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Economic and Environmental Impact Assessment of Proposed Bark-Free Requirements for Wood Pallets in International Trade

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ABSTRACT

In 2004 the European Commission issued Directive 2004/102/EC which, among other things, introduced the concept of requiring wood packaging materials to be "debarked." While previous research has established that as many as one in five North American wood pallets contain at least one occurrence of bark, the process changes required to eliminate or segregate barky defects from pallets have not been adequately defined or quantified. Simulation-based findings as described in this paper indicate that the proposed EC regulation could add $2.7 billion over 10 years to the cost of U.S. pallets alone as they enter international trade markets, and depending on the degree of universal adoption of bark-free regulation, could result in as much as 16 billion additional board feet of lumber being consumed, again in U.S. pallet production alone. Labor, administration, and environmental costs dwarf the capital costs required to make this process transition. The largest potential cost, however, may come in the form of product substitution, as product manufacturers convert to alternative shipping platforms to avoid potential quarantine and return-of-product risk.

Keywords: pallets, phytosanitary regulation, bark-free

Introduction

The production and use of pallets play a surprisingly important role in the U.S. economy. For example, pallets are thought to consume more than half of all U.S. hardwood lumber production (e.g., McCurdy et al. 1988). The more than 400 million new pallets produced per year have an especially important function in terms of increasing demand for low-grade hardwood lumber that might otherwise be destined for lower value uses. The pallet industry has even been noted for its importance at the state level (e.g., Fraser et al. 1990, Michael 1997, Smith 1991).

It has often been said that "pallets move the world" and this statement is not far from the truth (e.g., White and Hamner 2005). For example, nearly 100 percent of U.S. grocery distribution companies and more than 90 percent of U.S. manufacturing firms are thought to utilize solid wood pallets for transportation of their goods (McCurdy and Phelps 1996, Scheerer et al. 1996). Moreover, wood pallets have a critical role in transportation of goods being exported from the United States to foreign buyers. Of note is the more than $75 billion worth of products being shipped annually on wood pallets to the European Union (EU) alone. Not only do these export pallets serve a key economic role in helping to move our products overseas, but they also consume a significant quantity of wood-based materials. Unfortunately, the future of wood pallets as a means for carrying unit loads to the EU is not a bright as it could be. Recent legislation proposed by the European Commission has the potential to drastically reduce the use of wood pallets for exporting to EU countries.

The governance of wood packaging materials used in international trade stems from a series of treaties and regulations. One of the most important is the International Plant Protection Convention (IPPC), which is an international treaty relating to plant health administered by the Food and Agriculture Organization (FAO). FAO established the Interim Commission on Phytosanitary Measures (ICPM) as an interim measure until the New Revised Text of the IPPC comes into force. ICPM published International Standards for Phytosanitary Measures Publication No. 15 (ISPM 15) *Guidelines for Regulating Wood Packaging Material in International Trade* in March 2002 (ICPM 2002). ISPM 15 describes phytosanitary measures to reduce the risk of introduction and/or spread of quarantine pests associated with solid wood packaging materials, including pallets, containers, and dunnage.

After its publication, implementation of ISPM 15 began as approved in its 2002 form. In October 2004, however, the European Commission (EC) issued Directive 2004/102/EC (EU 2004) which put additional restrictions on wood packaging materials related to the raw material composition, specifically, that wood packaging materials be debarked, bark-free, or free of pests in other forms that might be indicated by the physical appearance of the wood itself. The terminology used to describe the concept of debarked wood is varied throughout Directive 2004/102/EC and its predecessor Directive 2000/29/EC, somewhat obscuring the true intent of the EC. With postponement of the proposed directive until January 2009, the latest overview document provided by the EC states simply that "From January 2009, all wood packaging material imported into the EU will have to be debarked" (EU 2006).

Various industries and governmental agencies around the world have interest in determining the impact this directive might have on the wood packaging industry, its customers, and consumers worldwide. Mumford (2002) elucidated the need for proportionate and reasonable response to quarantine regulation in order to fairly, effectively, and efficiently preserve the world's natural resources for future generations without applying undue hardship on current generations. Partly in response to this stated need, and partly to establish a theoretical baseline of potential impact on the total cost of the proposed regulation, this study sought to determine a framework for evaluation of the economic and environmental costs that might be incurred under the most likely scenarios. The objective of the study was to provide contextual detail of the potential implementation costs to U.S. pallet producers and pallet customers for support of international dialogue and implementation of the ultimate regulation.

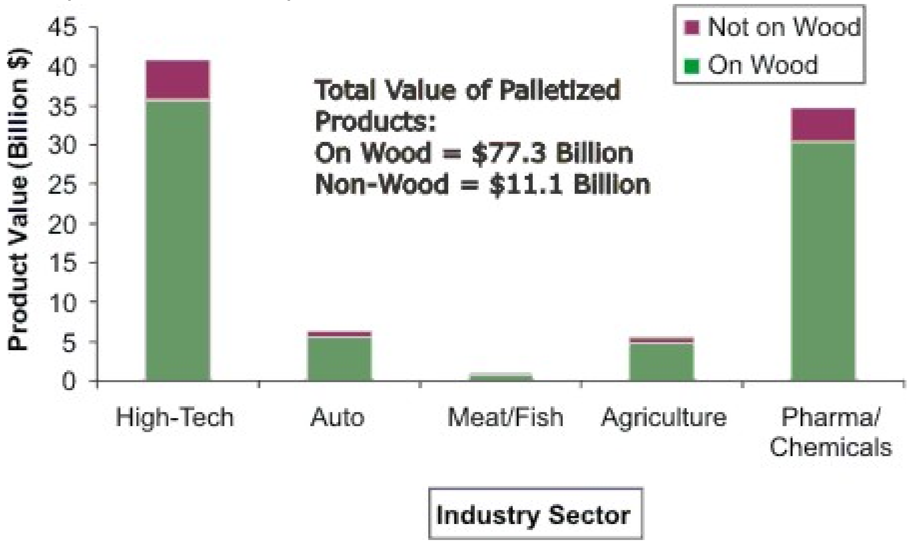
Literature Review

The number of sawmills that typically produce low-grade lumber for the pallet industry and smaller mills that produce less than 5 million board feet of lumber per year has decreased in recent years (Luppold 2005). In addition competing markets for low-grade lumber, especially from overseas wood products industries and the domestic railroad tie industry, has created the most competitive pallet lumber market in history (Brindley and Brindley 2004). The concentration of lumber production in fewer, large mills has been correlated with increasing stumpage and log prices (Luppold 1996). In particular, the hardwood market could be expected to feel price pressure from any increase in grade specification for pallet lumber, as pallet production consumes an estimated 40 to 60 percent of all hardwood lumber produced in the United States (Christoforo et al. 1994). Partially offsetting the additional demand for the lower grade resource is its availability in the changing forest composition as higher quality oak, cherry, and hard maple is replaced by increasing soft maple stocks. The overall average grade of lumber produced from the North American forest may decrease to the benefit of the pallet industry (Luppold 2003).

Pallet production has a much smaller impact on the softwood market. The total volume of softwood lumber and cants produced in the United States in 1995 was 32.2 billion board feet versus 11.9 billion board feet of hardwood lumber and cants (Pease et al. 1996). That year, pallet production consumed an equivalent of only 5.6 percent of the softwood production versus 38 percent of the total hardwood production (Bush et al. 1997). Pallet stock production is considered an insignificant by-product for most large softwood lumber operations, while it is a significant co-product for most hardwood lumber operations. Although no references are available for specific overall lumber market impact by pallet lumber consumption, numerous commentators focus on the hardwood markets when discussing pallet lumber (e.g., Bush et al. 1997, Brindley and Brindley 2004, Christoforo et al. 1994).

The proposed EU bark-free regulations are expected to have the greatest effect on those countries using large amounts of wood pallets as logistical unit-load platforms. The United States clearly is one of these countries. Over 90 percent of U.S. manufacturing firms surveyed in 1993 used solid wood pallets (McCurdy and Phelps 1996), and U.S. wood pallet production was surveyed in 1995 at 411 million new units manufactured from more than 6.5 billion board feet of hardwood and softwood lumber (Reddy et al. 1997). The size of the entire in-use wood pallet pool in the United States is more than 4 billion pallets (Ray et al. 2006). From this pallet pool, approximately 60 to 75 million are used directly in trade with the EU each year (Molina-Murillo et al. 2005), and they carry an estimated $77 billion in trade goods (**Fig. 1**). A further 200,000 or so are sold each year directly to EU manufacturers for their use (Parker 2004). At minimum, these 60 to 75 million pallets would be subject to the proposed EU bark-free pallet regulation. Several major export product manufacturers have hinted that they would require the EU standard for all of their pallets, in order to avoid the logistical problem of maintaining separate pallet inventories (Ray and Deomano 2007). This raises the possibility that the EU standard will become a “de facto” standard imposed on wood pallet production worldwide. Pallet producers are concerned that the magnitude of this impact may cause severe hardship to the worldwide wood pallet industry, perhaps even a gradual elimination of the industry as environmentalists push an agenda to alternative materials (NWPCA 2005a).

Figure 1. Product value by industry sector of U.S. exports to the European Union (source: U.S. Department of Commerce, Harmonized Trade Schedule, 2004 data).



EU leadership has taken a hard line on the issue thus far supporting the implementation of the rule as formulated. The Director General for Health and Consumer Protection for the European Commission has stated that "the risk-aversion policy [for the European Union] has been set at zero..." and that "...as regulators we hear all the time that a new regulation will wipe out an industry" (NWPCA 2006). At this point in time, enforcement of the proposed regulation by the EU is due to begin in March of 2009.

Underlying the proposed directive is an interest in reducing environmental risks to the forests of Europe posed by invasive species. Quarantined pest data collected at Australian ports indicated that about 0.3 percent of ISPM-stamped pallets had both insects and bark (IFQRG 2005) and about 0.1 percent were similarly found in a study of six U.S. ports (Haake et al. 2006). The actual amount of expected decrease in environmental risk due to enforcement of "bark-free" regulation is not well established for any specific forest species, geographic region, or inspection protocol (IUFRO 2006, IFQRG 2006), and "infestation of marked wood packaging is rare" (IFQRG 2006). By introducing complex regulation differentiated from the global ISPM 15 standard, the proposed directive may increase the cost of the global trade goods system (NWPCA 2005b) while ignoring the environmental benefits that accrue to utilization of carbon-neutral wood pallets (Skog and Nicholson 2000) and the environmental cost in additional wood consumption of required sawing to clear lumber (Araman et al. 2003, Steele 1984, Kuenzi 2002). Furthermore, the introduction of regional modifications to the accepted world phytosanitary standard for wood packaging (ICPM 2002) promises to increase the level of diversity and complexity of pallet standards (Portman 2005). It may also introduce economic inefficiency similar to those stemming from the lack of harmonization of world pallet size standards (Raballand and Aldaz-Carroll 2005).

Of particular concern to the wood packaging industry is the lack of a clear definition of the bark requirement actually targeted by the EC directive. The definitive document, EC Directive 2004/102/EC, refers to six different descriptions of a bark-free state: "stripped of its bark" (9 times); "free of grub holes" (3 times); "debarked" (5 times); "bark-free" (11 times); "roughly squared" (9 times); and "made from debarked round wood" (specifically with respect to wood packaging) (EU 2004). This range of descriptive terminology has led to speculation of the exact definition of the "bark-free" requirement, and the relevant risk associated with any specific definition. In response, the IPPC has initiated an international survey to measure bark occurrence on wood packaging marked as in compliance with ISPM 15 (IPPC 2007). This survey requires participating inspection agencies to measure each occurrence of remnant bark on the pallet.

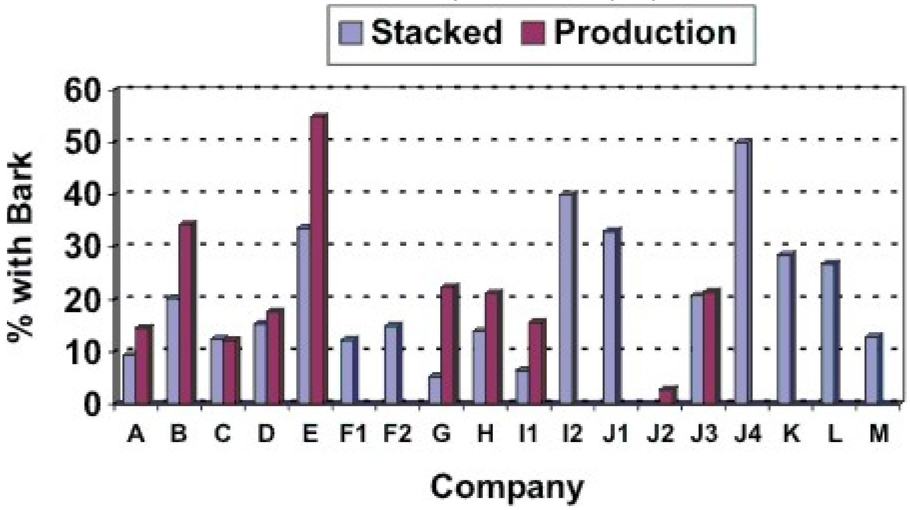
This may prove to be problematic. Ray (2006) has quantified high levels of alpha-type (**Fig. 2a**) and beta-type (**Fig. 2b**) risk of error in detection of bark occurrences on wood pallets as manufactured in current processes. Confirmed high levels of inspection error would cast doubt on the effectiveness of an inspection protocol and ultimately, the EC directive.

Figure 2a. Alpha-type error (false positive) in pallet board. Bark-free wane as it typically darkens is difficult to distinguish from a distance from real bark. This example was incorrectly identified by 7 of 20 inspectors as a bark occurrence (from Ray 2006).

Figure 2b. Beta-type error (false negative) in pallet board. Bark pocket residing on the bottom of the pallet not visible to inspectors. This pallet was incorrectly passed as "bark-free" by 20 of 20 inspectors (from Ray 2006).

In order to ascertain the potential impact of a bark-free standard, in terms of number of pallets that might be impacted by a "debarking" or "bark-free" requirement, Ray and Deomano (2007) visited 15 sawmills, pallet producers, and pallet customer locations. Bark-occurrence data on pallets in stock was collected from all but two of these locations. In collecting data on the actual occurrences of bark on pallet wood, the data collection methodology of their study initially followed an unofficial standard of a "credit card" size of bark occurrence. But, this concept proved unworkable in actual inspection practice, and they modified their data collection to a scheme deemed reasonable in practice and compliant with the intent of the regulation. **Figure 3** is a summary graphic illustrating the results of inspection of 5,584 solid wood pallets and crates. Production facilities were visited in three different geographic regions (Pennsylvania, Ontario, and Washington) to determine whether regional differences in pallet bark populations could be detected. The alphabetic identification of the companies on the x-axis of the figure identify individual companies, and in the case of alphanumeric identifiers, different types of pallets at the same company. At 10 of the pallet production facilities and three of the customer facilities, data was collected on the number of pallets with bark or barky-type defects relative to bark-free pallets. The statistics reflected in **Figure 3** led to the understanding that bark and barky-defect occurrences are quite prevalent on solid wood pallets in North America, even if produced from debarked lumber. The authors conclude that typically one in five pallets and containers produced from solid wood in North America contain at least one occurrence of bark remnant or barky defect.

Figure 3. Pallets inspected for bark occurrence by company and whether inspected as stacked or in production (Ray and Deomano 2007).



Unfortunately, an exact specification defining a "bark-free" state is not explicitly stated in 2004/102/EC, and enforcement of the regulation is likely to be varied by geographic and cultural standards. Bark occurrences on the wane portion of lumber, for example, typically have a narrow, triangular shape that abruptly ends where a debarker was effective in removing the bark (**Fig. 4a**). Bark pockets normally appear as long, narrow defects in pallet stringers (**Fig. 4b**) or deckboards (**Fig. 4c**). Other "barky defects" that could be identified as potential pest harbors are commonly found in pallet blocks (**Fig. 4d**), deckboards (**Fig. 4e**), and stringers (**Fig. 4f**) (Ray and Deomano 2007) and are the result of several types of unsound defects commonly found in pallet cants (Araman et al. 2003).

Figure 4a through 4f. Typical bark occurrences on pallets (from Ray and Deomano 2007).

Figure 4a. Remnant bark on wane after debarking.

Figure 4b. Bark pocket in pallet stringer.

Figure 4c. Bark pocket in pallet deckboard.

Figure 4d. "Barky" defect in pallet block.

Figure 4e. "Barky" defect in pallet deckboard.

Figure 4f. "Barky" defect in pallet stringer.

Methodology

Seventy-seven interviews were conducted, in a variety of settings, with people familiar with the workings of both the international phytosanitary standards and the global logistics community. Government officials and industry trade representatives from the EU, Canada, and the United States were surveyed, in most cases through telephone interviews, to establish the relative positions taken by those countries toward the proposed regulation, and to frame the issue for further data collection and analysis. Fifteen pallet producers, suppliers, and customers were visited and interviewed informally to establish the detail necessary for proper analysis of the problem. During these visits, pallet production methods, storage procedures, and shipping standards were reviewed with operational personnel. Cost components (e.g., raw material, labor, processing alternatives, etc.) of these processes were discussed, and the issue of bark-free production was explored with respect to what process changes would necessarily be required. Managers at more than a dozen additional companies using wood pallets for export, representing the food, plastics, and high-tech industries were informally interviewed as to their knowledge of this issue, and their reactions to each of several possible outcomes were noted. For the customer interviews, informality and confidentiality were given a high priority because of pallet suppliers' reluctance to prematurely raise the issue into prominence in the eyes of their customers.

Selection of participating government and trade officials was made through investigation of agencies and organizations most involved in the topic. Selection of the data collection locations was made with pallet industry assistance. In this regard, representatives of the National Wooden Pallet and Container Association (U.S.) and the Canadian Wood Pallet and Container Association targeted and recruited companies for participation in the study.

Having defined the issues surrounding "debarked" or "bark-free" pallets and measured the magnitude of product impact on a representative sample of North American pallet producers, computer modeling techniques were devised (as described in detail in the following section) to quantify the different cost components of bark-free pallet production and simulate them over three possible future scenarios.

The general modeling methodology was to establish production and cost range estimates from the interviewed and cited sources, represent these point estimates and ranges in formulated spreadsheet scenarios of the different investment levels, and generate year-to-year estimates of the various costs. These annual costs were summed over a determined period of 10 years to cover the expected time until the regulatory transition had been concluded to a steady-state. For those variables in the modeled scenarios for which the potential ranges were relatively wide, simulation techniques of generating random numbers from appropriate statistical distributions were used to generate representative averages, which were then plugged into the modeled scenarios. Finally, the calculated value of each scenario was multiplied by its probability and summed, resulting in an expected value (cost) of all of the scenarios combined. This general methodology of modeling events under uncertainty is similar to techniques commonly used in corporate strategic planning and operational analysis (Ray 1998).

Data Collection and Model Formulation

Data determined necessary to the modeling effort were collected from the sources as summarized in **Table 1**. These data were used to develop sensitivity models to examine three different scenarios.

Table 1. Baseline data used in economic simulation exercise.

Variable category	Variable	Data point estimate or range	Source
Economic impacts	Total numb		