An Abstract of the Thesis of

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Title: The Impact of Research and Training Programs on the Demand for Grass Seed in Overseas Markets.

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This research examines whether alternative methods of export commodity promotion and market development, such as technical training and trade servicing activities, have been successful in increasing the demand for grass seed produced in Oregon in international markets. A single equation linear input demand model and a linear model adjusted to introduce the effects of habit were those most successful in explaining the demand for grass seed imports in the selected sample of countries. The results show that market development and promotional initiatives, undertaken by the Oregon Seed Council and partially financed by the Market Access Program, have successfully increased the demand for grass seed in Chile and China, countries where they were undertaken. Positive net rates of return for promotion, based on current and expected future values minus seed production cost, have been obtained for both Chile and China, for the entire sample of years.

Impact The Impact of Research and Training Programs on the Demand for Grass Seed in Overseas Markets

by
Esteban Vega-H

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I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

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Esteban Vega-H, Author

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List of Abbreviations

Asia Pacific Economic Cooperation	APEC
Chinese Academy of Agricultural Sciences	CAAS
Chinese Agricultural University	CAU
European Union	EU
Export Incentive Program	EIP
Foreign Agricultural Service	FAS
Foreign Market Development Program	FMD
Food and Agriculture Organization of the United Nations	FAO
Gross Domestic Product in Constant Dollars of 1995	GDPc
Market Access Program	MAP
Market Promotion Program	MPP
Nanjing Agricultural University	NAU
Official Journal of the European Communities	OJEU
Oregon Seed Council	OSC
Oregon State University	OSU
Seemingly Unrelated Regression	SUR
US Department of Agriculture	USDA
World Trade Organization	WTO

Dedication

To Vero for walking with me through every project I undertake

To my parents for teaching me the valuable things of life

AOPSC

The Impact of Research and Training Programs on the Demand for Grass Seed in Overseas Markets

1. Introduction

1.1 Introduction

Since 1954 the Foreign Agricultural Service (FAS) of the US Department of Agriculture (USDA) has been working to aid the creation, expansion and maintenance of long term export markets for US agricultural commodities. Its role consists in sharing the costs of overseas marketing and promotional activities with US agricultural trade organizations, US cooperatives, US state agencies, US producers and US private companies wanting to promote their products abroad.

FAS develops these activities basically through two programs, the Market Access Program (MAP), formerly known as Market Promotion Program (MPP), and the Foreign Market Development Program (FMD), also known as the Cooperator Program.

The MAP helps non-profit agricultural trade associations, cooperatives and small businesses to develop overseas marketing and promotional activities such as consumer promotions, market research, trade shows and trade servicing. The program partially finances generic and brand promotion activities. Promotions are made through the subcomponent called Export Incentive Program (EIP). Most recently, the program allocated around $ 90 million among 66 organizations.

The FMD focuses its efforts to aid nonprofit organizations interested in reducing market impediments related to infra-structure, improving processing capabilities and identifying new markets or new applications or uses for the agricultural commodities or products in the foreign markets. This program does not provide brand promotion assistance or activities targeted directly toward consumer purchasing as individuals (consumer promotion). During 2000, the program spent $ 33 million on 25 organizations.

One of the beneficiaries of the MAP is the Oregon Seed Council (OSC). Since 1996, OSC has been using MAP funds to investigate the adaptability of Oregon turf and forage grass seed and to promote it in Chile, China and Mexico. In these countries, the OSC-MAP program has done market development and promotional activities in order to increase the local knowledge about the availability and adaptability of Oregon seeds and to increase the volume of Oregon grass seed exports.

The OSC and Oregon State University (OSU) also undertook market development and promotional activities in China from 1982 to 1987 under the coordination of Dr. Harold Youngberg. Dr. Youngberg, now an emeritus professor of Oregon State University, has also been coordinating the OSC-MAP program. Therefore the analysis of these types of activities includes the decade of the eighties as well.

The market development efforts have, basically, consisted of establishing a number of trials using Oregon seeds in different ecological zones of each country to determine which varieties are well adapted to the local environments. The implementation of the trials has been characterized by the integration of local researchers and by the execution of educational activities through "field days"[1]; that help to spread the results of the research.

To promote grass seed from Oregon, the OSC-MAP program has organized seminars and distributed brochures. The two main goals of these activities have been to transmit grass seed propagation technology and information about the characteristics of the Oregon Grass seed to potential customers.

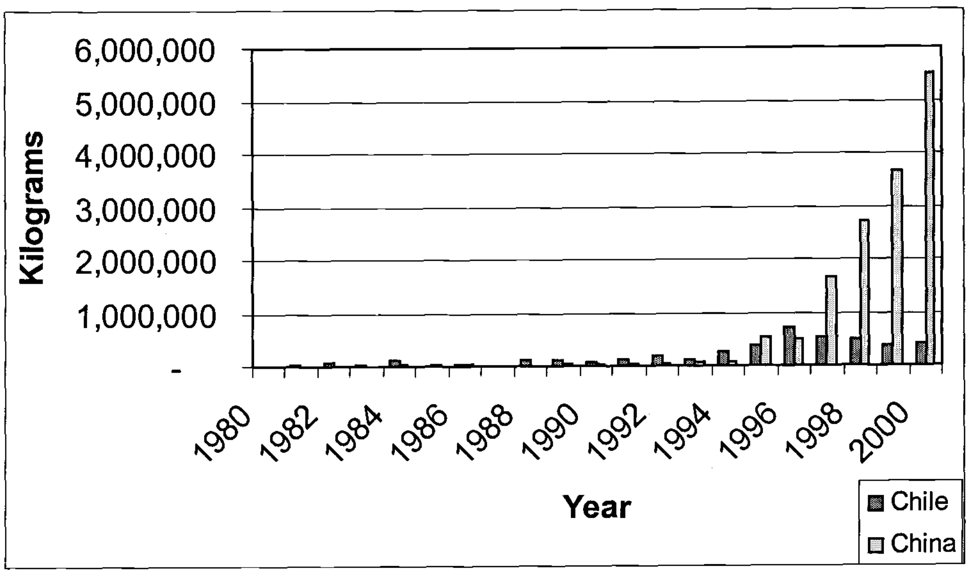
China is somewhat atypical of Oregon grass seed importing countries because of government's active participation in the economy. Chinese customers also lack familiarity with the techniques for selecting, planting, maintaining and harvesting cool-season forage and turf grasses. These facts motivated the OSC-MAP project to develop the Chinese market by undertaking cooperative research and education programs with scientists from the most influential Chinese agencies and universities, such as the Chinese Academy of Agricultural Sciences (CAAS), the Chinese Agricultural University (CAU), Nanjing Agricultural University (NAU), etc. In promotional activities the OSC-MAP program has targeted key forage managers, seed handlers and farm managers (see OSC (1998)), the decision makers in the process of buying seed.

[1] Under this methodology, the OSC experts and personnel of the local industry and universities visit the trial locations to present the trail results and teach management harvest and storage techniques.

1.2 Problem Statement

The market development and promotional activities, explained above, had the final goal of increasing the amount of exports of Oregon turf and forage grass seed to the mentioned countries. While the OSC-MAP marketing activities were being implemented, China and Chile's imports for Oregon grass seed increased (see Figure 1.1). There could be several different hypotheses about the trends in the imports. Perhaps the strong growth of the Chinese economy explains the trend in the demand; alternatively, the OSC-MAP promotions in China could explain such increases; or possibly, the increase in the flows of tourists could have motivated the Chinese government and entrepreneurs to beautify the country and consequently increase the demand for high quality grass seed. The problem faced in this research is to understand the most important economic variables explaining changes in the demand for Oregon grass seed exports, with particular reference to the impact of the MAP-OSC efforts.

Figure 1.1 Evolution of the Chilean and Chinese
Imports of Oregon Grass Seed



1.3 Objectives

1.3.1 General Objective

The objective of this study is to determine the most important economic variables affecting the grass seed import behavior for a selected sample of thirteen, industrialized and emerging, economies that represent the major international markets for Oregon turf and forage grass seed. The research will pay special attention to the role of market development and promotions in explaining import demand.

1.3.2 Specific Objectives

- To identify the most important variables that influence imports of Oregon grass seed in the selected countries.
- To determine if market development and promotion variables are important in explaining grass seed import demand in China and Chile and to estimate the rates of return for these marketing activities.
- To determine if the relative prices of other major grass seed suppliers, Denmark, The Netherlands and New Zealand, have influenced demand for Oregon grass seed.
- To investigate if there are group differences between industrialized and emerging economies in their grass seed import demand.

2. Literature Review

Over the past two decades local and international generic advertising and promotion of commodities have been important marketing strategies for farmers and farmer associations in the United States. Considerable amounts of research have been devoted to analyze the effects of these strategies on demand. The findings and methods for some of the most important studies that have analyzed export promotion initiatives are presented in section 2.1. Relevant studies that have been developed to examine domestic markets are presented in section 2.2.

2.1 Studies on Export Promotion of Agricultural Commodities

In a 1995 study, Halliburton and Henneberry, used an ad-hoc import demand model to evaluate almond promotion programs made in the Pacific Rim. To overcome the limited number of observations on the promotion variable for individual countries, they used panel data (a seven year time series was pooled with five cross sections). Cobb-Douglas, linear and exponential functional forms were tested and the programs were found effective in Hong Kong, Japan and Taiwan giving returns of $4.95, $5.94 and $3.69, respectively, for every dollar invested. The promotion elasticities found for South Korea and Singapore, the other cross-sections, were not significantly different from zero.

Lanclos et al. (1997) used a utility maximization theoretical specification to develop an import demand function to estimate the effects of advertising and US food service industry investments on the export demand for U.S. frozen potatoes in Japan, Mexico, the Philippines and Thailand. An interesting feature of their model was the introduction of a variable that represents foreign (from United States) direct investment, which may impact the tastes and preferences of consumers in the importing country and hence, the import demand for U.S. frozen potatoes. They found marginal gross rates of return to advertising expenditures from 1.13 to 1.51 for the US Potato Board and from 1.29 to 16.36 for third-party advertisers. They found an inverse relationship between the degree of market development and the value of the marginal rates of return.

Comeau et al. (1997) used an inverse almost ideal demand system to determine the effectiveness of the MPP expenditures in the Japanese market for beef, pork and poultry. They used three different functional forms to determine possible carryover effects of advertising/promotion efforts. The first option represented the stock of effective advertising/promotion effort as an exponential function of the current advertising/promotion levels. The second option assumed the impact was a function of current and previous year advertising/promotion; and, the last option introduced current, one and two lagged year periods of advertising/promotion as explanatory variables. For estimation, a nonlinear maximum likelihood estimation method was used. Their results show that advertising and promotion expenditures had a positive effect on the demand for beef, with gross marginal returns of incremental beef advertising and promotion of 15.56 dollars per dollar spent in 1987 and 13.06 dollars in 1994. The returns represent an upper bound of the true figures because they do not include private expenditures. The authors assumed that the FAS contribution is one third of the total export and advertising promotion in this region, the gross returns would be 5.18 and 4.35 for 1987 and 1994 respectively. Finally, they did find positive, but decreasing, effects of lagged advertising and promotion expenditures on current beef demand.

Le, Kaiser, and Tomek (1998) used an ad-hoc double logarithmic import demand equation to evaluate the effectiveness of US non-price promotion programs on US exports of red meat to Hong Kong, South Korea, Singapore and Taiwan. An interesting characteristic of this study was the use of the estimated import demand function for in sample simulations to address the issue of what would have happened if the current promotion expenditures had been reallocated among the four countries. They found that promotions had a statistically significant effect on South Korean imports, while no evidence of this was found in the remaining countries. They also estimated a gross rate of return of $15.6 for every dollar invested by FAS in the promotion program. Using the in-sample simulation to move promotion expenditures from the less effective markets to the most effective one, South Korea, they found that a reallocation of 10% represents an increase of 27% in the South Korean imports of U.S. red meat.

Onunkwo and Epperson (1999) designed a single equation demand function for US pecan exports to Asia and the European Union (EU). In addition to US pecan promotion expenditures, they included promotion expenses on US walnuts and almonds to analyze possible spillover effects of these on US pecan exports. Returns to promotions of $6.45 and $6.75 per dollar spent for Asia and the EU, respectively, were obtained. Regarding the spillover effects of walnuts and almonds on pecans mixed results were found.

Richards and Patterson (1998) developed an alternative approach to those centered on the demand side by treating export promotion, in a dynamic dual framework based on Epstein, as an input to U.S. producers' export supply decision. They found that investments in product equity through promotion expenditures have multi-period effects. Their results show that in the short-run a 1% increase in export promotion expenditures causes a 5%, 2.1%, 0.47% and 0.05% increase in apple, wine, grape, and almond exports respectively. They found also positive and relatively large short-run spill over effects of export promotion. For example a 1% rise in apple promotion causes almond sales to rise by 0.22% (effect which is greater than almonds' own promotion elasticity) or a 1% rise in almond and wine promotions raises apple sales by 1.03% and 1.13% respectively. Long-run promotion elasticities were larger in absolute value than those for short-run. Finally, they found interesting dynamic relationships between these commodities. For example, grape promotions increase apple sales in the short-run, but decrease them in the long-run, therefore these products are dynamic substitutes. The result related to negative promotion externalities provides an argument against subsidizing products that extend negative impacts to associated products.

Jakus, Jensen and Davis (2000) estimated firm level impacts of export promotion funds (MPP funds) on export revenues. They developed a model that jointly estimates direct [2] and indirect [3] methods to estimate the revenues added by MPP funds in 1994. The research found that large firms (with more than 500 employees) have a greater than one to one revenue payoff for each dollar of MPP funds invested with a confidence of 95%; gross marginal returns, on average, of 5.4 were obtained for these firms. This evidence was not found for small firms. Finally the study found that inexperienced firms are no more or less effective than experienced firms in converting MPP funds into increased export revenues.

2.2 Studies on Promotion of Agricultural Commodities in the Local Markets

Although the domestic markets are not the objective of this research, their findings and methodologies can provide valuable insights for the analysis of export promotion initiatives.

Chung and Kaiser (2000), developed a varying parameter advertising model and applied it to the New York City fluid milk market. The advertising parameters were specified as a function of advertising strategies and market environments to

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[2] The method uses the firm's own subjective estimations to calculate the effect of MPP funds on its sales.

[3] This approach considers several variables such as firm size, "newness-to-exporting", etc. that can be used to estimate the effects of MPP funds on firm level export sales through regression analysis.

explain the varying nature of the advertising responses.[4] A valuable contribution of this study to the present research is the methodology developed to measure advertising goodwill. They defined the advertising goodwill variable (this also could be seen as advertising stock) as a function of current and lagged advertising expenditures; the latter are incorporated addressing the issues of lag structure and length. For the lag structure a second-order exponential lag specification was chosen, which is flexible and its parameters are parsimonious. Finally, another contribution of this work was to cope with the fact that most of the variables that define market environment were in different measurements; to solve this issue the authors standardized all independent variables. Finally, in order to compare the relative importance of the variables that define market environment, the authors standardized all independent variables, harmonizing, in this way, the differences among measurement.

There is a small group of studies that derive the theoretical basis of the effects of commodity promotion on demand from production theory instead of using the traditional approach of utility maximization. Myer, Bhattacharyya and Liu (1998) based their work on a behavioral assumption of cost minimization on the part of alfalfa hay growers to derive a demand function for alfalfa seed using a generalized Leontief cost function. Richards (1999), applies the household production framework of Stigler and Becker (1977) to obtain a dynamic household production model of fresh fruit promotion.

[4] Responses change because peoples' taste, demographics, advertising campaigns and other economic and social factors change over the time.

2.3 Current Approach

The current study covers new ground in a number of respects. First, although there is a number of studies available on export promotion for food products. There have not yet been evaluations conducted on grass seed export promotions. Second, this is the first study to separate market development and promotional activities. And, finally most of the studies that introduce dynamic relationships between promotion expenditures and quantities exported are based on utility maximization approaches to analyze commodities that are generally inputs, without considering the use of more theoretically adequate approaches centered on production theory. In contrast, this research uses production theory to develop a demand function for Oregon grass seed exports, which is characterized by the inclusion of promotion and market development as explanatory variables.

3. Model Specification

3.1 Theoretical Model

The fact that grass seed is normally used as an input in the production of forage, turf or lawn grass implies that the users are firms or farmers and not final customers.[5] Their objective is to maximize profits, not utility, or to obtain a given amount of output at the minimum cost. Therefore, the more appropriate method would be to derive an input (or factor) demand function using production theory.

To obtain the input demand function for grass seed, it is possible to use the cost minimization objective - the dual of profit maximization -. This methodology can be used even when the firms in the importing countries are not price takers in their output markets as long as they are price takers in their input markets, which could be the case of many firms in China where the government actively intervenes in the economy. This approach is also useful if firms, in a free market economy, are not pursuing a profit maximization objective.[6]

Given the characteristics of the data, it is adequate to assume that all the firms produce a single multipurpose output that could be a field of grass, which could be used to feed animals, to play golf, for beautification of parks and buildings, etc. Under these circumstances the cost minimization problem can be stated as follows:

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[5] To simplify we will refer to these, farmers and firms, simplify as the firm.

[6] The objective of the firms, in a given period of time, could be to increase its market share instead of maximizing profits.

The following section relies on Applied Production Analysis by Chambers (1988) and Microeconomic Theory by Mas-Colell, et. al. (1995), and Notes on Microeconomic Theory by Arrow (2000).

$$(1)\quad \underset{z\geq 0}{MIN}\, TC_{tj} = \sum_{i=1}^{I}(w_{tji}\cdot z_{tji}) \\ s.t. f(z_{tj}) \geq q_{tj}$$

Where, w_{tji} is the strictly positive price of input i for country j in time t; z_{tji} is the amount of input i used in country j in time t; $f_{tj}(z_{tj})$ is the production function for country j in time t; from now it is assumed that all the countries present the same production function and it is constant over time, consequently $f(z_{tj})$ becomes $f(z_{tj})$; and q_{tj} is the amount of output required to be produced in country j in time t.

t = 1, ... , s where s is the total number of years being analyzed.

j = 1, ... , n where n is the total number of countries being analyzed.

i= 1, ... , I where I is the number of inputs included in the production function.

This cost minimization problem can be solved using a Lagrange Multiplier method:

$$(2)\ \min \ell_{tj} = \sum_{i=1}^{n}(w_{tij}\cdot z_{tij}) + \lambda(q_{tj} - f(z_{tj}))$$

If z* is optimal, and the production function f (.) is differentiable, then for some λ≥0, the following first order conditions must be satisfied for every input i =1, ... , I-1:

(3) $w_{tji} - \lambda \dfrac{\partial f(z^*)}{\partial z_{tji}} \geq 0,$ with equality if $z_{tji}{}^* > 0$,

Solving for $z_{tji}{}^*$ we obtain conditional input demand functions (the term *conditional* takes place because these input demands are conditional on the requirement that an output level q_{tj} be produced):

(4) $Z_{tji}{}^* = g(q_{tj}, w_{tj1}, \ldots w_{tji}, \ldots, w_{tjI})$

In order to obtain the properties that equation (4) should present, it is appropriate to obtain the cost function associated with (4), list its properties and from these derive the properties of the conditional input demand functions. If all the Z^*_i are replaced in the right hand side of equation (1), it will be possible to obtain the cost fucntion,

(5) $C(W\ ,q\ ) = \min\limits_{z \geq 0} \left\{ \left(\sum_{i=1}^{I} w_i z_i \right) : z_i \in V(q) \right\}$, where V(q) is the input requirement set and W is a vector containing the input prices.

Following Chambers, (5) will satisfy the subsequent properties:

a) $C(W\ ,q\ ) > 0$ for W>0 and q>0 (nonnegativity);

b) If W' ≥ W, then $C(W', q) \geq C(W, q)$ (nondecreasing in W);

c) Concave and continuous in W;

d) $C(T \bullet W, q) = T \bullet C(W, q), T > 0$ (Positively linearly homogeneous);

e) If q ≥ q' then $C(W, q) \geq C(W, q')$ (nondecreasing in q); and,

f) C (W, 0)=0 (no fixed costs).

g) If the $C(W,q)$ is differentiable in w, then there is a unique vector of cost minimizing demands that is equal to the gradient of $C(W,q)$ in w. That is (6) $z_i(W,q) = \partial c(W,q)/ \partial w_i$ (Shepard's lemma). Equation (6) is equivalent to equation (4).

Once the properties of the cost function are defined, it is possible to obtain the properties of the conditional input demand equations. Linear homogeneity (property d)) of the cost function implies that the conditional demands are homogeneous of degree zero in input prices since the partial derivatives of a function of degree k are homogeneous of degree k-1. Mathematically,

(7) $z_i(TW,q) = z_i(W,q)$, where W is a vector of input prices.

If $C(W,q)$ is concave (satisfies property c)) and twice continuous differentiable then $\nabla_{ww}C(W,q)$ is negative semidefinite, which impose the following restrictions on conditional demand behavior:

(8) $\frac{\partial z_i(W,q)}{\partial w_i} \leq 0$, as it can be seen this condition states that raises in any input price induce a decline in the use of that input.

(9) $\frac{\partial z_i(W,q)}{\partial w_u} = \frac{\partial z_u(W,q)}{\partial w_i}$, Which is a symmetry condition.

Where w_u is the price of other input u.

In addition, from $C(W,q)$ it is possible to determine the characteristics of the conditional-demand (E_{ii}) and cross-price elasticities (E_{iu}). The elasticities are:

$$(10)\ \varepsilon_{iu} \equiv \frac{w_u}{z_i(W,q)} \frac{\partial z_i(W,q)}{\partial w_u}.$$

Applying Euler's theorem to (7) and using it together with (10) we obtain,

$$(11)\ \sum_u \varepsilon_{ij} = 0.$$

Finally, (8) and (10) imply:

$$(12)\ \varepsilon_{ii} \leq 0$$

Once the conditions that should be satisfied by equation (4) have been defined, it is possible to analyze the elements that form part of this expression.

The fact that w_{tji} is the price that firms in the importing country pay for input i, implies that w_{tji} depends on variations of other economic variables such as exchange rate and tariffs. Also, to be able to compare the prices that are facing the different countries it should be appropriate to transform them to a common currency (the U.S. dollar). It is possible to represent this as follows:

(13) $w_{tji} = p_{tki}(1 + R_{tjk})$ If the exporting country is the United States; or,

(14) $w_{tji} = p_{tki}(1 + R_{tjk}) * E_{tk}$ Otherwise.

where, p_{tki} is the price of the input i in the exporting country k in period t; R_{tjk} is the import tariff in time t in importing country j for products coming from country k, and; E_{tjk} is the exchange rate of the U.S. dollar to the currency of country k in period t.

In order to obtain the conditional input demand function for grass seed, given by equation (4), we should analyze the right hand side of equation (2). The first term of (2) is the total cost of producing a given amount of grass by firms of country j in period t, while the second term is the constraint given by the amount of output required, q^o, and the production function. This last element can be represented as follows:

(15) $f(z^*) = f(G_O, G_D, G_H, G_N, F, Wa, La, IMD, IP)$

Where:

G_O	is grass seed from Oregon;
G_D	is grass seed from Denmark;
G_H	is grass seed from The Netherlands;
G_N	is grass seed from New Zealand;
F	is fertilizer
Wa	is water
La	is labor
IMD	is the input stock of information or knowledge that is used by the importing firms to start producing grass fields using grass seed. The Knowledge is produced by the market development efforts made by the OSC and perhaps the own research of the firms.
IP	is the stock of information or knowledge that motivates the importing firms to keep or increase using a certain input, Oregon grass seed, to produce the output. In this case the promotional activities realized by the OSC and the own experience of the firms produce the knowledge.

Before continuing, it is important to define the terms promotion, advertising and market development in order to understand clearly the effects that the variables representing these concepts will have on the import demand for grass seed. Promotion has various interpretations, from the broad concept that defines it as one of the four controllable variables of the marketing mix, which consists of various communication techniques such as advertising, personal selling, sales promotion, and public relations/product publicity available to a marketer (Bennett, 1995); to the one that sees promotion as the activity oriented to offer goods at an unusually attractive prices in order to increase trade volume or market share. This latter concept is usually considered as sales promotion or price promotion. Bennett defines advertising as the placement of announcements and persuasive messages in time or space purchased in any of the mass media by business firms, nonprofit organizations, etc. who seek to inform and/ or persuade members of a particular target market or audience about their products, services, or ideas. Market development can be defined as a strategy by which a company or organization seeks growth by taking its existing products into new markets.

Given the characteristics and diversity of the activities developed by the Oregon Seed Council to access to new markets and the implications of the concepts defined above, it is appropriate to divide these activities in two principal groups; market development that is composed of activities oriented to test the adaptation of the different varieties of grass seed to the local environments, and to understand the local conditions, and; promotion which includes all those activities oriented to transfer the necessary technologies that allow consumers an efficient use of Oregon grass seeds.

It is of special interest for this study to analyze the structure of IMD and IP. Many theoretical and empirical studies have found a lagged relationship between sales (acquisitions for the input demand function) and promotion expenditures (Clarke, 1976; Cox, 1992; Comeau, 1997; Chung and Kaiser, 2000; Richards, 1999). Following this, the present research considered that the stocks of information IMD and IP are function of current and lagged expenditures in market development and promotion respectively.

(16) $\mathrm{IMD}_{jt} = h(MDA_{jt}, MDA_{j(t-1)}, \ldots, MDA_{j(t-v)})$ Where $s \geq t > v$ (v is unknown), $\mathrm{MDA}_{jt} \geq 0$, $\mathrm{MDA}_{j(t-1)} \geq 0$, $\mathrm{MDA}_{j(t-v)}$ are the market development activities in time t-v and j is the country that is receiving MDA.

(17) $\mathrm{IP}_{jt} = m(PA_{jt}, PA_{j(t-1)}, \ldots, PA_{j(t-v)})$ Where $s \geq t > v$ (v is unknown), $\mathrm{PA}_{(t-v)}$ are the promotional activities in time t-v and j is the country that is receiving PA.

3.2 Net Rates of Return to Market Development and Promotion

The fact that the market development and promotion variables could have influence on future responses of quantities demanded of grass seed, indicates the necessity of making some modifications to the calculation of the rates of return.

Under normal conditions the marginal net rates of return[7] for every dollar invested in promotion are:

[7] If the functional form of the input demand function with respect to the activity is linear, the calculated marginal rates of return will be equal to average rates of return.

$$(18)\ ROR_t = \frac{\delta(\text{GO})}{\delta(PA)} \frac{(\text{Price of GO in time t - Cost per unit of GO in time t})}{(\textit{Cost per unit}\text{ of PA in time t})} - 1$$

The first factor of the first term in equation (18) is just the increase in kilograms of grass seed obtained as a result of increasing PA in one unit. The numerator of the second factor of the first term is the contribution margin of every kilogram exported (the price per kilogram of grass seed minus the average cost of producing it). The product of $\frac{\delta(\text{GO})}{\delta(PA)}$ by the contribution margin is the total increase in exports, in value, obtained as a consequence of doing one more PA. If we divide this by the cost of doing one unit of PA and subtract one we obtain the net rates of return.

If the effects of the current promotional activity have influence in the demand for grass seed in the current and future periods of time, it would be more appropriate to use the following formula:

(19)

$$ROR_t = \left(\begin{array}{l} \frac{\delta(\text{GO})}{\delta(PA_t)} (\text{Price of GO in time t - Cost per unit of GO in time t}) + \\ \frac{\delta(\text{GO}_{(t+1)})}{\delta(PA_{(t)})} \frac{(\text{Price of GO in time (t + 1) - Cost per unit of GO in time (t + 1)})}{(1+r)} + \\ \ldots + \frac{\delta(\text{GO}_{(t+v)})}{\delta(PA_{(t)})} \frac{(\text{Price of GO in time (t + v) - Cost per unit of GO in time (t + v)})}{(1+r)^v} \end{array} \right)$$
$$\div\ (\textit{Cost per unit}\text{ of } \text{PA}_t \text{ in time t})\ - 1$$

Where r is the nominal rate of discount in decimal form.

Equation (19) yields the present value associated with increases in the demand for grass seed, net of the "investment" made in promotion in the current period. The same methodology could be applied to market development activities if they have a lagged relationship with the demand for grass seed.

If a lagged dependent variable is introduced in the model, the effects of current promotions or market development activities will have influence in the future demands for grass seed though this variable. Consequently, equation (19) takes the following form:

(19b)

$$ROR_t = \frac{\sum_{t=1}^{n}\left(\frac{(\text{Price GO in time t - Cost per unit GO in time t})}{(1+r)^{t-1}}\frac{\delta(GO)}{\delta(PA)}\left(\frac{\delta(GO)}{\delta(GO_{-1})}\right)^{t-1}\right)}{\text{Cost per unit of PA in time t}} - 1$$

Where t = 1,2, …, ∞.

In (19b) the factor $\frac{\delta(GO)}{\delta(PA)}$ represents the direct effects of PA on GO and

$\sum_{t=1}^{n}\left(\frac{\delta(GO)}{\delta(GO_{-1})}\right)^{t-1}$ represents the indirect effects of PA, through the lagged

dependent variable (GO_{-1})), on GO.

4. Data Description and Sources

In order to achieve the objectives of this study, the selected sample of countries has the following characteristics: it includes those countries where the OSC has organized market development and promotional activities such as Chile and China, and other countries, without market development and promotional activities, which are important destinations for Oregon grass seed exports. These countries include Argentina, Australia, Belgium, Colombia, Ecuador, France, Hong Kong, Italy, Japan, Korea, and Spain. During the year 2000, these countries were the destinations for around 62% of the total US exports of grass seed and around 69% of Oregon grass seed exports.

Mexico and Canada are very important destinations for Oregon grass seed and Mexico has also been a recipient from market development and promotional activities made by the OSC-MAP program. However, they were not included in the study because much of the shipments of grass seed to these countries are made by rail or truck, and information on the amounts exported from the United States cannot be reconciled.

Although Oregon has been exporting grass seed since the 1950s (Ryan; 1981), data that satisfies the requirements of this study is available on annual bases in most cases only since 1981. In addition OSC-OSU and OSC-MAP market development and promotional programs began in the 1980s. Therefore, the period from 1981 to 2000 will be analyzed.

By combining a twenty-year time series with a wide sample of countries the possibility of examining the factors that explain import demand for grass seed is improved. Another benefit of this data set is that it allows examination of whether developing countries are different from developed economies in respect to their demand for grass seed.

An important consideration in estimating the demand for Oregon grass seed is competing seed from other major grass seed exporting countries. These include Denmark, New Zealand and The Netherlands. Canada is also an important grass seed producer and exporter but it was not included because detailed information on export prices and quantities of grass seed was not accessible.

Grass seed exports, in pounds, from Oregon and the rest of US, come from the Journal of Commerce records at shipment level. These observations were grouped according to the harmonized tariff system at the six-digit code level (HS-code). The HS-codes selected are 120922 corresponding to Clover seed (Trifolium spp.), 120923 for Fescue seed (Festuca), 120924 for Kentucky Blue Grass seed (Poa pratensis l.), 120925 for Ryegrass (Lolium multiflorium/perenne), 120926 for Timothy grass seed, and, 120929 for other types of grass seed. This last group includes Bent grass seed (Genus agrostis), Bermuda grass seed, Orchard grass seed, Sudan grass seed and other unspecified types of grass seed. The information was converted from pounds to international units, kilograms.

The Journal of Commerce did not use HS-codes before 1990, and it is necessary to assign the HS-codes for the period 1980 to 1989, based on key words given in the description of shipments. It is also important to state that a meticulous screening of the data was made to correct misallocations of hay as grass seed and the inverse. The screening method was to check key words in the description of shipments and, analyze the names of the firms that export these products to see if they specialize in hay or grass seed or in both.

Two other sources of US grass seed data were considered, the statistical database of FAS and the International Trade Commission database. However these two presented problems because their numbers did not show coherent magnitudes during the decade of 1990s. Durham and Vega (2001) suggest two possible reasons to explain this, one is the fact that during the past decade there was a change in the units of quantity used by these two institutions from the English system (pounds) to the international system (kilograms); and, that some shipments of hay might have been registered as grass seed.

Dutch grass seed exports in kilograms and value (Dutch Guilders) come from the Statistics of Netherlands at nine-digit code level and include the same HS-codes selected for Oregon. For 1980 to 1987, HS-codes were derived from an equivalent nomenclature used by the Statistical Service of that country. Danish data come from Statistics of Denmark at six-digit code level, in kilograms and value (Danish Crowns). For the period 1980 to 1987 the HS-codes were derived from an analogous nomenclature.

Data from New Zealand, kilograms and value (New Zealand dollars) come in monthly periods and by country of destination. The data were obtained from the statistical service of New Zealand. For the period 1988 through 2000 data are recorded at the ten-digit HS-code level. For 1981 through 1987, HS-codes at the six-digit level were assigned following key words given in the description of this country's own code. Data were grouped into calendar years to match other sources.

Nominal average free on board (FOB) prices in local currency for Denmark, The Netherlands, and New Zealand, were obtained dividing the yearly export values by the yearly export quantities. Then two different sets of prices were calculated, weighted average prices specific for each country and weighted average prices equal for all countries.

These prices are adjusted for import tariffs and exchange rates. Historical information on tariffs is limited for grass seed. For Argentina, Australia, Chile, China, Colombia, Ecuador, Hong Kong, Japan and Korea, information on tariffs was not available prior to 1995. Consequently, it was assumed that the same rates applying in 1995 were applied in the previous periods (1981 to 1994).

Information on tariffs between members of the European Union (EU) is available from 1990. Consequently, it is necessary to assume that before 1990 the EU importing countries were applying to EU exporters the same tariffs that they applied in 1990.

Information on import tariffs for Argentina, Colombia and Ecuador comes from FAS online.[8] Information for Australia, Chile, China, Hong Kong, Japan and Korea comes from the Asia Pacific Economic Cooperation (APEC) for 1999 and

[8] FAS online recollects information on tariffs from the World Trade Organization (WTO) tariff schedules.

2000 and from FAS online for earlier years. Belgium's, France's, Italy's and Spain's import tariffs against other EU members, from 1990, come from the Official Journal of the European Communities (OJEU) and tariffs to non-EU exporters, from 1995, come from FAS online.[9]

Transportation costs were assumed to be constant. The main reason behind this assumption is that in a specific moment of time the prices of maritime transportation per unit of quantity and per unit of distance are not homogeneous. Therefore it is not possible to use instrumental variables such as fuel prices or an index to specific markets as approximations. For example, during the Asian crisis of 1997 the transportation cost of one metric ton of grass seed from Taiwan to the United States was not necessarily the same as the transportation cost for the same product in the opposite direction.[10]

Once domestic prices were adjusted for tariffs it was necessary to convert then to a common currency for comparison and to incorporate into the price the effects of exchange rate variations on the prices paid in the importing countries. The currency selected was the US dollar because it leads international trade transactions and the expenses in market development and promotion were in this currency. Annual average exchange rates for Denmark (US dollar to Danish crown) for the period 1980

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[9] It is important to note that transformation of units was not needed because all the rates are applied as a percentage to be added to the price.

[10] The prices are frequently not the same. A recent example occurred due to the depreciation of the Asian currencies, which increased the flows of products to United States. In order to prevent empty return trips, firms reduced shipping costs from United States to Asia to less than cost and in this way made extra returns (the costs were already paid by Asian products).

to 1988 come from the United Nations (2000) and for the period between 1989 and 2000 come from Danmarks Nationalbank (2001).

Exchange rates for New Zealand (US dollar to New Zealand dollar) come from the United Nations (2000) for the period 1980 to 1985. For the years 1985 to 2000 rates come, in monthly average numbers, from the Reserve Bank of New Zealand. This last group of figures was converted to annual average terms using a simple average. Annual average exchange rates for the Netherlands for 1980 to 1998 come from the United Nations (2000) and for 1999 and 2000 come, in daily average numbers, from the De Nederlandsche Bank (2001). These daily figures were also transformed to annual average terms using a simple average.[11]

Data from the Journal of Commerce records information at the shipment level and does not include actual values of what is exported. Consequently, it is not possible to obtain average prices from this source. For Oregon grass seed, seasonal weighted average prices at the producer level were used as a basis to calculate calendar prices. Using the data on prices for Oregon grass seed published by the Extension Economic Information office at Oregon State University (2001),[12] and a weighted average procedure (which took into account the amount of each type of grass produced), average grass seed prices for Oregon were obtained.

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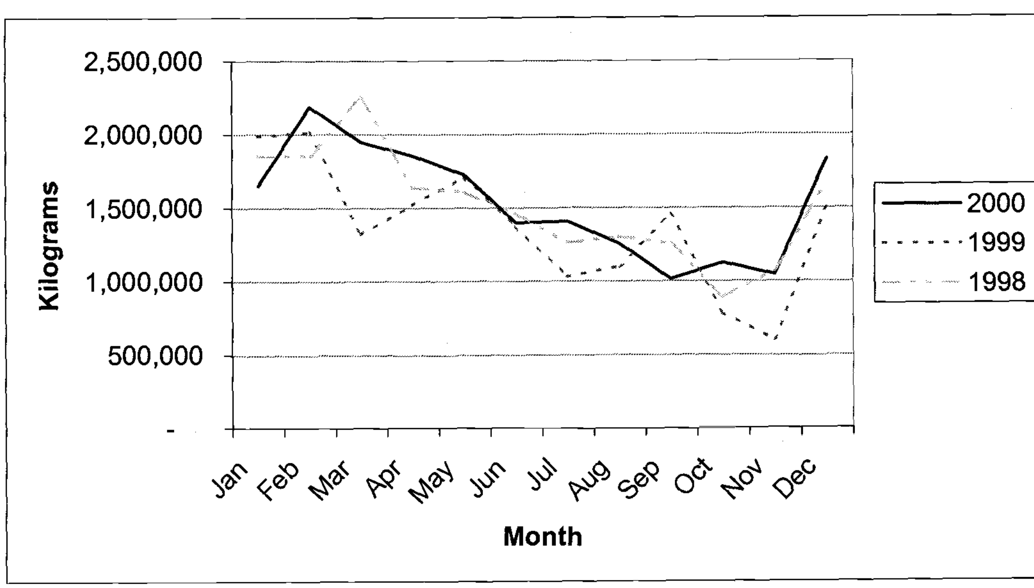
[11] For all these countries official exchange rates were used.

[12] This research discovered some problems with the methodology used to recollect data on prices of grass seed in Oregon. The sample of firms selected to assess the price information might not be a large enough proportion and the method of recording the information could be biased because it occurs in a meeting where every firm is able to listen what the other firms have to say. Additional research could be done to identify the problems in more detail and to recommend an alternative methodology of recording the information.

Before introducing these prices for analysis it was necessary to transform them to calendar years. As Young et. al. (1997) explain, "harvest of grass seed begins in late June or early July with swathing (cutting) and windrowing the crop. ... After the seed has dried in the windrow, the crop is taken to a seed cleaning warehouse...". Seed is then cleaned and bagged and then sampled for germination and purity. Seed for the crop year begins to be sold in August and should begin to arrive in international markets no earlier than September. Figure 4.1 shows the typical pattern of international sales.

Figure 4.1
Monthly Shipments from Oregon to the Thirteen Importing Countries (Kg)



These facts imply that seasonal prices are in effect from September of year t to August of year t+1. With this information in hand, it is possible to obtain the year t calendar prices by multiplying the seasonal price in t by (4/12) and adding the multiplication of the seasonal price in t-1 by (8/12).[13] Figure 4.2 presents the relationship between calendar and seasonal years and consequently prices. Finally the prices were adjusted from producer to market prices by multiplying then by 1.10 (10% is the average margin charged by the commercialization company).

Figure 4.2
Relationship between Calendar and Crop Years

	Calendar Year 1998	Calendar Year	Calendar Year 2000
Crop Year 1998			
Crop Year 1999			

The next step is to select those variables that could characterize the output to be produced. A single multipurpose field of grass that uses turf, lawn or forage grass

[13] It would be more accurate to obtain weighted average calendar prices for each country, which are just the result of the multiplication of the current seasonal price by a weighted average of the percentage of grass seed shipped in the last four months of the current calendar year plus the multiplication of the seasonal price lagged one year by a weighted average of the percentage of grass seed exported during the first eight months of the current calendar year. However to maintain consistency with the prices assigned for the other three exporting countries this has not been done.

seed was assumed to be the output in order to develop the theoretical model. To represent it, variables such as the number of tourists visiting the country[14], the level of livestock, number of cattle, livestock production indexes and gross domestic product are considered. The rationale for selecting number of tourists is that the greater the number of these, the greater the incentives of local firms and government to invest in parks, green areas and sport fields. Livestock and cattle were chosen because one of the main sources of food for them is forage. Gross domestic product was selected because it includes all the different industries that produce outputs using grass seed.

For all countries, data for Gross Domestic Product in constant dollars of 1995 (GDPc) and at market prices, for the years 1980 to 1999 come from the United Nations (2001). For 2000, GDPc was calculated using real growth rates.[15] Rates for Argentina, Colombia and Chile come from Latin Focus (2001). Rates for Australia, Belgium, Japan, France, Italy and Spain come from the Organization for Economic Cooperation and Development (OECD) (2001). Rates for China come from National Bureau of Statistics. Rates for Ecuador come from Banco Central del Ecuador (2001); for Hong Kong come from Hong Kong Monetary Authority, and; for Korea come from Bank of Korea.

Data on the number of tourists visiting the importing countries for 1980 to 1999 come from the United Nations (2001). Information on the number of cattle, level

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[14] Tourists increase the necessities for beautification and recreation in the country and consequently the amount of grass seed demanded.

[15] Where it was possible real growth rates based on GDPc in US dollars were used.

of livestock and livestock production indexes, for the years 1980 to 1999, comes from the Organization of the United Nations for Food and Agriculture (FAO, 2001).

As discussed in Chapter one, since 1982 the OSC has participated in a diverse number of activities related to market development and promotion to increase the demand for Oregon grass seed overseas. To represent market development the number of field trials made per year has been chosen. Field trials are scientific activities that provide data on adaptability, productivity and performance of US-grown turf and forage species under local environments and consequently help producers to understand the local conditions and peculiarities and buyers to evaluate the benefits of Oregon seed. Once the seed has been tested field trials are made to demonstrate the capabilities of the input.

The main kind of promotion that has been undertaken by the OSC are person to person business contacts and seminars where economic agents that use grass seed as an input can attend to learn about the seeds and appropriate technologies to use them efficiently. The variable selected to represent promotions is the number of people contacted per year.[16] This variable includes those individuals that were trained in the importing countries and in the United States and other business contacts made in China.

Information on the number of trials and people contacted was obtained from annual reports of activities (1997, 1998, 1999, 2000), final reports (1999) and trip reports (1996), all of them made by the OSC-MAP program for the USDA. For

[16] An important strength of the training is that it provides a two-way communication between the supply and demand. Consequently the client will attain a greater level of knowledge.

China, activities occurring between October and December were used as part of the next year's activities because the information received will not affect the demand for grass seed during the current year since the planting season has already passed. Following the same logic with Chile, data recorded between April and December were used as part of the next year's activities.

From chapter three we know than the input demand function might be explained also by movements in the relative prices of other inputs used to produce the field of grass such as water, fertilizer and labor. However, information about these relevant to analysis of demand for grass seed is not available. For example it is not possible to obtain information for water because the provision of it could differ between the regions of a country and there will not exist a unique price. Water could come from an irrigation system, from rain and/or from a potabilization plant, consequently two different prices could take effect or it could be obtained at no price (rain). Another problem is that in some areas the local government might impose the price of water and if it were also a user of grass seed, the requirement of being price taker in inputs prices would not longer be satisfied.

5. Empirical Methods & Tests

5.1 Functional Forms

The functional forms of the cost or production functions, from which it is possible to derive the conditional input demand functions for grass seed, are unknown. Economic theory offers little guidance on the appropriate functional forms for import demand functions (Thursby and Thursby, 1984); making it necessary to examine several functional forms to find the model that generates unbiased (if not possible, consistent) and efficient parameter and elasticity estimates. In the following sections the transcendental logarithmic, the linear, the linear with habit and the semi-log functional forms are examined.

5.1.1 Transcendental Logarithmic Functional Form

The first functional form examined in this research is the transcendental logarithmic (translog) cost function as described by Chung (1994) from which the factor share equations where derived. This functional form was chosen based on its attractive properties.[17] The translog cost function is defined as:

[17] For a reference see Chung (1994) Chambers (1988) or Berndt (1991).

(20)

$$\ln C = \ln a_0 + a_q \ln q + \sum_i a_i \ln w_i + \frac{1}{2}\beta_{qq}(\ln q)^2 + \frac{1}{2}\sum_i\sum_j \beta_{ij} \ln w_i w_j + \sum_i \beta_{iq} \ln q \ln w_i$$

Where i= 1, 2, … I.

For simplicity the subscripts for time and country are omitted. Differentiating (20) with respect to each of the input prices, the demand functions for input x_i can be obtained:

(21) $$\frac{\partial \ln C}{\partial \ln w_i} = x_i \frac{w_i}{C} = S_i = share\_equation = a_i + \sum_{j=1}^{I} \beta_{ij} \ln w_j + \beta_{iq} \ln q$$

For (20) to be well behaved it must be homogenous of degree 1 in prices given q; which implies that $\sum_{i=1}^{I} a_i = 1, \sum_{\mathrm{i}=1}^{\mathrm{I}} \beta_{ij} = \sum_{\mathrm{j}=1}^{\mathrm{I}} \beta_{ji} = \sum_{\mathrm{i}=1}^{\mathrm{I}} \beta_{iq} = 0$. Applying these conditions to (21) it is possible to estimate I-1 share equations, which have the following form:

(22)

$$Si = a_i + \beta_{ii} \ln(w_i / w_I) + \sum_{j=1}^{I-1} \beta_{ij} \ln(w_j / w_I) + \beta_{iq} \ln q, \text{ where i} = 1 \ldots (\mathrm{I}-1) \text{ and i} \neq \mathrm{j}$$

The characteristics of the data on the stock of information given by market development and promotional activities are incompatible with equations based on prices[18] and with logarithmic equations[19] as (22). These variables could be introduced

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[18] There is not annual information on prices for the stocks of information given by market development and promotional activities made by the OSC.

as shifters of the input demand functions, the greater the knowledge of the benefits of input i the higher the demand for that input for a given price. Consequently, these variables are set up in the model as components of the intercept (a_i).

(23) $a_i = \alpha + f(IMD, IP)$.

5.1.2 Linear Functional Form

Another approach is to develop a single equation linear input demand function, which comes from an unknown cost function. This can be represented as follows:

(24) $z_{ijt} = \alpha + \sum_{i=1}^{n} \beta_i w_{ijt} + \beta_q q_{jt}$

Where i is input, j is the importing country and t is the year.

The fact that this equation is based on input prices (as (22)) makes it necessary to introduce the stocks of information given by market development and promotional activities in the same way that it was made for the translog functional form. Replacing the term α in equation (24) by equation (23), we obtain:

(25) $z_{ijt} = \alpha + f(IMD_{ijt}, IP_{ijt}) + \sum_{i=1}^{n} \beta_i w_{ijt} + \beta_{iq} q_{jt}$

Equation (25) represents as closely as possible those variables that economic theory defines as components of an input demand function. But a more empirically

[19] For some countries and some periods of time, the stocks of information obtained are equal to zero

oriented point of view could include other variables that also explain the demand for grass seed in the importing countries. It is pertinent to consider a variable that represents commercial penalties resulting from political problems. An example would be the one occurred in 1989 between China and the exporting countries after the massacre in the Tiananmen Square. A dummy variable is introduced to represent this issue.

$$(26)\ z_{ijt} = \alpha + f(IMD_{ijt}, IP_{ijt}) + \sum_{i=1}^{n} \beta_i w_{ijt} + \beta_q q_{jt} + \beta_t Tiananmen$$

5.1.3 Linear Functional Form with Habit

Many empirical studies have found that habit formation, represented by a lagged dependent variable, is relevant in explaining demand (Goddard and Amuah, and Heien and Durham). For the case of grass seed the lagged dependent variable could be seen as an element that increases further the stock of information own by firms in the importing countries. The inclusion of this variable provides the following functional form:

$$(27)\ z_{ijt} = \alpha + f(IMD_{ijt}, IP_{ijt}) + \sum_{i=1}^{n} \beta_i w_{ijt} + \beta_q q_{jt} + \beta_x x_{ij(t-1)}$$

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and the logarithm of zero is not defined.

5.1.4 Semi-log Functional Form

Onunkwo and Epperson (2000), suggest that the appropriate functional form for export demands may vary according to the life cycle of a product, and affirm that for the early stages of a product life cycle a semilog functional form should be used. This form might be adequate to explain the demand for grass seed in those newly importing countries.

$$(28)\ \ln z_{ijt} = \alpha + f(IMD_{ijt}, IP_{ijt}) + \sum_{i=1}^{n} \beta_i w_{ijt} + \beta_q q_{jt}$$

5.1.5 Functional form for IMD and IP

The functional form chosen to represent the influences of market development and promotional activities on the stocks of information is linear. The final results of trials (which represent market development) made by the OSC are essentially ready two years after they start (OSC, 1999, 2000). Consequently this relationship will be represented in the functional form:

(29) $IMD = \beta_{i(t-2)j}\ MDA_{(t-2)j}$

As explained in the literature review, many studies have found that promotion has lagged effects on commodity demand. However, to the author's knowledge, there has not been research conducted to determine the lag of promotions based on seminars. Therefore this becomes an empirical issue for this research. The stock of knowledge is defined as a linear function of the current and lagged one year promotions:

(30) $IP = ß_{PA} PA_{tj} + ß_{PA-1} PA_{(t-1)j}$.

Inserting (29) and (30) on (23), we obtain:

(31) $\alpha = \alpha + ß_{MDA-2} MDA_{(t-2)j} + ß_{PA} PA_{tj} + ß_{PA-1} PA_{(t-1)j}$

For the translog functional form, (31) should replace the term a_i in equation (22).

If habit, represented by lagged quantity imported, is included in the analysis the introduction of lagged promotions is altered since its effects on demand are incorporated through lagged quantity imported. Under these conditions, equation (31) becomes:

(32) $\alpha = \alpha + ß_{MDA-2} MDA_{(t-2)j} + ß_{PA} PA_{tj}$

5.2 Estimation Methods

The fact that this research combines time series and cross sectional data makes it necessary to use panel or pooled data econometric procedures. There are several panel data estimation procedures that depend on the statistical characteristics of the error components in the model. The principal error structures and estimation methods are discussed here:

A fixed effects model assumes that differences across cross-sections and/or time series can be captured with a group specific constant term. If the differences are just in the cross-sections, the number of dummy variables added is the same as the number of cross sections in the model and the method is known as one-way fixed effects. Otherwise if there are specific effects for each cross section and period of time (viewed as discrete changes of state) the method is known as two-way fixed effects. Equations (33) and (34) shows the corresponding specifications for one-way and two-way fixed effects respectively.[20] Griffths (1993) and SAS (2000).

(33) $z_{ijt} = \beta_x' X_{jt} + \beta_j Dj + \varepsilon_{jt}$

(34) $z_{ijt} = \beta_x' X_{jt} + \beta_j Dj + \beta_t Dt + \varepsilon_{jt}$

Where, j=1, ... J-1, t=1, ... T-1; Dj is a matrix of dummy variables to represent country specific fixed effects; Dt is a matrix of dummy variables to represent time specific fixed effects, X_{jt} is a matrix composed by the rest of explanatory variables; and, ε_{jt} is the disturbance.

Another possible way to look at the error structure is to assume that there is a group specific disturbance in addition to ε_{jt} . If the group disturbance is only for every cross section the method of is known as one-way random effect. If in addition there is a time specific disturbance, then the method is known as two-way random effect. Under random effects models the terms β_jDj and β_tDt in equations (33) and (34) become random, and the error term takes the following forms:

[20] The inclusion of both intercept and all the dummy variables induces to the dummy variable trap (unless no intercept is included), therefore one of the dummy variables has to be omitted and its

(35) $u_{jt} = v_j + \varepsilon_{jt}$ for the one-way random effects model

(36) $u_{jt} = v_j + \varepsilon_t + \varepsilon_{jt}$ for the two-way random effects model

If the research includes cross-country comparison, tremendous variation in the scales of all variables in the model is expected. Therefore it would be appropriate to relax the assumption about homogeneity by allowing σ^2 to vary across i (Greene, 2000). In other words, groupwise heteroscedasticity should be expected. Additionally, autocorrelation and contemporaneous correlation across countries can be expected. To deal with these issues Parks (1967) developed a first-order autoregressive model in which the random errors u_{it} (I=1,2, …, N, t=1,2, … ,T) have this structure (SAS, 2000):

(37) $E(u_{it}^2) = \sigma_{ii}$ (heteroscedasticity)

(38) $E(u_{it}u_{jt}) = \sigma_{ij}$ (contemporaneous correlation)

(39) $u_{it} = \rho_i u_{i,t-1} + \varepsilon_{it}$ (autoregression)

Where:

$E(\varepsilon_{it}) = 0$

$E(u_{i,t-1}\varepsilon_{jt}) = 0$

$E(\varepsilon_{it}\varepsilon_{jt}) = \phi_{ij}$

---

potential effects have to be included as part of the constant term. That is why i goes up to J-1 and t goes up to T-1.

$E(\varepsilon_{it}\varepsilon_{js}) = 0 \ (s \neq t)$

$E(u_{i0}) = 0$

$E(u_{i0}u_{j0}) = \sigma_{ij} = \phi_{ij} / (1 - \rho_i \rho_j)$

The fact that the share equations of the translog model have to be estimated simultaneously makes it necessary to use the Seemingly Unrelated Regression (SUR) method. However the use of this method forces us to assume that our panel data is not autocorrelated or heteroscedastic across countries.[21] The first step in the SUR estimation procedure is to estimate the σ_{ij} from OLS residuals as:

$$(40)\ \hat{\sigma} = \frac{1}{\tau}(y_i - Z_i \hat{\delta}_{ols,i})'(y_j - Z_j \hat{\delta}_{ols,j})$$

Where: $\hat{\delta}_{ols,i} = (Z_i'Z_i)^{-1} Z_i' y_i$, $\tau = \dfrac{MN - P}{M}$, M is the number of equations, i= 1, … , M , N is the number of observations in each equation, P is the number of explanatory variables. With $\hat{\sigma}_{ij}$ in hand, the SUR estimator is defined as:

$$(41)\ \hat{\delta}_{SUR} = \left[Z' \left(\hat{\Sigma}^{-1} \otimes I_N \right) Z \right]^{-1} Z' \left(\hat{\Sigma}^{-1} \otimes I_N \right) y$$

Where $\hat{\Sigma}$ contains the individual elements $\hat{\sigma}_{ij}$.

5.3 Specification Tests

To test if the fixed effects models are relevant an F statistic is used. The hypotheses tested are that the parameters representing country specific effects, for the one-way fixed effects model, and country and time specific effects, for the two-way model, are jointly equal to zero.

As Greene (2000) explains, to test the null hypothesis that the disturbances are both homoscedastic and uncorrelated across countries it is appropriate to use a likelihood ratio test. Which has this form:

$$\lambda_{LR} = (nT)\ln\left(\frac{e'e}{nT}\right) - T\ln\left|\hat{\Sigma}\right|$$

Where:

$\hat{\Sigma}$ is the maximum likelihood estimator for the unrestricted model (the one has allows for cross sectional correlation).

To test for autocorrelation, the Durbin Watson statistic is used when the models don't have the lagged dependent variable as explanatory variable. This statistic is calculated as:

$$\sum_{i=1}^{N}\sum_{t=2}^{T}(\tilde{\varepsilon}_{it} - \tilde{\varepsilon}_{i,t-1})^2 \Big/ \sum_{i=1}^{N}\sum_{t=1}^{T}\tilde{\varepsilon}_{it}^2$$

Under the presence of a lagged dependent variable it is appropriate to use a Lagrange multiplier test that is calculated as follows:

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[21] The development of a methodology to make these corrections goes beyond of the goals of this research.

$$h = \left(1 - \frac{d}{2}\right)\sqrt{\frac{T}{1 - Ts_c^2}}$$

Where d is the Durbin-Watson statistic and s_c^2 is the estimated variance of the least squares regression coefficient on the lagged dependent variable. If $s_c^2 >$ 1/T this test cannot be computed. An alternative is to regress e_t on X_t, y_{t-1}, … , e_{t-1} and then to test the joint significance of the coefficient on the lagged residual with the standard F test (Greene, 2000).

6. Results

In this chapter, results from a number of model formulations are discussed. The first one presented is the basic linear model that is shown in equation (25). This has been developed to represent as closely as possible those variables that theory defines as components of an input demand function. The second formulation analyzed is the linear model modified to bring in the effects of habit through the use of a lagged dependent variable (equation (27)). Each of these models will be econometrically tested, interpreted and rates of return for market development and promotion will be presented. In the last part of this chapter other specifications and functional forms, which were tested and did not provide meaningful results, are discussed.

Before discussing the models it is pertinent to examine a number of characteristics of the data that have influenced the model designs and econometric procedures used. The inclusion of several countries as part of the import demand equations leads to tremendous variation in the scales of all variables in the model. For example, relatively small values are found for Ecuadorian GDP and very large values for Japanese GDP. Consequently, cross sectional heteroscedasticity was expected and was tested. This mix of several countries in the same import demand model also makes it possible to have common unknown disturbances $(E(u_{it}, u_{jt}) = \sigma_{ij})$ that affect the demands for grass seed for all countries in period t. Therefore contemporaneous correlation was tested as well.

As Brown (1991) suggests, there are several factors that can explain the presence of autocorrelation but the two most common are inertia and omitted variables. If we consider that equations (25) and (27) are simplifications of reality where some of the inputs that could be used to produce the field of grass, such as water or fertilizer, are not included, we might suspect the presence of autocorrelation given by the omission of these variables.

If the cost function is concave and twice-continuous differentiable then $\nabla_{ww}c(w_{tj}, q_{tj})$ is negative semi definite, which requires that increases in prices from Oregon reduce the demand from Oregon. Restriction that determines a negative sign in the parameter estimate for Oregon prices (equation (8)), and it is also expected a positive relationship between prices from other countries and demand for Oregon grass seed.

6.1 Linear Model (Equation 25)

6.1.1 Tests

To test for heteroscedasticity and contemporaneous correlation, following Greene (2000), a likelihood ratio test is performed on the linear model (equation (25)) and the null hypothesis that the disturbances are both homoscedastic and uncorrelated across countries is rejected with more than 99% of confidence.

The linear model was also tested for autocorrelation of first degree using the Durbin Watson statistic. The null hypothesis of no autocorrelation was rejected with more than 95% of confidence. Table 6.1.

Table 6.1
Statistical Tests for the Linear Model (Equation (25)) Applied to Imports from Oregon

	Critical value	Test Value	Ho*:
Durbin Watson test for A/C	1.697 (dL) 1.841 (dU)	1.5775	Rejected
Likelihood ratio test for Heter. & Contemp. Corr.	21.03	720	Rejected
LM test for Cross Sect Heter.	21.03	187.07	Rejected
* Null hypothesis			

From a concave and twice continuously differentiable cost function a negative sign is expected for the own price parameter estimate and positive signs are expected for the parameter estimates of substitute inputs. Table 6.2 shows that the model given by equation (25) applied to imports from Oregon satisfies these restrictions with more than 95% of confidence for the prices of substitute inputs. The parameter estimate for own price is negative but only significant at a 66% level of confidence; consequently it could also be zero. This unexpected result could be caused by the high correlation (0.68) between the prices of grass seed from Oregon and the Danish prices. In most of the models tested these two variables trade-off in significance. One solution suggested in the literature is to drop one of these variables, however Oregon and Denmark are the two major exporters of grass seed in the world and both prices should be included in any demand model for grass seed. Figure 6.1 shows the average market share for these four producers in the thirteen selected economies for the period 1995 to 2000. Finally, it is important to mention that these parameter results indicate negative own-price and positive cross-price elasticities, which are also given in Table 6.2.

Figure 6.1
Average Market Share 1995 to 2000

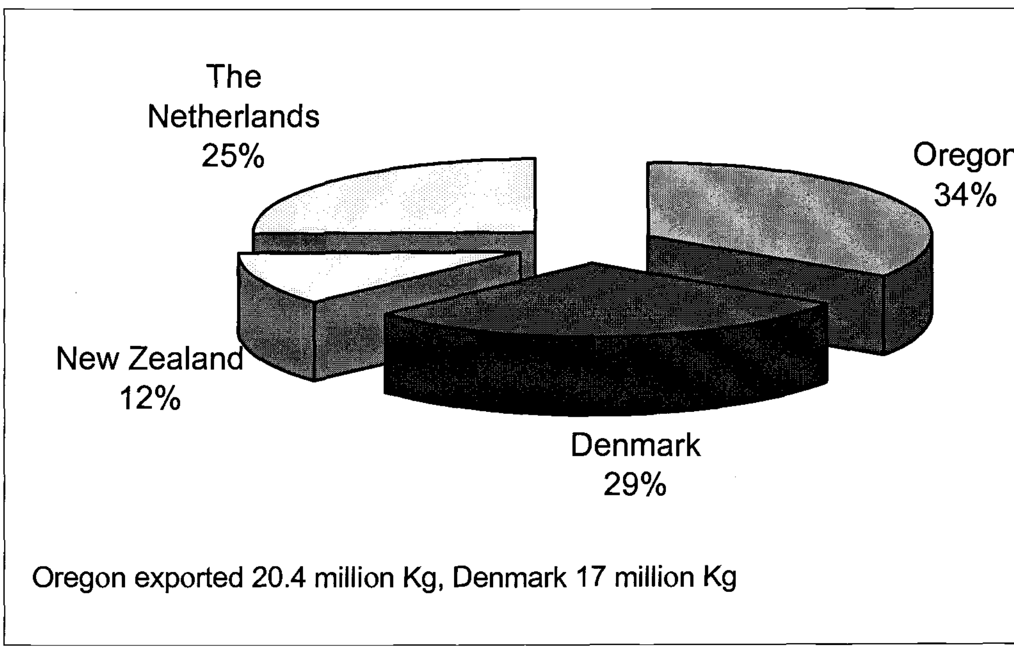

Table 6.2
Parameter Estimates and Average Demand Elasticities for the Linear Model (Equation (25)) Applied to Imports from Oregon

Estimation Method:	Parks.			
Number of Countries	13			
Number of Years	19 (1982 to 2000)			
Dependent Variable: Grass Seed Imported from Oregon (100,000 Kilograms)				
	Estimate	t value	P value	Avg Elasticities
Intercept	-4.146	-2.6	0.009	
GDPc (Billons)	0.016	14.2	0.000	0.95
Price from Oregon	-1.312	-1.0	0.341	-0.10
Price from New Zealand	1.698	2.4	0.016	0.19
Price from Denmark	2.436	2.1	0.036	0.22
Price from The Netherlands	2.220	4.4	0.000	0.16
Trials lagged two years	0.011	8.2	0.000	0.10 *
People Contacted	0.026	5.6	0.000	0.18 *
People Contacted Previous Year	0.048	11.6	0.000	0.20 *
* Calculated using the countries and periods where these activities have been made				
R-Square	0.8149			
SSE	123.6			
DFE	238			

6.1.2 Interpretation

As expected the parameter estimate for the own-price effect was negative however not statistically different from zero with more than 90% of confidence. An increase in Oregon prices of one dollar yields a reduction in the demand of grass seed by 131,200 Kg (289,000 pounds). The calculated average price elasticity of the demand for this input is inelastic and equal to -0.10.[22] This indicates that prices

[22] Unless otherwise stated, elasticities were calculated for the whole group of countries and years at the mean.

in the observed range are not of great importance in developing and maintaining the selected markets.

The parameter estimate for GDP is positive as expected and highly significant, implying that the greater the income of the country the greater the demand for grass seed. The average elasticity of demand for grass seed with respect to GDP (output elasticity) is 0.95 and supports the idea that grass seed is a normal input and falls in the category of necessity.

The parameter estimates for the prices of grass seed coming from the other three countries: New Zealand, The Netherlands and Denmark, as expected, have positive signs and are significant with more than a 95% level of confidence. The magnitudes of these parameter estimates are similar to the estimate made for Oregon. An increase of one dollar in the prices for New Zealand, Denmark and The Netherlands, will increase the demand from Oregon Grass Seed by 169,800 Kg, 243,600 Kg, and 222,000 Kg, respectively. The cross price elasticities of demand for grass seed coming from these countries are, as expected, positive but low, with values of 0.19, 0.22 and 0.16.

The low own-price, cross-price and output elasticities for grass seed coming from Oregon sources supports the idea that this input is a necessity and that grass seed from other countries are not perfect substitutes. These arguments are congruent to the tendency of the industry to develop new varieties, patent them (especially perennial ryegrass and tall fescue) and consequently differentiate the seed from the competition.

From Table 6.2 it can be observed that trials, a market development activity, have a positive and highly significant effect. The execution of one extra trial by the OSC-MAP program increases the demand for grass seed from Oregon by 1,100 Kg once the information from it is complete, two years later.

The impact of people contacted in the current and previous periods, which represent promotion, is found to be positive and significant in increasing the demand for Oregon grass seed. For every person contacted in the present year the current demand for grass seed increases by 2,600 Kg, and for every individual contacted in the previous year the demand goes up by 4,800 Kg in the current year. The average promotion elasticities of demand for these two activities are 0.18 and 0.20 respectively.

These results are important because they show that the activities made by the OSC-MAP program in China and Chile have generated a positive increase in demand. However these results do not tell us about the returns on the investments made by the program.

6.1.3 Net Rates of Return for Market Development and Promotion

Net rates of return for market development and promotion, for China and Chile, have been calculated using equation (19). To make this calculation three assumptions were made. The first assumption was that the opportunity cost of the capital invested by the OSC-MAP program is 6%. The second is that the weighted average cost of producing one Kilogram of grass seed in Oregon is 81 cents.[23] The last is that the production and marketing of grass seed in Oregon is vertically integrated.[24] Additional information required are the average training and contact costs per person. These were estimated to be $ 280 for China and $ 437 for Chile. Average costs per trial were estimated to cost $ 750 and $ 1,150 for China and Chile respectively (Youngberg, 2001).

The numbers in Table 6.3 show that promotions have been very successful in both countries with rates of return higher than five hundred percent for China and three hundred percent for Chile. The application of equation (19) gives different rates of return for different years for the same country because the extra dollars received as a consequence of the promotions made in the present period are also a function of the current and next year's prices. For example, for China in 1999 the rate of return was equal to 702%, which implies that in addition to recover the dollar invested the producer-exporter from Oregon obtained 7 more dollars, in present value, if the seed was sold at $1.2 per Kg in 1999 and $ 1.08 per Kg in 2000. Table 6.3 also shows the average cost of promotion for every extra kilogram exported as consequence of making one more promotional activity (person contacted), values of $ 0.04 and $ 0.06 per Kg of grass seed exported are obtained for China and Chile respectively. These numbers could be seen as another measure of cost effectiveness.

[23] This is an average of the production costs for Ryegrass in the Willamette Valley. The figures are estimated by the Extension Service of OSU and do not include non-cash expenses.

The net returns for trials are not positive. China shows negative rates that go from -47% in 1998 to -66% in 2000. Chile also presents negative net rates of return that go from -66% in 1998 to -78% in 2000. To illustrate the meaning of these rates of return, the -68% for Chile for the year 1999 implies that for every dollar invested in trials by the OSC-MAP program only 32 cents was recovered. One possible explanation of these results is that to calculate the rates of return, average producer prices adjusted to market values were used, however the prices that China and Chile faced could have been higher particularly if they bought patented or certified seeds. Another consideration is that the market development efforts (seed trials) are not mainly oriented to commercialize the seed but to find the scientific reasons that in the future will support the promotions and sales of the seed. Consequently trials could be seen as basic inputs of information that should be implemented in advance to promotional activities that emphasizes the technical advantages of Oregon grass seed even though they do not show positive rates of return.

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[24] Under this assumption profits obtained by producers and exporters from Oregon are jointly considered to calculate the rates of return.

Table 6.3
Returns to Promotion and M. Development Investments for
Linear Model Equation (25)

Year	China		Chile		Ref.
	Promotion	Mkt. Develop	Promotion	Mkt. Develop	Price ^
1998	924%	-47%	556%	-66%	1.232
1999	702%	-51%	414%	-68%	1.199
2000	592%	-66%	343%	-78%	1.080
Cost/kg*	0.04	0.80	0.06	1.24	
Inc. Kg~	7372	1058	7372	1058	

~ Total increase in Kg in current and future periods as a consequence of increasing one trial or person contacted in the current period.
* Cost of doing one extra trial or contacting one more person over total increase in Kg obtained as a result of this.
^ Prices are the same for Chile and China because same tariffs where applying to grass seed from Oregon.

From Table 6.3, it is also possible to see that the sales obtained by the execution of trials have an extra cost of $ 0.80 for every extra kilogram exported to China and $ 1.24 to Chile. This difference is mainly explained by the larger size of the trials and extra data colleted in Chile (Youngberg, 2001).

6.2 Lagged Dependent Variable Model, Equation (27)

6.2.1 Tests

The only difference between the previous model and the current one is the introduction of the lagged independent variable as part of the intercept to represent habit. Consequently, with exception of the Durbin Watson test, all of the tests made to the model given by (25) are pertinent for this model.

The model was tested for cross sectional heteroscedasticity and contemporaneous correlation using a likelihood ratio test. The null hypothesis that the disturbances are both homoscedastic and uncorrelated across countries is rejected (Table 6.4).

Table 6.4
Statistical Tests for the Linear Model Corrected for Habit Effects (Equation (27))
Applied to Imports from Oregon

	Critical value		Test Value	Ho:
Lagrange Multiplier Test for A/C	1.697 (dL)	1.841 (dU)	0.172622	Rejected
Likelihood ratio test for Heter. & Contemp. Corr.	21.03		689	Rejected
LM test for Cross Sectional Heteroscedasticity.	21.03		334	Rejected

Testing for autocorrelation is especially important in this model because the introduction of the lagged dependent variable brings inertia to the model, past consumption pushes current consumption. To test autocorrelation in equation (27) a Lagrange multiplier test also known as Durbin-H was used. The null hypothesis of no autocorrelation of first degree was rejected (Table 6.4).

As explained above, it is expected that increases in prices from Oregon reduce the demand of Oregon grass seed, which requires a negative sign in the parameter estimate for Oregon prices (equation (8)). As shown in the lagged dependent variable model, Table 6.5, the parameter estimate for Oregon price is negative but only significant at an 87% level of confidence. In other words, even though Oregon grass seed prices have a negative sign, they are not statistically different from zero. As explained in the previous model, this result could be due to the high correlation between own and Danish prices.

Table 6.5
Parameter Estimates and Average Demand Elasticities for the Linear Model Corrected for Habit Effects (Equation (27)) Applied to Imports from Oregon.

Estimation Method:	Parks.			
Number of Countries	13			
Number of Years	19 (1982 to 2000)			
Dependent Variable: Grass Seed Imported in from Oregon (100,000 Kilograms)				
	Estimate	t value	P value	Ave Elasticities
Intercept	-6.309	-5.2	0.000	
Lagged dependent variable (100,000 kilograms)	0.815	38.6	0.000	0.79
GDPc (Billions)	0.003	10.5	0.000	0.17
Price from Oregon	-1.597	-1.5	0.126	(0.12)
Price from New Zealand	2.239	4.2	0.000	0.25
Price from Denmark	2.634	2.8	0.006	0.24
Price from The Netherlands	2.642	6.3	0.000	0.19
Trials lagged two years	0.003	4.8	0.000	0.02 *
People Contacted	0.041	28.8	0.000	0.28 *
* Calculated using the countries and periods where these activities have been made.				
R-Square	0.9947			
SSE	121.5			
DFE	238			

The restriction regarding the signs of the prices of inputs from other countries applies to this model. A positive relationship between prices from other countries and the demand for Oregon grass seed is expected. The model in equation (27) shows that these relationships hold for New Zealand, The Netherlands and

Denmark with more than 99% of confidence. The fact that prices have positive signs indicates that all of these are substitute inputs. See Table 6.5.

6.2.2 Interpretation

The most important addition of the model represented by (27) is the lagged dependent variable to represent habit. It is positive and significant as expected. The average elasticity of the demand for grass seed with respect to habit is 0.79[25], and tells us that those previous experiences related to the use of this input are very important to explain the current demand for grass seed. This finding tells us also that even though grass seed from Oregon is a commodity, it has special attributes that motivate customers to demand it in future periods.

As in the previous model, the calculated average price elasticity of demand is inelastic, 0.12%. In other words, prices are not the important factors explaining the demand for grass seed in the thirteen selected countries. This finding is corroborated by the lack of statistical significance of the prices from Oregon.

The parameter estimate for GDP is positive as expected and highly significant. The average elasticity of demand for grass seed with respect to GDP (output elasticity) is 0.17, which tells us that grass seed is a normal good whose demand will be increased as the income of the countries increases. The value of this elasticity is substantially lower than the one obtained in the previous model because some of the trend that was necessarily explained by GDP is now explained by the variable representing habit.

The parameter estimates for the prices of the substitute grass seeds from New Zealand, The Netherlands and Denmark, satisfy expectations, having highly significant positive signs. The cross price elasticities of demand for grass seed coming from these countries are positive as expected with values of 0.24 for Denmark, 0.25 for New Zealand and 0.19 for The Netherlands.

The high elasticity of demand with respect to habit, and the low own price and cross price elasticities, indicate, as in the previous model, that grass seed from other countries are not perfect substitutes. This is a sign that grass seed from Oregon has achieved some differentiation.

The parameter estimate representing market development is also highly significant indicating that the implementation of one additional trial will increase the quantity demanded two years later by 258 Kg. If we consider also that the level of grass seed imports after two years will increase the demand for the same good after three years, we will find that the current market development initiatives will also affect the demand for grass seed three and more years later. To represent promotion only the number of people contacted in the current period was included because the effects of previous promotional efforts are represented though the lagged dependent variable. The parameter estimate obtained is positive and highly significant. One more person contacted in the present year increases the demand for

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[25] For every kilograms of grass demanded in the previous period it is expected to face a demand of 0.81 Kg of grass in the current period

grass seed in the current year by 4,100 Kg and will also increase future demands through the lagged dependent variable.

6.2.3 Total Effects and Net Rates of Return for Market Development and Promotion

Due to the inclusion of the habit variable, the market development and promotion parameter estimates alone do not present information on their total effects on the demand for grass seed and on the returns on the investments made by the OSC-MAP program in China and Chile.

The net rates of return were calculated using equation (19b) and the same assumptions and information on costs used to obtain rates of return for the linear model (equation (25)). In the lagged dependent variable model the effect of current spending has infinite but decreasing influence on future demands for grass seed through the lagged dependent variable, which results in higher net rates of return for promotion, even in present values, than for the previous model. The total increase in demand for grass seed in the current and future periods of time[26] as a consequence of the current training of people in Chile and China is more than 23,860 Kg. The execution of one extra trial today increases the demand a total of 1,515 Kg distributed between this and future periods of time (Table 6.6).

[26] The use of more periods of time is pertinent because the current increased demand of grass seed forms habit in the customers and will be present as an element that explains future demands for grass seed. It is important to clarify that the horizon of periods is infinite and decreasing.

Table 6.6
Returns to Promotion and M. Development Investments for the Lagged Dependent Variable Model, Equation (27)

	China		Chile		Ref.
Year	Promotion	Mkt. Develop	Promotion	Mkt. Develop	Price ^
1997	1963%	-62%	1222%	-76%	1.202
1998	1868%	-66%	1161%	-78%	1.232
1999	1687%	-66%	1045%	-78%	1.199
2000	1515%	-66%	935%	-78%	1.080
Cost/kg*	0.01	0.50	0.02	0.77	
Inc. Kg~	23860	1515	23860	1515	

~ Total increase in Kg in current and future periods as a consequence of increasing one trial or contacting one more person in the current period. Future effects are indirect through the lagged dep variable.
* Cost of doing one extra trial or contacting one more person over total increase in Kg obtained as a result of this.
^ Prices are the same for Chile and China because same tariffs where applying to grass seed from Oregon.

For China the net rates of return go from 1963% in 1998 to 1515% in 2000 and for Chile from 1222% to 935% in the same period of time (Table 6.6). Since promotions are more effective now, the average cost of promotion for every extra kilo exported is 0.01 and 0.02 dollars for China and Chile respectively.

Net rates of return of holding one additional trial are also negative in this model. For China they are equal to -62% in 1998 and, as a result of the reduction of the Oregon prices, decline to -66% for the year 2000. For Chile the rates of return are negative for every year and decrease as the prices go down; for example in 2000 for every dollar spent in market development 78 cents were not recovered that year and will not be recovered in future years by Oregon producers-exporters. The costs incurred in market development (trials) for every extra kilogram of grass seed exported are $ 0.50 for China and $ 0.29 for Chile. The possible reasons for obtaining such negative net rates of return were already discussed in the previous model (equation (25)).

6.3 Other Specifications and Functional Forms Tested

Several other combinations of functional forms, model specifications and variables have been tested to represent the demand for grass seed, however the best results in terms of economic logic of the parameter estimates and econometric fit are obtained in the estimation of equations (25) and (27).

One of the issues considered in this research was whether or not to use the fixed effects models to estimate the equations. To impose that a model has country specific intercepts there has to be a belief that there is a fixed component which is invariant over time and for which there is no explanation in the model, a condition that is not reasonable for this diverse sample of thirteen countries. Another problem related to the use of fixed effects occurs when panel data models involve lagged dependent variables. Nerlove (1971) found that using a dummy variable model (fixed effects) biases positive lagged dependent variables coefficients towards zero. Although these findings discourage the use of a fix effects model, some experiments were made but economically logical parameter estimates were not obtained. In addition, the country dummy variables were not significant.

The fact that the output produced with grass seed (fields of grass) could be used for beautification (parks or public areas), for sport fields (soccer, golf, etc) and to produce forage for animals motivated the use of variables such as the number of livestock, livestock production indexes, number of cattle and number of tourists to represent it. However none of these were statistically different from zero. One possible explanation for these results is that each of these variables takes into account only some of the possible reasons that motivate the importing countries to increase their demand for grass seed. GDP, includes all the possible activities that motivate the demand for grass seed to a certain extent and in fact works well in explaining the demand for grass seed as the results presented in sections 6.1 and 6.2 indicate.

Another issue was related to the fact that GDPs among the thirteen countries are not homogeneous in magnitude and in the size of the sectors that form them. To analyze this issue the GDP slope parameters were allowed to differ according to country characteristics. One group had either a large share of its GDP from agriculture or a growing agricultural sector and small GDP (these were Colombia, Chile and Ecuador) and the second group consisted of countries that did not have those characteristics. The models represented by equations (25) and (27) were altered to introduce these new slope parameters, however the new results did not explain as well as the original ones (presented in sections 6.1 and 6.2) the variability in the dependent variable (lower R^2s).

A share equation model was also tested. For the transcendental logarithmic form it was necessary to solve the issue that for many of the importing countries and periods of time exports from Denmark, The Netherlands and New Zealand were equal to zero and consequently the dependent variables in the share equations were equal to zero for a significant number of observations. To correct this, inverse mills ratios were calculated, using a Probit procedure[27], and were included as part of each share equations. Then, the share equations were estimated using a seemingly unrelated regression (SUR) estimation method. Despite the adjustments and procedures used, very low R^2s were obtained (less than 0.4) and none of the explanatory variables, with exception of the inverse mills ratios, constant terms and for some equations GDP, were statistically different from zero.

One problem with using a share equation model and a panel data set is that it makes adequate econometric adjustments, for autocorrelation, heteroscedasticity and contemporaneous correlation, extended and very difficult, and this is beyond the scope of this research.

A single equation model using a semilog functional form was also examined. This model was suggested by Onunkwo and Epperson (2000) to represent a growing market (like China); however this model did not produce estimates meaningful in economic terms. The parameter estimate for number of people contacted was not significant, the prices for Oregon, Denmark and The

[27]In this procedure the dependent variable takes a value of one if the country imported and zero if not. Own prices, prices from the other countries, the lagged dependent variable, GDP, trials lagged two years, and the number of people trained are included as explanatory variables.

Netherlands presented signs that are not congruent with economic theory, and the goodness of fit (R^2 0.55) was considerably lower than the models discussed in sections 6.1 and 6.2. One possible explanation for such results is that not all of the thirteen selected markets were growing during the period being analyzed, some of them were stable and some others were declining, consequently to assume that all of them were growing through the use of a semilog equation might be inappropriate.

One of the objectives of this research was to discover any possible difference between developed and emerging economies in respect to their demand for grass seed. A model similar to the one given by equation (27) was developed with the only difference that it allowed the variable representing habit to be different for the developed[28] and developing[29] countries. Even though the model had a good R^2 (0.97) and the signs of the parameter estimates were right, none of the explanatory variables, with exception of trials, was statistically different from zero (Appendix). In addition to this, the models represented by equations (25) and (27) were estimated with a dummy variable that had values of one for the developed countries and zero for the others, however it was not statistically different from zero in either cases.

The influence of the adverse political situation after the incident in Tiananmen Square was also evaluated with the introduction of a dummy variable.

[28] These are Australia, Belgium, France, Hong Kong, Italy, Japan, Korea and Spain.

[29] These are Argentina, Chile, China, Colombia and Ecuador.

This variable was significative however it was relatively high correlated with the prices of Oregon and Denmark (0.47 and 0.54 respectively) and these two price variables were no longer statistically different from zero.

Following Chung and Kaiser (2000) the variable representing promotion (number of people contacted) was defined to follow a second order exponential lag specification (also suggested by Cox) and a nonlinear equation was obtained. Assuming that there were not cross country heteroscedasticity, contemporaneous correlation and first order autocorrelation a non-linear ordinary least square estimation method was used to calculate the equation. Under this formulation the explanatory variables explained 76% of the variation in the dependent variable and only the intercept term, GDP, and prices for The Netherlands were significant and had the expected signs. The rest of variables were not significatively different from zero.

Finally single equation models for the demand for grass seed from the other three exporting countries, Denmark, New Zealand and The Netherlands, were estimated using a functional form like the one given by equation (27). The large number of zeros in these data sets[30] apparently interfered with the estimation. Therefore a two step procedure like the one used for the share equations model was used. In the first step inverse mills ratios were calculated, using the Probit procedure. In the second step, these were introduced in the model and it was calculated using a Parks specification. Despite these adjustments, none of the

[30] The zeros were observed because the sample of importing countries are the most important markets for Oregon and not necessarily for the other countries.

equations showed meaningful results. For Denmark, GDP and prices from Oregon were not significant and own prices did not have the expected sign. For New Zealand, GDP was negative, prices from Oregon and Netherlands had a negative sign while a positive one was expected and own prices were not significant. Finally for The Netherlands, GDP, Oregon prices, New Zealand prices and Danish prices were not significant and contrary to expectations the own prices had a positive sign.

7. Conclusions

This research has been motivated by the desire to discover if innovative activities that link research to marketing and training to marketing (such as field trials, seminars and business contacts) are cost efficient ways to develop demand in international markets for Oregon grass seed. These issues have not been addressed in the existing literature on commodity promotion, nor has anyone published research on import demand functions for this commodity.

It is also important to mention that most of the empirical studies on export promotion of agricultural commodities are based on consumer theory while most agricultural commodities do not go untransformed to final customers. Consequently the use of production theory, as in the present research, would be more appropriate as long as commodities are not exported to final customers.

The results revealed that the market development and promotional initiatives undertaken by the Oregon Seed Council and Oregon State University and financed by the Market Access Program have been successful in increasing the demand for grass seed in the those countries where these activities were undertaken. Positive net rates of return for promotion, based on current and expected values minus seed cost, have been obtained for each of the years and for both Chile and China. Returns to market development (seed trials) activities on the other hand were negative. However, this result should not be used as a determinant to suppress further investments in this kind of activity because it generates valuable information that is essential for technical training and other forms of promotion.

Regarding the rates of return, it is important to point out that the characteristics of the data obtained, in terms of costs of producing and promoting the seed, and the degree of detail used to develop equations (19) and (19b); made it possible to calculate very good approximations of the real net rates of return for market development and promotion. More detailed information on prices and on private market development and promotional initiatives could increase further the accuracy of these rates.

As important as the strategies used to increase the exports of grass seed from Oregon are the individuals and organizations that implemented them. For example, from interviews with the team that has been running this project it was learned that in China it is especially important to make contacts and to train people in the major universities because they recommend to government agencies which inputs to use. This indicates that promotion and market development activities might have not increased the demand for grass seed in the analyzed countries if the team and these strategies had not been used.

The research did not find differences among emerging and industrialized economies regarding their demand for grass seed. However this could be due to the degree of aggregation of the seed data across types of seed. If both quantities and prices at six-digit code level could be obtained, this hypothesis could be accepted or rejected with more confidence. Consequently this is an area where further research is needed.

Another objective of this research was to determine the effect of competition from other exporting countries on the demand for grass seed from Oregon. The results show that prices of substitute seed do impact demand for Oregon's grass seed. However the cross price elasticities are low, which implies that demand for Oregon grass seed is not very sensitive to changes in these prices over the period of analysis.

Given the level of aggregation of the data on prices and quantities, various functional forms and specifications have been tested in this research. However, if more disaggregated data could be obtained for Denmark, New Zealand and The Netherlands and more accurate prices could be obtained for Oregon, further research could be done to discovered potential spill over effects of the market development and promotional activities on the demands for grass seed from the other three exporters. This could be achieved by developing a share equation model similar to the one tested in the current research.

Finally, it is important to recognize that further research will be needed to estimate the total effect of market development and promotion on Oregon grass seed producers. The total effect could be attained through the development of a model that, in addition to the international demand for grass seed, incorporates the domestic supply and demand for this commodity. From such a model the total effects of these marketing activities on producer returns could be obtained.

In summary this research has covered new ground in a number of areas. It is the first that has evaluated grass seed export promotions and one of few that have used production theory to derive demand equations. The most unique aspect is the evaluation of promotion using data on the number of activities undertaken instead of the traditional approach that uses promotion expenditures. Through the application of these methodologies, the research found that the strategy used by the OSC has been successful in increasing the demand for grass seed.

Bibliography

Arrow, "Notes on Macroeconomic Theory", University of Chicago, (2000).

Asia Pacific Economic Cooperation, APEC Tariff Database, http://www.apectariff.org/

Bennett, P., "Dictionary of Marketing Terms", American Marketing Association, 2d edition, multiple pages (1995).

Brown, W.S., "Introducing Econometrics", St Paul, MN: West Publishing Company, (1991).

Chambers, R.G., "Applied Production Analysis", Cambridge, University Press, (1988).

Chung, C., Kaiser, H., "Determinants of Temporal Variations in Generic Advertising Effectiveness", Agribusiness, Vol. 16, No 2, 197-214 (2000).

Clarke, D.C., "Econometric Measurement of the Duration of Advertising Effect on Sales", Journal of Marketing Research, Vol.13, 345-357, (1976).

Comeau, A., Mittelhammer, R.C., Wahl, T.I., "Assessing the Effectiveness of MPP and TEA Advertising and Promotion Efforts in the Japanese Market for Meats", Journal of Food Distribution Research, Vol. 28, No.2, 27-35,(1997).

Cox, T.L., "A Rotterdam Model Incorporating Adverising Effects: The Case of Canadian Fats and Oils", in H.Kinnucan, S.R. Thompson & H.S. Chang (Ed.), Commodity Advertising an Promotion, Ames, Iowa State University Press, 139-164, (1992).

Danmarks Statistik, "External Trade Statistics", electronic file, 2001.

Davis, G., Jensen, K., "Two-Stage Utility Maximization and Import Demand Systems Revisited: Limitations and an Alternative", Journal of Agricultural and Resource Economics, 19(2), 409-424, (1994).

Durham, C. and Vega, E. "Evolution and Trends in Chinese Imports of Grass Seed", unpublished document prepared for the Oregon Seed Council by The Food Innovation Center Experiment Station, Oregon State University, 2001.

European Community, Official Journal of the European Communities, 106-110 (2000)

Goddard E.W. & Amuah, A.K., "The De,and for Canadian Fats and Oils: A Case Study of Advertising Effectiveness", American Journal of Agricultural Economics, 741-749, (1989).

Greene, W.H., "Econometric Analysis", New Jersey, Prentice Hall, (2000).

Griffiths, W.E., Hill, R.C. & Judge, G.G., "Learning and Practicing Econometrics", New York, John Wiley & sonsm Inc., (1993).

Halliburton, K., Henneberry, S., "The effectiveness of U.S. Nonprice Promotion of Almonds in the Pacific Rim", Journal of Agricultural and Resource Economics, 20, 108-121, (1995).

Heien, D. & Durham, C., "A Test of the Habit Formation Hyppothesis using Household Data", The Review of Economics and Statistics, Vol 73, No.2, 189-199, (1991).

Jakus, P.M., Jensen, K.L. & Davis, G.C., "Revenue Impacts of MPP Branded Funds: A Firm Level Analysis", Working paper presented at the Annual Meeting of the American Agricultural Economics Association, (2000).

Kerns, L., et. all., "Enterprise Budget: Perennial Ryegrass Seed Establishment, North Willamette Valley Region", Oregon State University Extension Service, EM8628, 3, 1995.

Lanclos, K., Devadoss, S. & Guenthner, J., "Impacts of Foreign Direct Investment on the Export Demand for U.S. Frozen Products", Agribusiness, Vol.13, No. 3, 273-284, (1997).

Le, C., Kaiser, H., and Tomek, W. "Export Promotion and Import Demand for US Red Meat in Selected Pacific Rim Countries" Agribusiness, Vol. 14, No 2, 95-105 (1998).

Mas-Colell, A., Whinston, M., and Green, J., “Microeconomic Theory”, Oxford University Press, 127-160 (1995).

Mellbye, M., et. all., "Enterprise Budget: Annual Ryegrass Production South Willamette Valley Region", Oregon State University Extension Service, EM8635, 3, 1995.

Myer, G.L., Bhattacharyya, A. & Liu, J., "Alfalfa Seed Demand Analysis Using Panel Data from Seven Western States", Agribusiness, Vol.14, No.2, 189-146, (1998).

National Bureau of Statistics, China Statistical Information Network, 2001 http://210.72.32.93/english/

Nerlove, M., "Further Evidence on the Estimation of Dynamic Economic Relations from a Time-Series of Cross Sections", Econometrica, Vol.39, 359, (1971).

Onunkwo, I.M. & Epperson, J.E., "Export Demand for U.S. Pecans: Impacts of US Export Promotion Programs", Agribusiness, Vol.16, No.2, 253-265, (2000).

Oregon Seed Council, "Annual Report of Activities FY98: Chile, Mexico, People's Republic of China", (1999).

Oregon Seed Council, "USDA MAP Annual Evaluation FY 96", (1997).

Oregon Seed Council USDA-Market Access Program, "Annual Report of FY99 Activities, People's Republic of China, Mexico, Chile", (2000).

Oregon Seed Council USDA-Market Access Program, "Final Report: Cool Season Forage Eco-zone Adaptation Demonstrations in the PRC 1995 - 1998", (1999).

Oregon Seed Council USDA-Market Access Program, "Evaluation of Activities FY97: Chile, Mexico, People's Republic of China", (1998).

Oregon State University Extension Service, "Oregon Agricultural Information Network, User Defined Report/Query", http://ludwig.arec.orst.edu/oain/SelUserDefinedCommodities.asp?ddCom=28ddYr=18ddReg=1, February 2001.

Papke, J., et. all., "Enterprise Budget: Fine Fescue Seed Production, Willamette Valley Region", Oregon State University Extension Service, EM8617, 3, 1995.

Papke, J., et. all., "Enterprise Budget: Hard Fescue Seed Establishment, Willamette Valley Region", Oregon State University Extension Service, EM8618, 3, 1995.

PIERS Journal of Commerce, "U.S. Exports All Foodstuffs", electronic file, years 1980 to 2000.

Richards, T., "Dynamic Model of Fresh Fruit Promotion: A Household Production Approach", American Journal of Agricultural Economics, 81, 195-211, (February 1999).

Richards, R.J. & Patterson, P.M., "Dynamic Complementarity in Export Promotion: The Market Access Program in Fruits and Vegetables", Journal of Agricultural and Resource Economics, Vol.23, No.2, 319-337, (1998).

Ryan, J., Conklin, F., Edwards, J., "Demand and Supply in The Oregon Grass Seed Industry: an Econometric Analysis", Agricultural Experiment Station, Oregon State University, 6 (1981).

SAS Institute, "SAS/ETS®, "User's Guide", Version 8.1, First Edition, Cary NC, 2000.

Statistics of Netherlands, "International Trade Statistics", electronic file, (2001).

Statistics of Netherlands, "International Trade Statistics", various issues, (1980-1995).

Statistics New Zealand, "International Trade Statistics by HS-code", electronic file, (2001).

Stigler, G. and Becker, G., "De Gustibus Non Est Disputandum", The American Economic Review 67, no. 2, 76-90 (March 1977).

Thursby, J. & Thursby, M., "How Reliable are Simple, Single Equation Specifications of Import Demand?", The Review of Economics and Statistics, Vol 66, No.1, 120-128, (1984).

United Nations, "World Development Indicators", electronic file, United Nations (2000).

US Department of Agriculture, Foreign Agricultural Service, "Foreign Market Development Program", online description of this program (2000).

US Department of Agriculture, Foreign Agricultural Service, "Market Access Program", online description of this program (2000).

US Department of Agriculture, Foreign Agricultural Service, "Programs to Develop Foreign Markets for Agricultural Commodities (Foreign Market Development Cooperator Program): Final Rule" online file (1999).

Young, W.C., Mellbye, M., and Gingrich, G., "The Oregon Grass Seed Industry", Crop & Soil Science Department, Oregon State University, http://www.css.orst.edu/seed-ext/pub/industry.htm, 1-6, last updated April 10, 1997.

Youngberg, Harold, Emeritus Professor OSU Crop & Soil Science Department and OSC-MAP Program Coordinator, Interview, September 2001.

Youngberg, H., "Trip Report People's Republic of China", Oregon Seed Council USDA-Market Access Program, (1996).

Appendix

Parameter Estimates and Average Demand Elasticities for The Linear Model (Equation (26)) that Includes the Tiananmen Effect Applied to Imports from Oregon.

Estimation Method:	Parks.
Number of Countries	13
Number of Years	19 (1982 to 2000)

Dependent Variable: Grass Seed Imported in from Oregon (100,000 Kilograms)

	Estimate	t value	P value	Ave Elasticities
Intercept	-3.123	-1.8	0.069	
GDPc (Billons)	0.015	12.7	<.0001	0.87
Price from Oregon	-1.932	-1.3	0.199	(0.15)
Price from New Zealand	0.863	1.2	0.253	0.10
Price from Denmark	3.116	2.5	0.015	0.28
Price from The Netherlands	2.186	4.0	0.000	0.16
Tiananmen Effect	-1.144	-1.2	0.223	
Trials lagged two years	0.012	7.2	<.0001	0.11 *
People Trained	0.024	4.2	<.0001	0.16 *
People Trained Previous Year	0.048	9.4	<.0001	0.21 *

* Calculated using the countries and periods where these activities have been made

R-Square	0.8246
SSE	235.1
DFE	237

Statistical Tests for The Linear Model (Equation (26)) that Includes the

	Critical value	Test Value	Ho:
Durbin Watson test for A/C	1.697 (dL) 1.841 (dU)	1.5289	Rejected
Likelihood radio test for Heter. & Contemp. Corr.	21.03	854	Rejected
LM test for Cross Sect Heter.	21.03	189.16	Rejected