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Voluntary Environmental Action and Export Destinations: The Case of Forest Certification

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There is an increasing tendency for forest product firms worldwide to adopt sound environmental management practices by voluntarily agreeing to have their forest practices certified by third parties. Using a simple model of profit maximization, we illustrate that the puzzling emergence of this non-state, self-imposed governance structure is compatible with firms' profit motives. An empirical model using firm data from three countries shows firm location and export destinations play a key role in firms' decisions to seek certification, while the nature of forestland ownership has no significant impact on certification decisions.

Key words: discrete choice models, export markets, forest certification, profit maximization

Introduction

One of the most challenging tasks facing policy makers today is that of developing appropriate policy instruments for addressing environmental spillovers. Different instrument choices available to governments for protecting the environment and encouraging sustainable development include command-and-control regulations which have historically been preferred and continue to be the instrument of choice (Stavins), and market-based incentives such as taxes and cap-and-trade schemes (Stavins; Lippke and Oliver).

Whether regulations or incentives are employed, state involvement is required, if only to determine a cap level, and enforce and monitor the subsequent trading mechanism. Reliance on private transactions to resolve environmental spillovers, as argued by Coase, is generally eschewed because empirical evidence of its success is lacking. The conclusion is often that transaction costs of reaching agreements are onerous, so some form of state involvement is required. Even where firms have voluntarily agreed to "correct" an environmental externality, the explicit threat of state intervention is generally a prerequisite for such an agreement (Segerson and Miceli).

Remarkably, there is now increasing evidence of the emergence of non-state, self-imposed governance structures for addressing environmental spillovers. These governance structures are now appearing in a number of sectors, such as agriculture (Loureiro,

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McCluskey, and Mittelhammer), fisheries (Johnston et al.), and forestry (Cashore, Auld, and Newsom). Forest certification is an example of governance seeking to address environmental spillovers related to the "proper" and "sustainable" exploitation of forests—i.e., that forest operations do not endanger wildlife and watersheds, and that logging companies and landowners practice sustainable forest management (SFM). Thus, under forest certification, private firms address spillovers voluntarily.

In the past, researchers investigating forest certification have described the evolution of institutions for certifying forest practices and wood products, or have focused on political and social explanations for voluntary behavior (Gale and Burda). There is the view that firms will voluntarily enter environmental agreements without the threat of state intervention because such agreements give them the social license to cause some environmental harm, as not all spillovers can be mitigated in any event. This is one form of the ethical argument of "corporate responsibility"—managers of firms feel they have to behave in a socially acceptable manner. Managers may have a social and environmental conscience that needs to be assuaged. Both the behavior of managers and community pressure are cited as impetus for forest certification (Hayward and Vertinsky).

There have been few studies on potential economic incentives for forest certification. Some economic studies have sought to determine whether and under what conditions firms would benefit from forest certification (Swallow and Sedjo), while others have focused on whether forest certification enhanced social welfare. For example, Vertinsky and Zhou demonstrate, theoretically, that voluntary certification coupled with a minimum quality standard is preferable to state-enforced SFM standards from a welfare standpoint. Haener and Luckert argue, however, that this comparison of two different forms of regulation is inadequate: if compared with market instruments, certification is not the economically most efficient means for addressing environmental spillovers related to forestry activities.

In this study, we claim that timber firms, like any other private market player, follow the paradigm of profit maximization when deciding to certify their forest practices. We develop a theoretical model of profit maximization consistent with the notion that certification may provide cost advantages in export markets. A simplified version of the model is implemented using firm-specific survey data from Canada, the United States, and Germany. To our knowledge, there exist no studies investigating voluntary forest certification from this profit-driven, market-based perspective, or which offer an empirical analysis of this phenomenon.

Forest Certification Programs

Forest certification programs can be divided into several categories, depending on their scope, what is certified, and their philosophy. At the global level, there are two forest certification programs, those of the Forest Stewardship Council (FSC) and the International Standards Organization (ISO). The FSC was formed in 1993 by environmental/nongovernmental organizations, foresters, and some timber companies. It develops standards for sustainable forest management and then certifies companies (or landowners) practicing sustainable forestry according to its rules. In this sense, FSC certification is a private regulatory scheme for sustainable forest management.

ISO certification of forest practices began when the Business Council for Sustainable Development, comprised of business leaders from around the world, charged the ISO in

1991 with the development of standards of environmental management. The result, in 1996, was ISO 14001 ("Environmental Management Systems—specification with guidance for use"), which established the requirements of an environmental management system for any industry, including forestry. ISO 14001 provides a generic, system-based forest certification program, but it is focused on processes (e.g., harvest methods) and not sustainable forest management (e.g., there is no requirement for post-harvest regeneration).

In direct response to FSC certification of sustainable forest management, domestic and regional competitor programs were started by the forest industry in North America and landowner organizations in Europe. In Canada, the Canadian Pulp and Paper Association (now the Canadian Forest Products Association) asked the Canadian Standards Association (CSA) to develop a forest certification program based on a systems approach to sustainable forest management. To become certified, forest companies owning land or logging timber from public lands under long-term management agreements would be required to establish environmental management systems for forestry which include auditing requirements. CSA certification has built-in flexibility to encourage ongoing improvements in forest management. Although CSA certification was initiated by industry, its requirements are quite stringent; costs of obtaining and complying with CSA certification are now comparable with those of FSC certification, but CSA lacks the same global recognition as FSC.

In the United States, the American Forest and Paper Association's Sustainable Forestry Initiative (SFI) requires firms to file reports with SFI regarding their sustainable forest management plans. Like CSA certification, no attempt is made to follow wood fiber through its various stages to the final consumer (chain-of-custody certification), although labeling of products is emerging (Meridian Institute). Because many Canadian forest firms are U.S. owned and the United States is Canada's main export market, about half of certified forestlands in Canada are SFI certified.

In Europe, it was landowners who developed their own certification program, because they felt their needs and opinions were ignored by the FSC. The various national forest landowner associations began the Pan-European Forest Certification (PEFC) program in 1999. PEFC endorses national programs which then rely on third-party certification.

With the exception of those under the auspices of FSC, sustainable forest management certification programs lack chain-of-custody provisions. The problem with chain of custody is that some of the wood from a forest goes into the production of pulpwood, thus getting mixed with fiber from various sources, making it nearly impossible to trace fiber from the forest to its final destination. Consequently, certification at this stage consists primarily of large retailers, such as Home Depot, guaranteeing that the wood products they sell come from certified forestlands.

FSC certification is based on the concept of market-driven, market-based governance that sees a private-sector certifier enforcing stringent global and domestic sustainable forest management standards. Procedures are developed with a view to eliminating business dominance and encouraging strict standards with limited discretion on the part of certified companies or landowners to vary actual implementation.

The competing regional certification programs are based on the notion that business should dominate rule making, while government and environmental/nongovernment organizations should act in an advisory, consultative capacity. Underlying these programs is the view that society's perception of extant forest practices differs from reality.

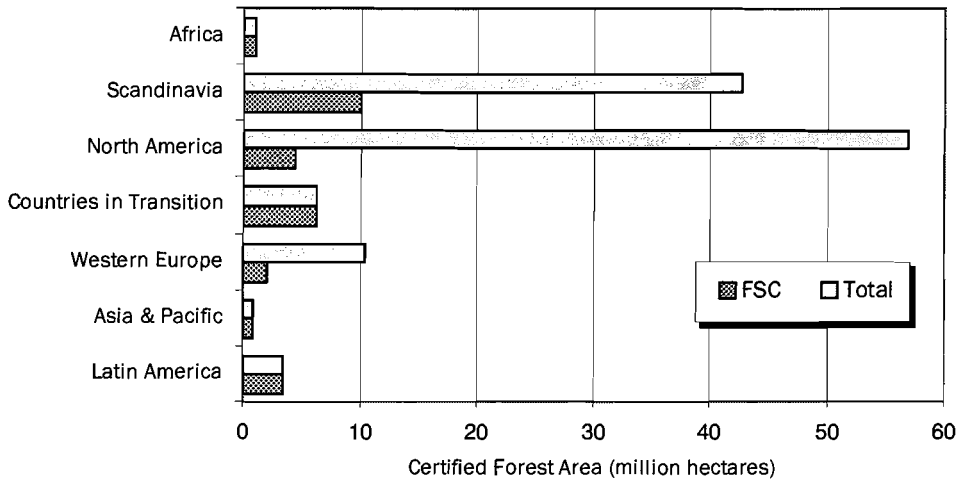

Figure 1. Distribution of global certified forests: Forest Stewardship Council (FSC) and total (total = 122 mil. hectares, June 2002)

Although addressing environmental externalities plays a role, certification is seen for the most part as a communication tool. With this conception, procedural approaches are ends in themselves, and individual firms retain greater flexibility over implementation of program goals and objectives. Because it was industry initiated, ISO 14001 reflects a similar perspective, except its forest management rules focus on processes, so that forests themselves are not certified. Thus, ISO 14001 is not directly comparable to the other programs (van Kooten, Nelson, and Vertinsky).

As of June 2002, some 122 million hectares of forests had been certified globally under the above programs (figure 1), nearly double the 66 million hectares certified in March 2001. This constitutes only 3% of all forests, and excludes ISO 14001 certification as it does not certify forestlands. FSC certification accounts for 28.4 million hectares, while regional competitor schemes account for 93.5 million hectares. Further, as evident from figure 1, industrial countries account for nearly all of the certified forest area, with FSC certification being more important in Africa, Asia, Latin America, and Eastern and Central Europe—regions where domestic competitor programs have not taken hold.

Economic Incentives for Forest Certification

Economic incentives explaining why firms embark on unilateral environmental initiatives, such as forest certification, have been proposed in the past. One reason for unilateral action is its potential to lead to a reduction in operating costs while enhancing resource productivity. For example, firms frequently discover that, by implementing energy-saving programs or redesigning production processes, production costs are lowered (Schmidheiny and Timberlake).

A second reason for unilateral action is that certified products may command a price premium over uncertified goods, at least in some target markets (e.g., Johnston et al.). Swallow and Sedjo provide theoretical arguments for why a price premium might exist, and how both certified and noncertified firms can benefit. However, if certification does not increase marginal costs, there may be no price premium. In developed countries,

forest certification might not increase marginal costs because, as Swallow and Sedjo point out, many forests are already sustainably managed to satisfy extant government environmental regulations. Further, the international trade regime in wood products, which is characterized by distorting import duties, export subsidies, and exports of illegally harvested timber, might diminish or eliminate any price premium for certified products. These explanations could account for the lack of empirical evidence of a price premium for certified wood products (Baldwin; Kim and Carlton).

In the absence of price premiums, firms have an incentive to invest in certification if it reduces operating costs or costs of meeting government regulations (Khanna and Anton). Alternatively, as argued here, a firm will invest in certification if it generates goodwill for its products, thereby reducing lobbying and marketing outlays and diminishing the threat of product boycotts or environmental lawsuits. Of course, the latter benefits depend on the environmental awareness and preferences of consumers in different target markets.

As Johnston et al. have shown, this heterogeneity in preferences for sustainable resource management can be very pronounced across markets for certain products. For wood products, sustainable forest management appears to be of greater concern to European buyers than those in North America or Asia (Cashore, Auld, and Newsom).[1] Accordingly, one could hypothesize that the more a firm relies on European markets, the greater is the chance it will certify its forest operations. This study provides an empirical test of this premise.

The real or perceived benefits of forest certification need to be balanced against costs. Costs can be divided into the direct costs of obtaining and maintaining certification—filling out application forms, bargaining with the certifier, audit preparation, paying monitoring costs, etc.—and the indirect costs of changing forest practices to meet certification requirements. Forest companies operating in industrial countries already comply with a variety of environmental standards, but one expects firms harvesting timber on public lands to be held to a higher standard than firms operating on private lands, because the public manager takes into account the externality costs of logging. Accordingly, the incremental costs of adjusting forest operations to be compatible with certification requirements should be smaller for forest firms which rely predominantly on public timber. Apart from land ownership, one might expect certification to be more prevalent in Canada than in other countries, because it has the world's most stringent environmental regulations for forestry (Pearse). The empirical model proposed in this study investigates these premises.

Based on these arguments and the literature on this topic (reviewed by Khanna), the following section develops a theoretical profit-maximization model around three major factors: firm location, the cost of resource inputs, and the role of output markets.

The Theoretical Model

Suppose a given forest company i sells a homogeneous wood product to a domestic market (D), Asia (A), Europe (E), and (nondomestic) North America (NA), earning profit:

[1] In personal discussions with one of the authors, forest company executives have made similar observations about the difference between North America and Asia vis-à-vis Europe.

$$\pi_i = R(q_{iD}, q_{iK}, P_D, P_K) - C(\mathbf{N}_i, \mathbf{w}_i, q_{iD}, q_{iK}, \gamma_{i1}, t_{ir}, t_{ip}, \gamma_{i2}, c_i), \quad i = 1, \ldots, n, \quad K \in A, E, NA, \tag{1}$$

where R is total revenues, C is total costs, and there are n firms. Revenue is determined by firm i's output to the domestic market (q_{iD}) and the other export destinations, as well as by the price of its product in each of the four markets ($P_D, P_K, K \in A, E, NA$). Total costs are a function of the firm's nontimber inputs $\mathbf{N}_i$ and their associated price vector $\mathbf{w}_i$; output to each destination with cost vector γ_{i1} for marketing, transportation, and insurance; total timber inputs procured from private and public sources (t_{ir} and t_{ip}, respectively) with price vector γ_{i2}; and certification status c_i (=1 if certified, 0 otherwise).

Certification imposes a direct, fixed cost on the firm, labeled F_i, but certified firms do not have to incur lobbying costs in foreign markets. Specifically, the marginal costs associated with sales abroad for marketing, transportation, and insurance are assumed to increase by a fixed amount for noncertified firms, because such firms need to overcome, by increased advertising and lobbying efforts, say, the reluctance of foreign buyers to purchase noncertified merchandise.

For example, net revenues from certification and noncertification can be modeled as:

$$R_{iK}^1 = (P_K - \gamma_{iK}) * q_{iK} \quad \text{and} \quad R_{iK}^0 = (P_K - (\gamma_{iK} + \beta_K)) * q_{iK}, \quad K = A, E, NA, \tag{2}$$

where superscripts 1 and 0 indicate whether the firm is certified or not, and γ_{iK} is a constant marginal cost term including the unit cost of timber production and shipping to destination market K, regardless of certification status. The "goodwill" premium on marginal costs, β_K, is assumed negligible in the domestic market due to well-established marketing relations, and a hesitation to impose market barriers on a domestic firm (Cashore, Auld, and Newsom).

The remaining terms in the expression for total cost relate to timber inputs, which are assumed to be procured domestically. We assume a priori that the self-imposed environmental stipulations under certification translate into increased operating costs for a given firm when accessing timber from *any* land compared to pre-certification status. As discussed in the previous section, these incremental costs may be smaller for existing operations on *public land* (especially for firms with long-standing tenure on such lands) than for logging on private land. The cost specification incorporates this notion. Assuming additive separability between nontimber, timber, and export costs, total costs to noncertified and certified firms, respectively, are thus given by:

$$C_i^0(\cdot) = C(\mathbf{N}_i, \mathbf{w}_i) + \sum_{K \in A,E,NA} (\gamma_{iK} + \beta_K) * q_{iK} + \gamma_{iD} * q_{iD} + \gamma_{ir} * t_{ir} + \gamma_{ip} * t_{ip}; \tag{3}$$

$$C_i^1(\cdot) = C(\mathbf{N}_i, \mathbf{w}_i) + \sum_{K \in A,E,NA} \gamma_{iK} * q_{iK} + \gamma_{iD} * q_{iD} + (\gamma_{ir} + \beta_r) * t_{ir} + (\gamma_{ip} + \beta_p) * t_{ip} + F_i, \quad \beta_r > \beta_p,$$

where γ_{ir} and γ_{ip} are the constant per unit prices for private and public inputs, and β_r and β_p denote cost premiums on inputs from private and public sources, respectively, for certified firms. A firm will choose certification if it leads to an increase in profits, i.e., if $\pi_i^1 - \pi_i^0 > 0$.

Given the documented lack of observed price differentials between certified and uncertified timber products, total revenue is modeled independently of certification. Consequently, the difference in profits reduces to differences in costs,

$$\pi_i^1 - \pi_i^0 = \beta_A * q_{iA} + \beta_E * q_{iE} + \beta_{NA} * q_{iNA} - \beta_r * t_{ir} - \beta_p * t_{ip} - F_i. \tag{4}$$

This expression has intuitive appeal: the first three terms represent total benefits from certification, while the last three terms measure total costs. Thus, a given firm will seek certification if net benefits are positive.

Given information on quantities of inputs and outputs, certification costs, and certification status at the firm level, equation (4) could form the basis for a standard dichotomous choice model, such as a logit or probit, for estimating how each observed element on the right-hand side of (4) affects the probability of a given firm seeking certification. Such a model would also yield empirical estimates for the marginal cost differentials β_K ($K \in A, E, NA$), β_r, and β_p.

The data available for this analysis exhibit several shortcomings compared to this "ideal" scenario. In lieu of actual input and output quantities, the data contain only information on firm location, the value share of sales to various destinations, and on the share of inputs from public and private lands for a given firm. This preempts specification of an empirical model that is fully consistent with the theoretical framework outlined above. Instead, we implement the following estimable probability model:

$$p_i = \frac{\exp(\mathbf{x}_i'\beta)}{1 + \exp(\mathbf{x}_i'\beta)}, \tag{5}$$

$$\text{where } \mathbf{x}_i' = \left[1\ D_{CAN,i}\ D_{US,i}\ x_{A,i}\ x_{E,i}\ x_{NA,i}\ x_{p,i}\right].$$

Thus, the probability of observing that firm i is certified (p_i) is modeled as a standard logistic cumulative distribution function (Evans, Hastings, and Peacock). The elements of $\mathbf{x}_i$ are a constant; a dummy variable if firm i is located in Canada ($D_{CAN,i} = 1$); an analogous intercept shifter for the United States ($D_{US,i}$), value-of-sales shares to Asia, Europe, and (nondomestic) North America ($x_{A,i}$, $x_{E,i}$, $x_{NA,i}$); and the share of fiber inputs from public sources ($x_{p,i}$). Vector β includes associated coefficients. It should be noted that the elements of β do not directly correspond to the marginal cost terms in (4). They simply constitute empirical estimates which, as components of expressions for marginal effects, show how each regressor in (5) affects certification probabilities.

While this formulation is incomplete compared to a specification flowing from (4), it still allows testing of some interesting hypotheses associated with certification choices. Specifically, based on the discussion in the previous two sections, p_i is expected a priori to be positively related to firm location in Canada, export value shares to Europe, and reliance on public lands for timber inputs. As shown below, this empirical specification provides a close fit with the underlying sample data.

Data Analysis

The data come from three separate surveys: one conducted in Canada in 1999 (Wilson, Takahashi, and Vertinsky), one in the United States in 1999 (Auld, Cashore, and Newsom), and one in Germany in 2000 (Affolderbach). The sample made available is

Table 1. Percentages and Types of Certification by Firm Location

Item		Firm Location			Total Sample
		USA	Canada	Germany	
Number of Firms		283	143	134	560
Firms Not Certified:		242	102	125	469
▸ With some exports		120	84	64	268
▸ With some exports to Asia		50	36	16	102
▸ With some exports to Europe		51	30	59	140
▸ With some exports to North America		116	84	61	261
Firms Certified:		41	41	9	91
▸ With some exports		29	38	9	76
▸ With some exports to Asia		19	28	4	51
▸ With some exports to Europe		12	29	7	48
▸ With some exports to North America		27	36	8	71
Type of Certification:		<---------- (%) ---------->			
▸ Forest Stewardship Council (FSC)		9.5	6.3	3.0	7.1
▸ Internat. Standards Organization (ISO 14001)		2.1	19.2	0.7	5.4
▸ Canadian Standards Association (CSA)[a]		none	18.4	none	4.1
▸ Sustainable Forest Initiative (SFI) (USA)		7.1	none	5.2	4.8
Share of Timber from Private Sources:		<---------- (%) ---------->			
▸ All Firms:	Mean	67.2	10.2	21.8	41.8
	Median	85.0	0.0	10.0	30.0
▸ Certified:	Mean	74.3	11.0	23.9	41.9
	Median	90.0	0.0	30.0	30.0
▸ Not Certified:	Mean	65.9	9.9	21.6	40.8
	Median	85.0	0.0	10.0	29.0

[a] CSA includes an earlier program known as FOREST CARE.

comprised of 143 Canadian, 283 United States, and 134 German firms, yielding a total of 560 observations.[2]

For this study, a firm is considered certified if it had actually completed the certification process or was prepared for an audit by the certifier, having thus incurred all the direct costs of certifying. Based on this definition, approximately 16% of firms in the sample are certified (table 1). Naturally, the causality flow implied by the theoretical and empirical models described in the previous section rests on the underlying assumption that export patterns were in place before attainment of certification status. Of the firms treated as "certified" in our sample, half were in the final stage of the certification process, while the majority of the remainder actually became certified in the year prior to being surveyed. Therefore, the assumption of predetermined export shares appears reasonable for our sample.

[2] For Canada, 475 forest-industry executives were surveyed, with 143 responding (30% response rate); 2,131 firms in the United States were surveyed, with 286 completed surveys returned (13.4%), but only 283 usable; and 215 out of 2,764 firms responded (7.8%) to the German survey, but, for various reasons, only 134 surveys were made available. Questions used in the U.S. and German surveys were based on those in the Canadian survey, although in those countries the authors surveyed mainly smaller firms for which lower response rates are the norm. Response rates among executives are notoriously low and it would be erroneous to compare these with response rates from household surveys (e.g., see Friedman and Singh). For details on survey design, response rates, and so forth, the reader is referred to the original studies, although copies of the original surveys (in English) are available on request from the current authors.

On the basis of the surveys, Canada has by far the largest proportion of certified firms, followed by the United States and Germany (table 1). Some firms are certified under more than one program, but firms with multiple certification are a relatively small proportion of certified firms in each country.[3] In this sample, FSC is the leading certification scheme in the United States, while ISO and SFI dominate in Canada and Germany, respectively. For the entire sample of 560 firms, FSC certified firms comprise 7.1% of total forest firms, followed by ISO (5.4%), SFI (4.8%), and CSA (4.1%).

Certified firms rely more on private timber sources than do their noncertified counterparts (table 1). The average noncertified U.S. firm draws about two-thirds of its timber supplies from private sources, while certified companies obtain nearly three-quarters of raw fiber from private sources. The high median values relative to the means (85% versus 90%, respectively) indicate that, for most U.S. firms, private sources clearly dominate public firms, although a few companies may rely quite heavily on public timber.

On average, a Canadian company obtains only about 10% of its wood fiber from private sources, with no significant difference between the certified and noncertified firms. A zero median indicates this distribution is skewed to the right, and private providers play a significantly greater role for a few individual firms. This finding is not surprising, because Canada has the highest public ownership of timberlands in the world, with nearly 95% of land publicly owned (Wilson et al.). Finally, the average German firm purchases roughly 22% of its timber from private sources, but, as in Canada, certified and noncertified firms do not differ much by ownership.

The data also include information on export patterns for individual firms (table 1). Canada has by far the largest share of exporting firms, followed more distantly by Germany and the United States. For all three locations, the share of firms with at least some exports is significantly larger for those that are certified compared to those that are not. In Germany, for example, there is virtually no certified firm which does not sell some of its merchandise abroad. For the entire sample, the percentage of exporting firms in the "certified" category is about 25% higher than for the noncertified segment.

From table 1, it is also apparent that in all three countries more firms export to North America than to any other region. Specifically, close to 84% of all Canadian firms ship some output to the United States, compared to 40%–45% of Canadian firms that export to other regions. Conversely, Canada is the United States' primary destination for exports, with half of U.S. firms shipping to Canada versus less than a quarter to Asia or Europe. For Germany, the number of firms exporting to other European countries is comparable to the number of firms exporting to the United States, and clearly exceeds the number shipping to Asia. As for overall exports, the share of exporting companies among certified firms is larger than for the noncertified category for all origin-destination pairs. This also holds for the pooled sample.

The share of sales value accruing to firms from shipments to foreign destinations is also important (table 2). The mean percentage of sales exported over all firms in the sample exceeds 23%. This share is highest for Canada and lowest for the United States. On average, and for all three countries, a certified firm relies more heavily on exports, as measured by value, than a noncertified one (table 2). For the pooled sample, the share

[3] Because we are interested only in examining whether a firm is certified or not, we do not attempt to determine what factors cause a firm to choose a particular certification program or why a firm chooses two or more programs. Auld, Cashore, and Newsom examine this issue in more detail using the same data, while Cashore et al. use a multinomial logit model to examine non-economic factors which cause firms to certify forest management practices.

Table 2. Share of Sales to Various Destinations (%)

Firm Location	Percent of Sales Exported to: Asia	Europe	North America	All Destinations
United States:				
Not Certified	1.9	1.3	4.8	8.0
Certified	1.9	1.3	9.9	13.0
Total	1.9	1.3	5.6	8.7
Canada:				
Not Certified	4.2	3.3	44.6	52.0
Certified	12.8	11.4	45.5	69.7
Total	6.7	5.6	44.8	57.1
Germany:				
Not Certified	1.5	7.3	8.8	17.6
Certified	0.9	10.0	18.4	29.2
Total	1.5	7.5	9.4	18.4
All Firms:				
Not Certified	2.3	3.3	14.5	20.1
Certified	6.7	6.7	26.8	40.1
Total	3.0	3.9	16.5	23.4

of total proceeds stemming from exports is almost twice as high for a certified firm as for one not certified (40.1% versus 20.1%). As evident from the "total" rows in the first three columns, a typical firm collects a larger share of revenues from exports to North America than from sales in any other export region. This difference is especially pronounced for Canada, where sales to the United States constitute close to 45% of the revenue of an average forest products company, compared to 6%–7% of sales from exports to Asia and Europe.

Generally, the sample statistics captured in tables 1 and 2 strongly suggest a firm's decision to pursue forest certification is related to its reliance on exports. The econometric model described above is employed to investigate this relationship in a multivariate context.

Estimation Results

Estimation results for the logit model (5) are provided in table 3. The model fits the underlying data well, with all but one parameter estimate significant at the 10% level or higher. As indicated by the positive and significant coefficient for the United States (0.82), the probability of certification is higher for a firm located in the United States than for a German firm, our implicit baseline category. This probability further increases for a firm located in Canada ($\beta_{CAN} = 1.43$). These findings are consistent with the sample statistics shown in table 1. A possible explanation for Canadian firms being the most likely to certify is that Canadian firms are already subject to stringent environmental regulations, and thus do not need to make substantial adjustments to their forest operations to become certified.

Table 3. Binary Logit Model, Probability of Choosing One or More Certification Schemes

Variable	Estimated Coefficient	*t*-Statistic
Intercept	-2.57***	-5.24
= 1 if firm located in United States	0.82*	1.81
= 1 if firm located in Canada	1.43***	3.13
Share of sales value from exports to Asia	2.04**	2.12
Share of sales value from exports to Europe	2.34**	2.32
Share of sales value from exports to nondomestic N. America	1.00*	1.80
Proportion of fiber from public lands	-0.60	-1.46
Log likelihood = 227.66		

Note: Single, double, and triple asterisks (*) denote significance at the 10%, 5%, and 1% levels, respectively.

Shares of sales value directed to export markets have a strong and significant effect on a firm's decision to seek forest certification, as indicated by the positive sign and significant *t*-values for share of sales value from exports to Asia, share of sales value from exports to Europe, and share of sales value from exports to North America. As expected, value-of-export shares to Europe boost certification probabilities by the greatest amount, closely followed by shares to Asia. In comparison, the impact of value-of-export shares to nondomestic North America on the probability of becoming certified is lower, and less significant. This result is consistent with the observation of Cashore et al. that consumers in Europe are the most sensitive to sustainable forestry issues. Thus, to maintain market shares in that region, foreign firms are under more pressure to certify their products compared to other export destinations.

On the other hand, the relatively smaller impact of exports to North America on certification decisions might be related to the fact that more than 90% of wood products consumed in North America are produced within the region, which has led to many informal marketing channels and agreements. This existing framework may mitigate the need for certification.

Clearly, firm location and value-of-export shares play a more important role in firms' decisions to seek certification than the origin of input fibers. This is highlighted by the lack of significance for the share of inputs from public lands.[4]

Due to the predominance of the noncertification choice in the sample, the use of the "hit rate" or "highest probability principle" to assess model fit is problematic (Ben-Akiva and Lerman). Instead, predicted probabilities of certification are compared with sample shares for individual origins and for the pooled data. As shown in the first two rows of table 4, the logit model predicts certification shares with high accuracy, not only for the entire sample, but also for each origin category. In fact, predicted probabilities deviate from sample shares by no more than 0.5% for all three origins. This finding lends further credibility to the explanatory power of the empirical specification.

[4] A model with interaction terms for "proportion of fibers from public land" with "United States" and "Canada" was also estimated. This specification change did not lead to measurable improvements in model fit. A corresponding likelihood-ratio test ($\chi^2 = 0.06$, 2 degrees of freedom) does not allow rejection of the null hypothesis that these additional parameters are equal to zero at any conventional level of significance.

Table 4. Predicted Probabilities and Marginal Effects (%)

	Firm Location											
Description	USA			Canada			Germany			All		
Certification Shares:												
Sample	14.49			28.67			6.20			16.25		
Predicted	14.92			28.64			6.40			16.25		
Marginal Effects: [a]	Asia	Eur.	N.Am.	Asia	Eur.	N.Am.	Asia	Eur.	N.Am.	Asia	Eur.	N.Am.
Mean	0.25	0.28	0.12	0.39	0.45	0.19	0.13	0.14	0.06	0.26	0.29	0.13
Std. Error	0.12	0.13	0.07	0.18	0.19	0.11	0.07	0.08	0.04	0.12	0.13	0.07
	**	**	*	**	**	*	*	*		**	**	*

Note: Single, double, and triple asterisks (*) denote significance at the 10%, 5%, and 1% levels, respectively.
[a] Marginal effect = effect of share of sales value to a given destination on probability of certification.

The marginal effects of export shares on certification probabilities are reported in the bottom portion of table 4. These marginal effects were obtained by taking the average of firm-specific effects over all observations. Because value-of-export shares enter the model as fractions of one, the values presented in the table can be directly interpreted as the percentage change in the probability of certification from a 1% change in sales value shares associated with a specific destination.

Table 4 also shows approximate standard errors for these effects and associated levels of significance. Standard errors were derived following the procedures described in Krinsky and Robb using 10,000 draws of coefficient vectors. Except for the impact of value-of-export shares to North America for German firms, all marginal effects are statistically significant at the 10% level or higher.

By origin, these marginal effects are stronger for Canada than for the United States or Germany, and for all destinations. For example, a 1% increase in exports to Europe raises certification odds by 0.45% for a Canadian firm, compared to 0.28% for U.S. firms and 0.14% for German firms. By destination, the mean marginal effect of export shares to Europe is stronger than mean effects of exports to other destinations for all firm origins. This difference is especially pronounced for Europe versus North America, but subtler for Europe versus Asia. While the comparable magnitude of marginal effects for the latter two destinations could be an artifact of the relatively pronounced correlation between export shares to the two regions for many firms, it may also suggest that Asian customers' preferences for sustainable forest management goods are similar to those of Europeans.

Overall, a comparison of the results in table 4 to the sample statistics in tables 1 and 2 indicates that, while firms from all three origins rely most heavily on North America as an export destination, certification decisions are more sensitive to export shares allocated to Europe and Asia.

Discussion

Forest certification provides an example of a non-state, self-imposed governance structure for natural resources. While some have argued such governance structures emerge for reasons associated with social license—community pressure, desire to be good corporate citizens—the theoretical model and empirical results presented in this study suggest firms' economic motives also play a role in certification decisions. This is the case despite

the fact that certified forest products do not command a price premium (Kim and Carlton). In addition, it is shown here that sources for raw material inputs, such as whether timber comes from public or private forestlands, are not important. Rather, market factors and firm location are what matter. Indeed, concern about selling wood products in export markets seems to be an important factor explaining why firms certify forest practices.

Future research needs to separate the importance of the role played by "corporate responsibility" in firms' decisions to adopt voluntary environmental improvements vis-à-vis the profit motive. Richer data in conjunction with a more elaborate theoretical model will be required to separate goodwill from more tangible market incentives.

The results of this study also raise interesting questions regarding international spillovers from forest practices. For example, if consumers in Europe demand (certified) wood products from sustainably managed forests, citizens of exporting countries with lax environmental regulations in forestry may benefit. If forest companies in an exporting country follow market incentives, become certified, and engage in sustainable forest management, that country's citizens benefit from higher forest quality. To the extent that some of the costs of certification, and thus forest improvements, are eventually borne by European consumers, European preferences for green forest products may generate positive environmental externalities in forest exporting countries. Further investigation and quantification of economic spillovers and their impacts constitute fertile ground for future research.

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