing plots, and then build tract houses. From 1999 to 2007 tract houses increased from 25 percent to 40 percent of single family detached housing starts.

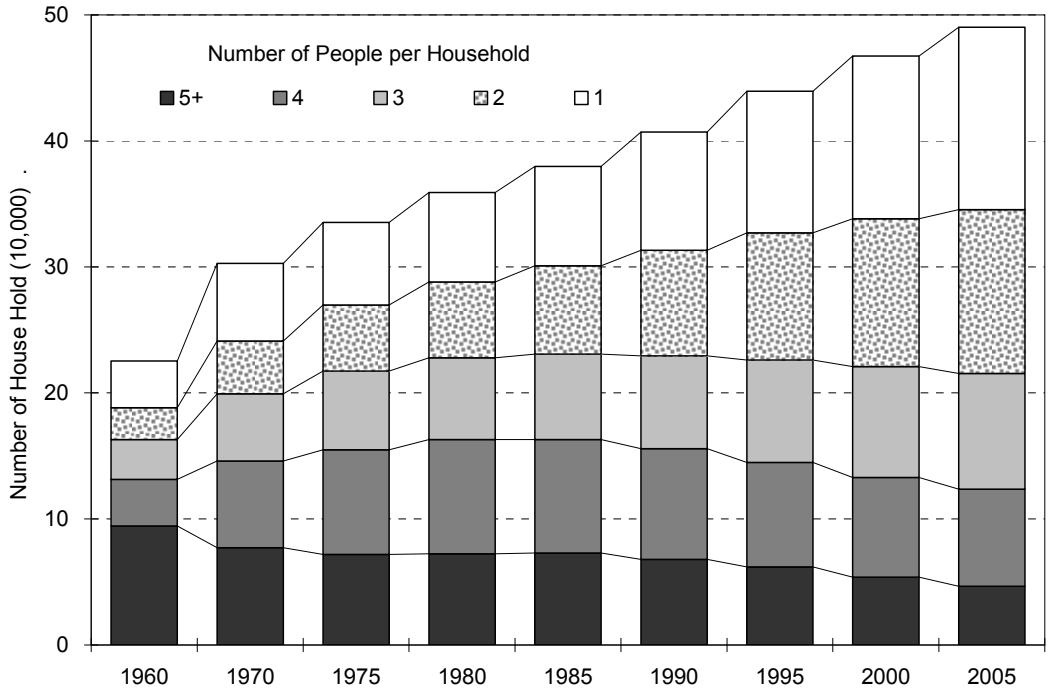

Figure 6.3: Number of Households

In targeting Japan's forest products market, two of the most important demographic segments are baby boomers and echo baby boomers. As discussed above, baby boomers are entering retirement age and have an interest in remodeling and repairing their homes. Therefore, companies that provide materials to meet this need should have a strong market. Products to consider are clear lumber, flooring, paneling, and cabinets.

Echo baby boomers are looking for value priced homes and spec home builders or power builders have been successful at meeting the home demands of younger buyers. Therefore, forest products exporters should seek to build relationships with spec home builders and find ways to provide products that meet the demands of younger home buyers. One part of the home younger people enjoy is decks. Alaska yellow-cedar and Western red-cedar decking material would be a good product to export to spec home builders. Another product to consider is Alaska yellow-cedar sill plate lumber that sits on top of the foundation. Alaska yellow-cedar has natural durability, which is essential for sill plates. As with the remodel market, wood interior paneling is product that could be exported to Japanese spec home builders. Wood paneling gives homes a warm feeling and spec home builders could use this product to differentiate their homes from other builders.

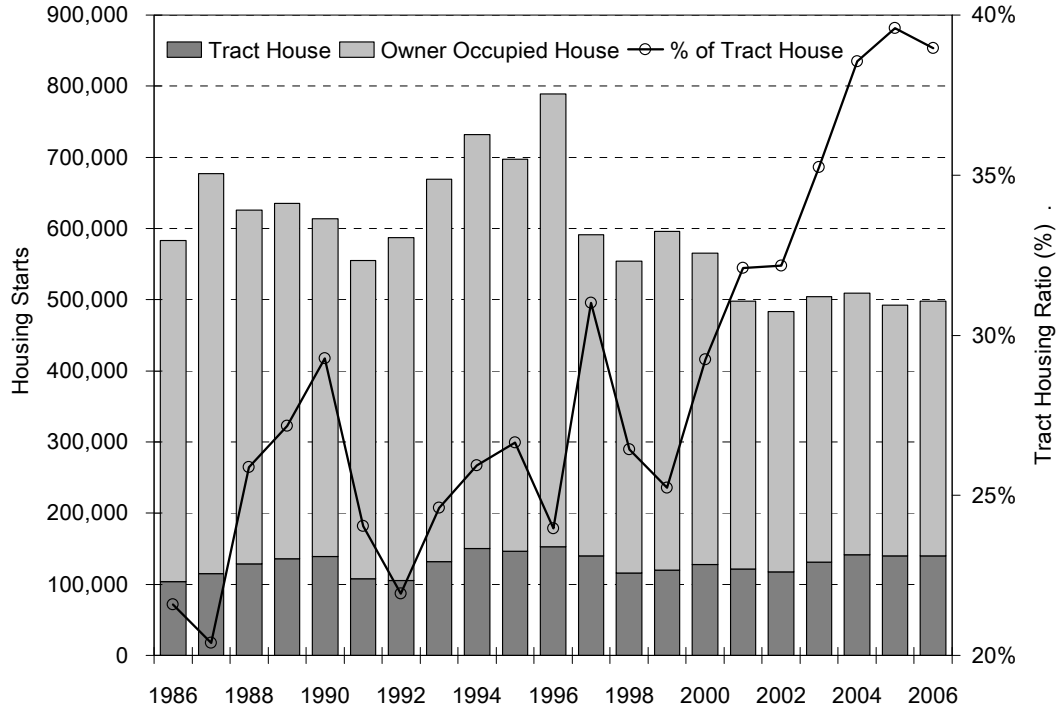

Figure 6.4: Trends for Owner Occupied and Tract Housing.

7. Conclusion and Recommendation

Alaska has unique quality forest products that are well suited for the Japanese market and many of the trends presented in this paper offer opportunities for Alaska forest products exporters. First, the weak U.S. Dollar makes U.S. products more competitive abroad. This year U.S. forest products priced in Yen are approximately 6 percent cheaper than two years ago. This makes Alaska yellow cedar, hemlock, and Sitka spruce much more price competitive than previously in the Japanese market. Second, Russia imposed a softwood log export duty of 20 percent on January 1, 2007 in an attempt to increase value added processing within Russia and the Russian government is planning to increase this to 80 percent by January 1, 2009. Many industry experts had pointed out that Japanese mills are looking for new suppliers to replace the Russian supply. Much of the Russian red pine and larch that was exported to Japan could be substituted with North American species. Third, increasing green building and procurement policies may require suppliers to provide documentation certifying that imported wood products are sourced from legally harvested timber. Since there is no question that Alaska forest products are harvested legally, developing a system of documentation to show where the timber originated, should be relatively easy. Based on the trends presented in this paper, the authors offer the following specific recommendations:

1. Identify Alaska Forest Products Companies Interested in Exporting to Japan

The first step to promote Alaska forest products in Japan is to identify companies interested in and qualified to export to Japan. These companies need to have the production capacity to do container load volumes and the commitment of management to pursue the Japanese market. Furthermore, they need to have the technical capacity to produce products demanded by the Japanese market. Once these companies are identified, a directory should be created in Japanese to distribute to Japanese forest products buyers. These companies should also be encouraged to participate in the Japan Home Show and trade mission described below.

2. Utilize Trade Organizations to Increase Awareness of Alaska Forest Products

Alaska's presence in the Japanese market has dwindled and needs to be rebuilt. This can be done at a relatively low cost through utilizing resources that are already in place. There are two organizations that the authors recommend Alaska's forest products industry utilize in Japan. The first is the Softwood Export Council headquartered in Portland, OR and with a Japan office in Tokyo. The University of Alaska is active with the Softwood Export Council and can assist with making connections. The second is the State of Alaska's Japan Office located in Tokyo. Both of these organizations participate in forest products events held in Japan. The Alaska forest products industry should work closely with both these organizations and the contact information for these organizations is listed in Appendix A.

3. Promote WWPA Alaska Forest Products' Labels in Japan

It is important for Alaska sawmills to promote the three WWPA registered species labels in Japan: Alaska Hem, Alaska Yellow Cedar, and Alaska Sitka Spruce. Each of these should be considered a brand with unique attributes. The goal should be to build brand recognition for Alaska timber species in Japan by promoting these species and their unique attributes. Literature should be developed and translated into Japanese explaining each species, their unique attributes, and the end products they are suitable for. It would also be beneficial to include contact information for Alaska forest products companies that can supply each species.

4. Promote Structural Values of Alaska Lumber in Japan

The revised Building Standards Law requires certification by approved architects for the structural integrity of materials (including species of forest products) and designs used for new building construction by. In order to do this, architects will need access to the strength values of structural members. In order to facilitate the use of Alaska timber species in structural applications, the results of the in grade testing program conducted by the Ketchikan Wood Technology Center should be translated

into Japanese. Japanese architects responsible for certifying building plans will need access to modulus of elasticity and bending strength calculations for Alaska yellow cedar, hemlock, and Sitka spruce.

5. Target the Glulam Beam Industry

As explained above, one expected outcome of the recent revision of the Building Standards Law is an increase in market share for glulam beams. Mr. Miyazawa (Miyazawa 2007), of the Japan Housing Newspaper, emphasized the revision to the Building Standards Law will favor glulam beams over solid sawn lumber because the exact structural values are written on each glulam beam. The opportunity for Alaska forest products manufacturers is to target the glulam beam industry with lamstock lumber. Japan's glulam beam industry has shown strong growth and there are substantial opportunities for Alaska yellow cedar, hemlock, and Sitka spruce (CINTRAFOR 2008).

6. Develop Certificate of Harvest Origin Program for Alaska Forest Products

As described above, the Japanese government is proposing to require all forest products purchased by government agencies to provide proof that the wood originated from forests where the timber was legally harvested. This program is still in the proposal stage but what is clear is that some documentation will be required. As of now, the Japanese government is being very flexible with the documentation. At the 2007 GOHO Wood (Legal Wood) Conference in Japan, the Japanese official explained that companies can develop their own certificate and attach supporting documents such as timber sale receipts. Exporters should work closely with their Japanese customers and make sure that proper documentation is provided.

7. Create an Alaska Forest Products Display for the Japan Home Show

One of the main conclusions to be drawn from this research is that Japan's forest products manufacturers are becoming very concerned with the stability of their raw material supply. Their concern centers on what will happen in the future to the Russian and European supply and so Japanese buyers are looking for alternative suppliers. However, in order for this to benefit Alaska forest products companies, Japanese companies need to be informed of what products exist and how to get them. An excellent outlet to meet Japanese buyers and educate them about Alaska forest products is the Japan Home Show. The Japan Home Show is held every year in November in Tokyo. The Softwood Export Council has a booth each year and allows members to display products. An Alaska forest products display should be designed including product samples, product literature, and copies of the Alaska Forest Products Directory. All literature distributed at the show should be translated into Japanese, which the Softwood Export Council could assist with.

8. Organize a Japan Trade Mission for Alaska Forest Products Companies

As a follow up to the Japan Home show, a Japan trade mission should be organized for Alaska forest products companies interested in the Japanese market. The primary purpose of this trade mission would be to introduce Alaska forest products companies to potential Japanese buyers. The secondary purpose of the mission would be to educate Alaska forest products companies about the Japanese market and the types of forest products used in the market. This trade mission should include Japanese mill visits, a seminar given by an Alaska representative explaining to potential Japanese buyers about Alaska forest products, and a reception to bring Alaska companies together with potential Japanese buyers. The visit should also include a visit to pre-cut lumber mills, laminators, and post and beam construction sites. This trade mission should be organized in cooperation with the Alaska Department of Trade, the University of Alaska, and the Softwood Export Council.

9. Invite Potential Japanese Customers to Alaska for an Alaska Mill Tour

This would be a way to introduce Alaska mill owners to Japanese forest products buyers. Additionally, it would allow the Japanese forest product buyers to educate Alaska mills about what products the Japanese market demands and their product specifications.

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Appendices

Appendix A

Contact Information

American Softwoods
(SEC, APA and SPC)
Japan Office
Director: Tomoko Igarashi
1st Fl Kowa No.9 Bldg-Annex
1-6-7 Akasaka, Minato-ku,
Tokyo 107-0052 JAPAN
Email: info@americansoftwoods.jp
http://www.softwood.org/international_offices.htm

American Forest & Paper Association (AFPA)
Japan Office
1st Fl Kowa No.9 Bldg-Annex
1-6-7 Akasaka, Minato-ku,
Tokyo 107-0052 JAPAN Representative: Ms. Aiba
Tel: (81)-3-3568-7450
Fax: (81)-3-3568-0720
http://www.afandpa.org/

American Hardwood Export Council
U.S. Embassy 10F, 2-11-5
Nishi-Temma, Kita-ku, Osaka 530-0047
Tel: (81)-6-6315-5101
Fax: (81)-6-6315-5103
Email: info@ahec-japan.org
http://www.ahec.org/

U.S. Commercial Service
U.S. Embassy Tokyo
1-10-5 Akasaka,
Minato-ku, Tokyo 107-8420
Tel: (81)-3-3224-5060
Fax: (81)-3-3589-4235
Email:Tokyo.Office.Box@mail.doc.gov
http://www.buyusa.gov/japan/en/

Japan External Trade Organization (JETRO)
(Tokyo Head Quarter)
Ark Mori Building, 6F 12-32, Akasaka 1-chome,
Minato-ku, Tokyo Japan 107-6006
Tel: (81)-3-3583-2850
Fax: (81)-3-3589-1560
http://www.jetro.go.jp/

(San Francisco Office)
235 Pine Street, Suite 1700
San Francisco CA 94104
Phone: 415-392-1333
Fax: 415-788-6927

Japan Lumber Journal
25 Sankyo Bldg. #523
1-48-10, Higashi Ikebukuro,
Toshima-ku, Tokyo Japan 170-0013
Phone (81)-3-5950-2251
Fax: (81)-3-5950-2271
Email: njlj@scan-net-ne.jp
http://www.jlj.gr.jp/

Japan Laminated Wood Association
Takamine Dai-2 Bldg. 2-22-4 Nishi-Shinbashi
Minato-ku, Tokyo Japan 105-0003
Tel: (81)-3-3434-6527
Fax: (81)-3-3434-6547
http://www.syuseizai.com

Appendix B

Tradeshows and Trade Missions in Japan (2005-2006)

Date	Name – Location	Contact Info
July 23-24th 2008	**Japan Remodeling Show** Tokyo @ Tokyo Big Sight (Same shows held in other cities: Please check the website)	Remodeling Business Newspaper Phone: +81-3-5537-5811 Fax: +81-3-3-5537-5822 http://www.the-reform.co.jp/
August 28-30th 2008	**Japan DIY Home Center Show 2008** Tokyo (Chiba) @ Makuhari Messe	Japan DIY Industry Association diy@smj.co.jp Phone: +81 3 3512 5670 Fax: +81 3 3512 5680 http://www.diy-show.jp/2008/e/index.html
November 21-24th 2008	**Ecobuild Show** Tokyo @ Tokyo Big Sight	Ecobuild Japan eco@delphi.co.jp Phone: +81 3 5261 5021 Fax: +81 3 5261 5023 http://www.ecobuild.jp/
November 12-14th 2008	**Japan Home & Building Show 2008** Tokyo @ Tokyo Big Sight	Japan Management Association Phone: +81-3-3434-0998 Fax: +81-3-3434-8076 http://www.jma.or.jp/jhbs/en/index.html
Date to be announced 2009	**Architecture & Construction Materials 2008** Tokyo @ Tokyo Big Sight	Nihon Keizai Shimbun arch@smj.co.jp Phone: +81-3-3512-5670 Fax: +81-3-3512-5680 http://www.shopbiz.jp/pages/t_index_e.phtml?PID=0004&TCD=AC

- Those shows and exhibitions are held annually. Please check organizers website to further information.
- Most tradeshows are annually held. Please check the future schedule on JETRO homepage. http://www.jetro.go.jp/en/matching/j-messe/

The above phone numbers do not include Japan's country code. In order to dial the above numbers, you need to first dial 011-81 and skip the first 0. For example, to dial the number 03-5537-58211 from the U.S., you dial 011-81-3-5537-58211**.**

Appendix C

Approximate volume and specifications for structural lumber used in ground contact applications for a typical 30 *tsubo* (1,066 square feet) Japanese post and beam house.

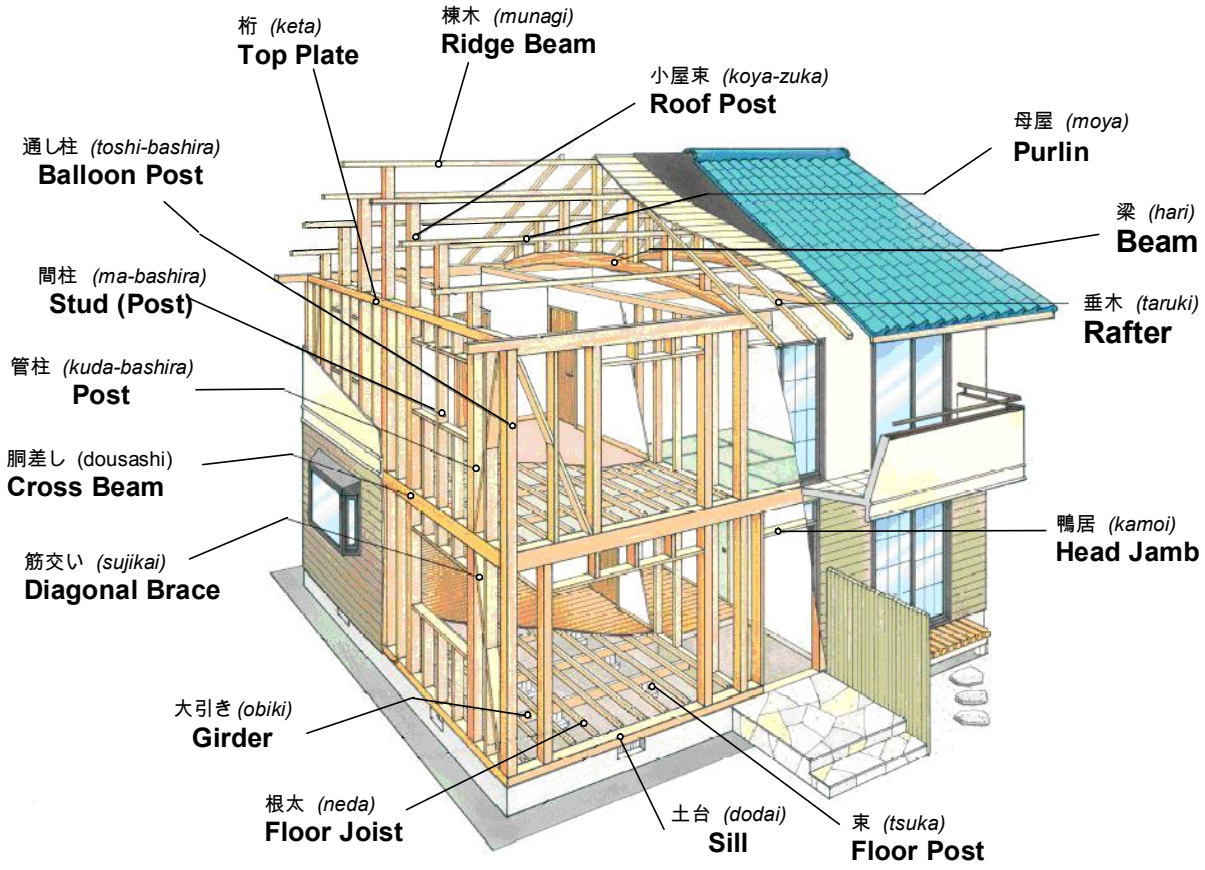
Structural Member	English Translation	Cross-section size (milli-meters)	Length (meters)	Lumber Volume
Dodai	Ground sill	105x105 (80-90) 120x120 (10-20)	4.0* 3.65, 3.0	0.8 m^3
Tsuka	Floor post	90x90	Short lengths	0.2 m^3
Obiki	Girder	105x105 (80-90) 90x90 (10-20)	4.0* 3.65, 3.0	0.2 m^3
Neda	Joist	45x45, 45x60, 60x60, 45x105	4.0* 3.65, 3.0	0.7 m^3
Toshi-bashira	Balloon Post	120x120 105x105	6.0	0.7 m^3
Kuda-bashira	Post	105x105 (75) 120x120 (25)	3.0* 2.8 (2^{nd} floor)	1.7 m^3
Ma-bashira	Non-structural stud	27x105 (70) 30x105 (25) 45x105 (5) new size	3.0* 2.8 (2^{nd} floor)	1.7m^3
Sujikai	Diagonal wall brace	45x90	3.0	0.5 m^3
Hirakaku	Structural beam	120x240, 105x210 105x180	4.0* (70-80) 3.0 (20-30)	5.0 m^3
Keta	Top Plate	105x105	4.0	0.4 m^3
Koya-zuka	Roof support post	105x105, 90x90	Various short lengths	0.4 m^3
Moya	Purlin	90x90	4.0	0.7 m^3
Taruki	Rafter	45x45, 30x40	4.0, 3.8 3.65, 3.0	0.5 m^3
Munagi	Ridge beam	105x105 90x90	4.0	0.1 m^3

Notes: 1 *tsubo* equals 3.3 square meters or 35.5 square feet
* indicates primary lumber length used.

Source: Eastin *et al*. 2003

Appendix D

House Diagram



Japanese Post and Beam Construction

Source: CINTRAFOR

Hirakaku（平角）: Cross beam.

Shokaku（正角）: Squared lumber. Usually, *shokaku* is used for post.

Kozo-zai（構造材）: Structural lumber. *Kozo-zai* includes structural post such as *toshi-bashira,* beam, *obiki, dodai,* and *moya*. Around 40 percent of total wood volume per house is structural.

Hagara-zai（羽柄材）: Non-structural lumber. *Hagara-zai* includes stud post *(Ma-bashira), neda, sujikai, taruki,* and so forth. Around 36 percent of total wood volume per house is non-structural.

Zosaku-zai（造作材）: Appearance grade lumber. *Zosaku-zai* is used for exposed applications where appearance is important. Around three percent of total wood volume per house is appearance grade lumber.

Appendix E

Conversion Factor

1 Millimeter (mm) = 0.00394 Inch
1 Centimeter (cm) = 0.394 Inch
1 Meter (m) = 3.28 Feet
1 Square Meter (m^2) = 1.20 Square Yards
1 Cubic Meter (m^3) = 35.3 Cubic Feet
1 Hectare (ha) = 2.47 Acres
1 Kilogram (Kg) = 2.20 Pounds
1 Metric ton (M.T.) = 2200 Pounds
(Japanese unit)
1 *Tsubo* = 35.6 Square Feet