TWO ESSAYS ON U.S. GRAIN EXPORT PROMOTION

A Thesis

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by

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ABSTRACT

More than one-third of agricultural production in the United States is exported. U.S. rice production has been increasing every year for decades in response to growing world rice trade and a relatively tight supply in other exporting countries. The U.S. competes with other major rice exporters such as Thailand, Vietnam, China, India and Pakistan.

The United States Department of Agriculture (USDA) has administered two export promotion programs to encourage the development, maintenance and expansion of international market of U.S. rice: The Foreign Market Development Program (FMD) in 1984 and the Market Access Program (MAP) in 1986. USA Rice Federation (USARF) and USA Rice Producer Association (USRPA) are the only two private money recipients. Those two public-private cost-share programs generate over $4 million annually to promote all varieties of U.S. rice.

This study investigates the economic impacts of U.S. rice export promotion program on U.S. rice export demand. The overall effectiveness of the export promotion program is evaluated in terms of benefits relative to costs. The optimality of export promotion expenditure levels is computed by computing a marginal benefit-cost ratio. The results indicate that U.S. rice export promotion has been effective in enhancing foreign market demand for U.S. rice and the U.S. is under-investing on rice export promotion.

However, these programs remain highly controversial with opponents claiming they amount to “corporate welfare”. Government intervention in funding export promotion can be rationalized in an economic standpoint if market failure exists. One

type of market failure, *"positive externalities or halo effects"* produced by export promotion of one commodity increasing the export demand for other U.S. commodities are not captured in a single equation demand. Also, foreign market promotion constitutes a type of *"international public good or free-riding effect"* when it has positive cross effects that dominate country-specific effects. Failing to take these cross effects into account tends to generate bias results of the promotion.

A dynamic linear approximation of an Almost Ideal Demand System (AIDS) model with Seemingly Unrelated Regression (SUR) method is employed to estimate the U.S. and non-U.S. grain market shares from 1975 to 2005 incorporated with major grain exports, i.e. rice, wheat and sorghum to examine the issues concerning cross-promotional effects. The simulation results indicate no halo effects of U.S. grain demand on rice, wheat, and sorghum export promotion; however, U.S. grain export promotion presents an anti-halo effect on competing country grain exports. Hence, there is no international free riding of U.S. grain export promotion.

BIOGRAPHICAL SKETCH

Pimbucha Rusmevichientong was born in Bangkok, Thailand on January 27th 1983 and received a Bachelor of Economics degree for her studies in the field of public finances in May 2005 from the Department of Economics at Chulalongkorn University, Thailand. In 2006, she received the Royal Thai Government Scholarship to pursue a course of studying leading to Master's degree in Applied Economics and Management at Cornell University. After graduation in 2007, she will return to her post in Cooperative Promotion Department, Ministry of Agriculture and Cooperatives where she is legally obliged to work.

Initial exposure to agricultural economics at Cornell University was challenging; however, it revealed a broad range of enthralling exploration in the area to her. This led her to get involved in many great academic opportunities to improve and develop her knowledge and research skill. Living in this fantastic gorge area one year and a half has given invaluable experiences to her not only in academia but also in learning how to live in multicultural society. Studying at Cornell and working with her advisor inspire her to further study in PhD in the future.

To my family and friends

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1

INTRODUCTION

Rice production in the United States has been increasing every year for decades in response to growing world rice trade and relatively tight supplies in other exporting and importing countries. From the late 1960's through 1980, the U.S. was the largest world rice exporter, with Thailand occasionally out-shipping the United States; however, since 1981, Thailand has been the leading rice exporter, largely due to expanding rice crop area. By the mid-1990's, Vietnam replaced the U.S. as the second largest rice exporter after it had recovered from the war (1957-1975) and political upheavals. China soon after became the third largest exporter due to declining per capita domestic consumption, and India emerged as a major rice exporter, ranking forth or fifth each year.

The global rice market is segregated by type and quality, with little substitution among buyers (Childs and Burdett, 2000). In fact, tastes and preferences are so strong that prices for various types of rice can possibly move in opposite directions. There is little substitution in production among the various types of rice either, as soil and climate often dictate the type of rice that can economically be grown in any particular area. As a result, global rice prices are typically more volatile than prices for other grains.

Traded rice can be categorized by physical type (long grain, medium and short grain), quality (high and low quality by kernel brokenness), and degree of milling (paddy or rough rice, brown rice, milled rice and parboiled rice). Milled rice accounts for the bulk of global rice trade, with brown rice ranking second. Very little rough rice is traded, as most countries prefer to either capture the value added from the additional processing. However, some countries e.g. Mexico, prefer to import mostly rough rice to support their domestic milling industries. The United States is the major rough rice exporter. Rough, brown and milled rice can be exported as parboiled[1] which is typically sold at a premium to non-parboiled. The major exporters of parboiled rice are Thailand, India, and the United States. The Middle East, Western Europe, and South Africa are the main markets for parboiled rice.

1.1 U.S. Rice Export promotion programs

To facilitate U.S. rice exports, three main types of government programs assist U.S. rice exports expansion. First, P.L. 480, Section 416(b) and Food for Progress etc. are the programs the United States sells rice on concessional credit terms and donates rice to needy countries bilaterally or through the World Food Program. Second, the U.S. Department of Agriculture (USDA) provides export credit guarantees for commercial financing of U.S. agricultural export, i.e. GSM- 102, GSM-103, and Supplier Credit Guarantee Program. Third, the creation, expansion, and maintenance of foreign markets for U.S. rice, which are the main focus of the paper, are funded by the USDA Market Development Program – Market Access Program (MAP) and Foreign Market Development Program (FMD). Several other programs such as the Emerging Market Program, the Qualities Samples Pilot Program, the Cochran Fellowship Program, and Section 108 also provide assistance to U.S. rice exports and/or market share expansion.

Market development programs – MAP (Market Access Program) and FMD (Foreign Market Development) are partnership programs between FAS/USDA and numerous non-profit private sector commodity and regional associations. Created in 1955, FMD embodies the agency's primary goal to develop, maintain and expand

[1] Parboiling is a process whereby rough rice is soaked in water and steamed under intense pressure. Parboiling makes the rice less likely to break during milling and pushes nutrients from the bran layer into the kernel.

long-term export markets for U.S. agricultural products and is generally used for bulk and generic products. One-half of U.S. government funding under FMD was spent on feed grains, wheat and soybeans. The remaining funds went to forest products, meat, **rice** and poultry exporters. The MAP program was originally started in 1985 as the Targeted Export Assistance Program (TEA) to offset the adverse impact of unfair trade practices of other countries on exporters of American agricultural products. Like FMD, the MAP program also helps U.S. producers, exporters, private companies and other trade organizations finance promotional activities for U.S. agricultural products. Unlike FMD, MAP is intended to be used for shorter- term, consumer oriented promotions and is primarily used for high value and processed products as well as branded promotions. USA Rice Federation (USARF) and USA Rice Producer Association (USRPA) are the only two money recipients for rice export promotion. These two public-private cost-share programs generate over $4 million annually to promote US rice in all varieties

1.2 Purpose

The purpose of this thesis is to investigate the economic impacts of U.S. rice and grain export promotions on U.S. rice export demand and U.S. grain export market shares. Export markets are important to U.S. agriculture accounting for 20% – 30% of total annual agricultural production over the past twenty years (Benson and Marchant (1996)). Export promotion is one of the major factors influencing US agricultural exports; however, questions remain concerning its economic impacts.

Numerous studies have been conducted on various commodities and individual countries, but few have focused on grain markets. This study is the first to estimate U.S. grain export promotion programs impact, i.e. rice and other related grains, on the U.S. grain export markets and evaluate a benefit-cost ratio as a bottom-line measure of promotion effectiveness of the program. To our knowledge, no study has estimated the effect of U.S. grain export promotion programs on grain exports as opposed to exports in targeted countries. This thesis provides empirical evidence on the impact of U.S. grain promotion programs and their net benefits.

1.3 Objectives

The main objective of the thesis is to analyze the economic impacts of U.S. grain export promotion programs (rice, wheat and sorghum). The specific objectives are:

1. to estimate the responsiveness of U.S. rice export demand with respect to U.S. rice export promotion.
2. to evaluate the overall effectiveness of the U.S. rice export promotion program as to whether it has been profitable to U.S. rice growers by evaluating the benefits relative to the costs.
3. to determine the optimality of export promotion expenditure levels regarding whether the U.S. has under- or over-invested in U.S. rice export promotion by computing the marginal benefit-cost ratio for the program.
4. to examine whether there is a "halo effect" of U.S. grain (rice, wheat, and sorghum) export promotion, i.e., test the cross-effects of one grain's promotion (e.g., U.S. rice promotion) on another grain's (e.g., U.S. wheat) market share.
5. to investigate whether U.S. grain export promotion has public goods characteristics, i.e., test the cross-effects of U.S. grain export promotion on non-U.S. grain market share (other countries).

1.4 Outline of the thesis

The thesis consists of two essays on U.S. grain export promotion. It is organized as follows: Chapter 2 consists of a literature review of previous research on U.S. export promotion programs for various commodities; Chapter 3 presents the first essay: *Measuring the Effectiveness of U.S. Rice Export Promotion Program.* This paper provides an econometric investigation on the responsiveness of U.S. rice export demand with respect to U.S. rice export promotion program and the effectiveness of the program; Chapter 4 presents the second essay: *The Halo Effects of U.S. Grain Export Promotion*. The study develops an integrated framework to examine the own- and cross-effects of U.S. grain export promotions for U.S. and non-U.S. rice and related grains, (wheat and sorghum). Finally, Chapter 5 provides the conclusion for the two essays.

CHAPTER 2

LITERATURE REVIEW

There have been numerous studies that examine the impact of the promotion programs in various commodities and individual country specific in term of promotion elasticity, generally conducted by econometric estimation. Most studies employed a single-equation with (per capita) import or export demand as a dependent variable and demand determinants as an explanatory variables.

Kaiser, Liu, and Consignado (2005) studied the effectiveness of the Raisin Administrative Committee (RAC)'s export promotion programs between 1965-1998 to Japan and the United Kingdom. A single equation import demand for California raisins in both countries was estimated to determine the responsiveness with respect to the RAC's export promotion, which included both government and private contribution. The estimated promotion elasticity of Japan and the U.K. was 0.029 and 0.133 respectively. Average and marginal benefit-cost ratios were estimated as a bottom line of effectiveness measurement. The average gross benefit-cost ratio was 5.13 for Japan and 15.29 for the U.K. The marginal gross benefit-cost ratio was 0.42 for Japan and 3.19 for the U.K.

Lanclos, Devodoss and Guenthner (1997) chose representative importing countries for U.S. frozen potatoes from four tiers based on 1983 import volume: Japan (tier1), Mexico (tier2), the Philippines (tier3) and Thailand (tier4). Geweke's Bayesian estimation procedure was used to estimate each single equation import demand function for the four countries from 1978-93, allowing for the incorporation of prior information into the coefficient estimation. The results indicated that U.S. Potato Board Advertising had very small impacts in each country with elasticities of 0.03 in Japan, 0.04 in Mexico, 0.06 in the Philippines, and 0.08 in Thailand. On the other hand, Third Party Program advertising had much larger impacts with advertising elasticities of 0.03 in Japan, 0.53 in the Philippines, and 0.87 in Thailand. The marginal benefit-cost ratio for the Potato Board and Third Party advertising was 1.3 and 1.29 in Japan, 1.42 and 11.77 in the Philippines, and 1.51 and 16.36 in Thailand. For Mexico, a marginal benefit-cost ratio for the Potato Board was 1.13.

Fuller, Bello and Capps (1992) estimated a single equation per capita demand for U.S. fresh grapefruit with quarterly data from 1969-88 for Japan, Canada, France, and the Netherlands. They regressed per capita imports for each country on the U.S. fresh grapefruit price F.O.B, the exchange rate between the importing country's currency and the U.S dollar, per capita GDP in each importing country, the price of grapefruit substitutes (banana) in each importing country, a trend term, seasonal dummy variables, several policy variables reflecting tariff and quota trade barriers, and U.S. export promotion expenditures to each country. The promotion elasticity was estimated in France (0.234), the Netherlands (0.153) and Japan (0.109). The marginal benefit-cost ratios for the three countries were 6.65 for the Netherlands, 5.02 for Japan, and 4.13 for France.

Halliburton and Henneberry (H-H) (1995) examined the effectiveness of the FMD and MAP programs from 1986-92 for almonds in Japan, South Korea, Hong Kong, Taiwan, and Singapore. Import price of almond substitutes and compliments (cashews, sugar, and cocoa butter) were included in the model. H-H estimated a single equation with three different functional forms: logarithmic, linear, and exponential forms. The results in terms of export promotion effectiveness were mixed. Using the promotion elasticities from the linear model, H-H computed marginal benefit-cost ratios of 4.95 for Japan, 5.94 for Taiwan, and 3.69 for Hong Kong.

Le, Kaiser and Tomek (1998) estimated the economic impact of FAS sponsored red meat export promotion on a single equation import demand in Hong Kong, South

Korea, Singapore, and Taiwan. Panel data (pooled time-series and cross-section data) were used to estimate an import demand for red meat which included export promotion expenditures for FMD and TEA combined as one of the explanatory variables. There was a positive and significant impact of red meat export promotion on South Korea (0.598), but not in other countries. The gross marginal benefit costs ratio calculated for four countries ranged 15.62 and 47.32

Unlike many studies that estimated single equation import demand equations for countries, Rosson, Hammig and Jones (1986)) examined a U.S. apple export demand equation which include export promotion expenditure from FAS program as well as U.S. cooperator and foreign agent funds. However, this study did not include income, competing promotion or other demand factors due to the limited number of observation. The results indicated that over the period 1974-1981, the export promotion elasticity for apples was 0.51, and the marginal benefit-cost ratio was 60.

Onunkwo and Epperson (2000) also investigated the impacts of FAS promotion programs on U.S. pecan exports to Asia and the EU. While most single equation studies have included export promotion expenditures for the specific commodity being investigated, this study included, as separate variables, promotion expenditures for pecans, walnuts, and almonds. Thus, any indirect or spill-in effect of almond and walnut promotion on U.S. pecan exports could be calculated. The export promotion elasticities were statistically significant and positive in Asia (0.98) and the EU (0.06). In Asia, U.S. almond and walnut promotion were actually larger than the direct effect of pecan promotion on pecan export. U.S. walnut promotion had a negative impact (cross-promotion elasticity of -1.64) while U.S. almond promotion helped U.S. pecan export with cross-promotion elasticity of 1.38. In the EU, the opposite results were found with walnut promotion helping (0.48) and almond promotion harming (-0.14) U.S. pecan exports. The Asian export promotion elasticity was over 16 times larger than the EU; this study reported a higher gross marginal benefit-cost ratio for the EU (6.75) compared with Asia (6.45)

Armah and Epperson (1997) estimated a single equation export demand for U.S. orange juice using cross sectional country (Japan and four European countries: France, Germany, the Netherlands, and the United Kingdom) data pooled with time series over the period 1984-92. U.S. export promotion gave the largest impact in the Netherlands with an estimated promotion elasticity of 0.302. Germany was 0.044; while Japan, the U.K. and France all had elasticities of 0.014. Marginal benefit cost ratios (MBCR) were calculated for each country: the Netherlands (51.92), Germany (37.10), the U.K. (7.64), France (7.44) and Japan (5.61).

Alston et al. (1997) estimated the effectiveness of U.S. export promotion of California table grapes to Asian countries with annual time series data from 1976-94. An aggregate export demand model was estimated and focused on eight importing countries: Hong Kong, Taiwan, Malaysia, Singapore, the Philippines, Indonesia, Thailand, and South Korea. Four import demand models for Asian countries were estimated using monthly data from 1976-94 for Hong Kong,, Malaysia, Singapore and Taiwan. Unlike the majority of other individual commodity studies above, Alston incorporated a supply response into the simulation, and therefore price was allowed to vary with any promotion induced demand increase in the simulation. The export demand model was combined with an assumed excess supply elasticity which was defined in constant elasticity form and equated with predicted demand quantities rather than econometrically estimating an excess supply function. This study specified a constant elasticity synthetic export supply function and used four different assumed own price elasticity of supply (1, 2, 5, and 10) to simulate alternative benefit-cost ratios. Given an own price elasticity of supply of 5, the average benefit-cost ratio (present value with 3 percent compounding) for U.S. table grape export promotion was

9.1.The marginal benefit-cost ratio was computed to be 4.3 indicating under spending on export promotion. Benefit-cost ratios were not calculated.

The single equation is the most popular means of evaluation in this area due to simplicity and data availability i.e. competing export promotion and private industry promotion expenditures results in only partial measurement with necessarily important variables; however, it is not comprehensive to investigate the spillover and spill-in (halo) effect of the promotions (see the summarized results of single equation estimation in Table 1). Not many studies have used demand systems as an integrated framework such as the Rotterdam model and the Almost Ideal Demand Systems (AIDS).

Richards and Paterson (1997) used a dynamic dual model of U.S. export supply for horticulture commodities: apples, almonds, wine and grapes based with time-series data from 1984-95 pooled with country-level data for Mexico, Sweden, Norway, Finland, the United Kingdom, France, Germany, Malaysia, Singapore, the Philippines, and Japan. The direct effects of U.S. export promotion in term of elasticity for all four commodities were positive and statistically significant: apples (5.011 in short run, 23.949 in long-run), almonds (0.052 in short-run, 0.387 in long-run), wine (2.096 in short-run, 2.736 in long-run) and grapes (0.467 in short-run, 0.778 in long-run). Most cross effects were positive and significant, indicating a halo effect among these commodities. For some commodities, cross effects were as large as or larger than direct effects, i.e. the elasticity of almond promotion and graph promotion on apples was 1.028 in short-run, 3.775 in long-run, and 0.647 in short-run, -4.258 in long-run, respectively.

Richard, Ispelen, and Kagan (R-I-K) (1997) developed a two-stage linear Expenditure System (LES)/Almost Ideal Demand System (AIDS) to estimate the effectiveness of apple export promotion in increasing U.S. market share and total apple import demand for Singapore and the United Kingdom markets. Other fruit products were included in the system, i.e., banana, orange, grapes imports and other domestic goods. The feature of the demand system model provided the ability to address the important issue of spillover effects of export promotion and be consistent with the adding – up, homogeneity, and symmetry restriction of consumer demand theory. Estimated U.S. apple promotion elasticities on U.S. market share in Singapore and the U.K. were significantly positive of 0.055 and 0.016 respectively. Cross-effects indicated that U.S. apple export promotion helped New Zealand (0.079), Chile (0.601), France (0.186) and Rest of the word (0.048) market share in Singapore, indicating significantly positive elasticities in those countries. This caused the U.S. to lose market share to other countries that are able to free ride. U.S. apple export promotion also provided a halo effect to other countries' market shares in the U.K. i.e. Chile (0.045), South Africa (0.034), France (0.079); however, it hurt New Zealand market share in the U.K. (-0.025). Taking both the aggregate and share effects into account, the total promotion elasticity for U.S. apples in Singapore was modestly positive comparing with the U.K. R-I-K suggested that promotion is more effective the less elastic is demand. Empirically, the effects of export promotion by one country have larger spillover effects the more inelastic is demand for a rival's product.

Table 2.1: Results from economic impact studies on U.S. export promotion using a single equation estimation.

	California raisins	US frozen potatoes	US fresh grapefruit	US almonds	US red meat	US apples	US pecans	US orange juice	CA table grapes
Study	Kaiser, Liu, and Consignado (2005)	Lanclos, Devodoss, and Guenthner (1997)	Fuller, Bello, and Capps (1992)	Halliburton and Henneberry (1995)	Le, Kaiser, and Tomek (1998)	Rosson, Hammig, and Jones (1986)	Onunkwo and Epperson (2000)	Armah and Epperson (1997)	Alston et al. (1997)
US export promotion in:	Japan and UK	Japan, Mexico, Philippines, Thailand	Japan, Canada, France, and Netherlands	Japan, Taiwan, Hong Kong, Singapore, South Korea	S. Korea, Taiwan, Hong Kong, Singapore	All countries US has programs in	Asia and EU	France, UK, Germany, Japan Netherlands	Asian countries
Period	1965-98	1978-93	1969-88 quarterly	1986-92 panel data	1984-94 panel data	1972-81	1986-96 panel data	1984-92 panel data	1976-94
Model	Import demand	Import demand	Import demand	Import demand	Import demand	Export demand	Export demand	Export demand	Export demand
Estimated promotion elasticities	Japan=0.029* UK=0.133*	Third Party: Japan=0.03* Philippines= 0.53* Thailand=0.87*	Japan=0.109* Netherlands= 0.153* France=0.234*	3 models range from -0.2788 to 0.85	Korea=0.598* HK=-0.019 Taiwan=0.047 Singapore=0.034	Apples=0.51*	Asia=0.98* EU=0.06*	France=0.014 Germany=0.044* Japan=0.014 Netherlands= 0.302* UK=0.014*	0.21*
Estimated BCR	Japan: AGBCR=5.13 MGBCR=0.42 UK: AGBCR=15.29 MGBCR=3.19	Third Party MGBCRs: Japan=1.29 Philippines= 11.77 Thailand=16.36	MGBCR: Japan=5.02 Netherlands= 6.65 France=4.13 Canada=no promotions	MGBCRs: Japan=4.95 Taiwan=5.94 HK=3.69	MGBCR: Range from 15.62 to 47.32 for all 4 countries	MGBCR=60	Asia: MGBCR=6.45 EU: MGBCR=6.75	MGBCRs: France=7.44 Germany=37.10 Japan=5.61 Netherlands= 51.92 UK=7.64	ABCR: 4.1-9.4 MBCR: 4.1-4.2

* means statistically significant at conventional significance levels, i.e. at least the 10% level.

Table 2.2: Results from economic impact studies on U.S. export promotion using an integrated framework.

	US horticultures	US apples	US non-alcoholic beverage
Study	Richards and Patterson (1997)	Richard, Ispelen, and Kagan (1997)	Xiao, Kinnucan, Kaiser (1999)
US export promotion in:	Mexico, Sweden, Norway, Finland, the United Kingdom, France, Germany, Malaysia, Singapore, the Philippines, and Japan.	a two-stage linear Expenditure System (LES)/Almost Ideal Demand System (AIDS)	milk, juices, soft drinks and coffee and tea
Period	1984-95 pooled with country-level data	1962-93	1970-94
Model	A dynamic dual model	Import demand, LES/AIDS demand systems	A Rotterdam model
Estimated own promotion elasticities	Apples = SR:5.0*, LR:23.949* Almonds = SR: 0.052*, LR:0.387* Wines= SR:2.096*, LR: 2.736* Grapes=SR: 0.467*, LR: 0.778*	Singapore=0.055* UK=0.016*	Milk = 0.0018 Juice = 0.14* Soft drink =-0.115* Coffee & Tea =-0.0085
Estimated cross promotion elasticities	**Apples:** Almonds = SR: 0.221*, LR:-2.31* Wines = SR:0.603*, LR: -0.369* Grapes = SR:0.362*, LR: 5.414* **Almonds:** Apples = SR: 1.028*, LR: 3.775* Wines = SR: -0.062*, LR: 0.027* Grapes = SR: 0.706*, LR: 4.898* **Wines:** Apple = SR: 1.128*, LR: 14.133* Almonds = SR: 0.045*, LR: -1.769* Grapes = SR:0.853*, LR:80.848 **Grapes:** Apples = SR:0.647*, LR:-4.258* Almonds = SR:0.029*, LR:0.198* Wines = SR:0.067*, LR:0.019*	**Singapore:** Australia =-0.011 New Zealand =0.079* Chile =0.601* France =0.186* China = -0.095 Rest of the word =0.048* **UK:** Australia =-0.008 New Zealand =-0.025* Chile =0.045* South Africa =0.034* France =0.079* Rest of the world =0.015	**Milk:** Juice =0.0479* Soft drink =-0.0117 Coffee & Tea = -0.0442* **Juice:** Milk = 0.0267* Soft drink = 0.0119 Coffee & Tea =-0.2849* **Soft drink:** Milk =-0.0181 Juice =0.0329 Coffee & Tea =0.2954* **Coffee & Tea:** Milk =-0.02* Juice =-0.2304* Soft drink =-0.0864*

Xiao, Kinnucan, Kaiser (1999) examined the effects of advertising on U.S. non-alcoholic beverage demand using a two-stage Rotterdam model, which is a major rival of AIDS model, with annual time-series data covering the period 1970-94. Four equations of the budget share (milk, juices, soft drinks and coffee and tea) expressed as an average of the current and preceding year's budget shares were simultaneously estimated with advertising expenditure variable of each beverage included as an explanatory variable. Results suggested many of the cross-advertising elasticities were larger in absolute value than the own-advertising elasticities, and in some cases exceed price and income elasticities. The estimated own-advertising elasticity for juices was positive and significant at 0.134 and for soft drink was negative at -0.115. The estimated own-advertising elasticity for milk was positive, but not large (0.002) and not statistically significance. Over all, coffee and tea was the most affected by other beverages' advertising even though its own-advertising did not give significant impact, and milk the least.

None of these studies using demand systems simulated the model system and calculated a net return of the direct and total effect.

CHAPTER 3

MEASURING THE EFFECITIVENESS OF U.S. RICE EXPORT PROMOTION PROGRAM

3.1 Introduction

Since 1984, the U.S. government has used export promotion as a means to increase rice exports to other countries. Three main types of government programs have been used to encourage U.S. rice exports expansion. First, the United States sells rice on concessional credit terms and donates rice to needy countries bilaterally or through the World Food Program (P.L. 480, Section 416(b), Food for Progress). Second, the USDA provides export credit guarantees for commercial financing of U.S. agricultural exports (GSM- 102, GSM-103, and Supplier Credit Guarantee Program). Finally, the USDA funds the creation, expansion, and maintenance of foreign markets for U.S. rice through its market development programs (Market Access Program (MAP), and Foreign Market Development Program (FMD)). Several other programs such as the Emerging Market Program, the Qualities Samples Pilot Program, the Cochran Fellowship Program, and Section 108 also provide assistance to U.S. rice exports.

The focus of the research reported here is on the effectiveness of the market development programs for U.S. rice exports. MAP and FMD are partnership programs between FAS/USDA and numerous non-profit private sector commodity and regional associations. The oldest market development program is the Foreign Market Development Program (FMD), also known as the cooperator program. Created in 1955, FMD embodies the agency's primary goal to develop, maintain and expand long-term export markets for U.S. agricultural products. Under the partnership, FAS/USDA and the cooperators pool their technical and financial resources to conduct market development activities outside the United States. These cooperators compete for USDA funding annually based on their proposed activities. Groups which have been successful in expanding export markets and contribute a substantial amount of their own funds are more likely to get increased funding. Under FMD, only generic promotions are funded. There were 32 cooperator groups which received funding in 1997, covering a broad range of agricultural commodities. One-half of the $27.5 million in U.S. government funding under FMD was spent on feed grains, wheat and soybeans. Most of the remaining funds went to forest products, meat, rice and poultry exporters.

The MAP program was originally started in 1985 as the Targeted Export Assistance Program (TEA), which was created from the 1985 Farm Bill, to offset the adverse impact of unfair trade practices of other countries on exporters of U.S. agricultural products. The 1990 Farm Bill replaced TEA with the Market Promotion Program (MPP). The 1990 Act shifted the focus of the effort from compensating applicants for unfair trade to a goal of increasing U.S. agricultural exports in promising foreign markets. The 1996 Farm Bill renamed this program the Market Access Program (MAP). Like FMD, the MAP program also helps U.S. producers, exporters, private companies and other trade organizations finance promotional activities for U.S. agricultural products. While it funds many of the same types of activities as the FMD program, MAP is intended to be used for shorter- term, consumer oriented promotions. It is primarily used for high value and processed products, while FMD is generally used for bulk products. Branded promotions are permitted under the MAP. Both MAP and FMD use funds from USDA's Commodity Credit Corporation (CCC). USA Rice Federation (USARF) and USA Rice Producer Association (USRPA) are the only two money recipients for rice export promotion.

Those two public-private cost-share programs generate over $4 million annually to promote US rice in all varieties. For 2000, FAS supported USA Rice Federation through MAP by nearly $2 million and FMD by almost $1.8 million, accounting for 2.2% and 5.2% of total program allocation, respectively (Wang). The USA Rice Federation has supplemented its request for nearly $6 million in MAP and FMD funds with an additional $1.9 million in special programming requests. In 2004, MAP funding for the U.S. rice industry topped $2.9 million, and reached $4.7 million in 2006. However, the FMD reduced the allocation from $1.8 million to $1.7 million in 2004 and decreased it further to $1.46 million in 2006. International rice promotion focuses on educating foreign consumers about the nutrition of rice, emphasize the high quality, versatility and dependability of United States rice. The FMD program has a statutory baseline total allocation for all agricultural commodities of around $34 million. MAP funding, however, is legislated to grow over the life of the Farm Bill, reaching the 1990 Food, Agriculture, Conservation and Trade Act level of $200 million in 2006. The proportion of money allocated for the U.S. rice industry has declined over time. U.S. rice exports decreased in world market share from 20% of global rice exports in 1980s to 14% in 1990s and only 12% in the current decade (Patricio Mendez del Villar).

There are three objectives of this research. The first objective is to empirically measure the responsiveness of U.S. export demand with respect to U.S. rice export promotion. The second objective is to evaluate the overall effectiveness of the promotion programs in terms benefits relative to costs. Finally, the optimality of export promotion expenditure levels is investigated by computing a marginal benefit-cost ratio.

3.2 Previous Research

There have been numerous studies that have investigated the impact of export promotion programs on demand for U.S. agricultural commodities. Table 3.4 provides a synopsis of 16 export promotion studies in terms of key assumptions, techniques used, and results. The studies are organized by commodity being studied. While not exhaustive, the studies depicted in this table provide a good representation of the literature. The majority of these studies have been commodity and individual country specific, e.g., U.S. raisin export promotion in Japan. These partial equilibrium studies have examined the direct (and in some cases indirect) impacts of FAS programs on specific commodity demand, and have varied in the type of estimation techniques used (e.g., single equation vs. system of equations estimation), functional form specification (e.g., linear vs. logarithmic), and variables included in the model.

The majority of studies have employed single-equation estimation. One problem with this approach is that all explanatory variables are assumed to be exogenous, however, the own price variable may in fact be endogenous (i.e., be dependent on the level of per capita imports). Researchers who have assumed price is exogenous have sometimes justified this by noting that importers are generally price takers and hence price can be considered as being exogenous. However, this is only true in the case where the U.S. is a small country in terms of its exports. Some of these studies have conducted statistical tests of the price endogeneity assumption as well, and justified this assumption by confirmation of price being exogenous based on the statistical test. There have been some studies that have addressed the issue by using statistical estimation techniques that correct for price endogeneity such as an instrumental variable approach.

While U.S. export promotion has been the focus of these studies, to accurately measure the impact of promotion on demand, one must sort out the impact of all other factors that impact the demand for the U.S. product. Ideally, an import (or export) demand model would include own price, price of substitutes and complements, income, exchange rates, population, trade barrier measures, own export promotion, and competing export promotion. Unfortunately, it is not always possible to get data for all these factors, e.g., competing promotion from other countries is usually very difficult to get and has not been included in any study known to us. In other cases, studies have been forced to use only partial measures for important variables such as U.S. export promotion expenditures. Many studies have only included FAS expenditures for this variable since private industry promotion data were unavailable. In this case, the estimated promotion impacts on demand could be biased upwards.

While a statistically significant and positive promotion elasticity is a necessary condition for export promotion to be profitable, it is not a sufficient condition. For promotion to be profitable it must increase the exported product's price sufficiently to cover the per-unit cost of producing, shipping, and promoting the commodity in the foreign market. Hence, the essential task of the economist in measuring returns to export promotion is determining the price effect of the demand shift. This requires specification of the supply side of the market. If this supply curve for any of the markets in question is horizontal, there can be no price effect from the promotion and thus no benefit to U.S. producers in terms of increased producer surplus. Thus, an implicit assumption of export promotion evaluations is that the U.S. accounts for a sufficiently large share of the total supply in the target market that promotion-induced shifts in the demand curve for the U.S. product will affect the market price.

Once the price effect of promotion has been determined, the benefit to producers is calculated using the change in producer surplus. To get a benefit-cost ratio (BCR), the gain in producer surplus is divided by some measure of promotion cost, typically total outlays, although some studies separate government from industry costs to distinguish between private and public returns. The majority of studies have computed benefit-cost ratios by simulating an export demand model without regard to the supply side of the market. The problem with such studies is that price is implicitly assumed to be constant, which means there can be no change in producer surplus. In essence, these studies equate gains in export revenue with gains in producer surplus, which is appropriate only when supply is fixed. Recalling that the area under the supply curve represents total costs, it is clear that when a demand curve shifts along a horizontal supply curve, the revenue gain is exactly matched by an increase in production cost and thus the profit or surplus gain is zero. Conversely, when demand shifts along a vertical supply curve there is no increase in production cost (since quantity is fixed) and thus the revenue gain represents pure profit or economic rent. In an export context, the outward shift in the export demand curve along a horizontal import supply curve merely diverts quantity from the U.S. market with no change in U.S. producer revenue. Stated differently, the revenue gain in the export market is exactly matched by a revenue loss in the domestic market. This issue, which is discussed in some detail in Kinnucan and Mryland, means that benefit-cost estimates from the literature must be interpreted with caution.

The majority of studies reviewed here shows a positive relationship between export promotion expenditures and export demand. For example, of the 15 studies in Table 3.4 done on individual commodities, eight studies found statistically significant positive export promotion effects for all countries and commodities in their specific study. The remaining seven studies obtained mixed results, with some commodities and/or importing countries studied showing no measurable demand effect. None of the studies presented evidence to suggest non-price export promotion has no effect on export demand.

What is less clear from the literature review is the economic impact of export promotion. Although many studies report benefit-cost ratios, most of these are based on revenue gains rather than gains in producer surplus, the preferred metric. Indeed, of the 16 studies in Table 3.4, only two incorporated a supply response in the simulation of benefit-cost ratios. Also, the majority of studies estimated marginal rather than average BCRs. In determining the private or social returns to promotion the relevant metric is the average BCR as this measures the return to *all* dollars expended, not simply the *last* dollar. Marginal BCRs are more appropriate for determining whether the level of promotion is too low or high relative to the economic optimum. Of the 16 studies listed in Table 3.4, only four estimated an average BCR. Finally, as emphasized by Jakus, Jensen and Davis, few studies provide confidence intervals, and thus one does not know whether reported benefit-cost ratios are truly greater than one.

In the current study, a single equation, instrumental variable regression approach is used to estimate export demand for U.S. rice. The constant price (horizontal supply function) assumption is relaxed by introducing a constant elasticity excess supply equation and the average BCRs is computed for a range of assumed own price elasticities of excess supply. Confidence intervals for the BCR are also computed and reported. Finally, marginal BCRs are estimated in order to explore the optimality of rice export promotion. The detailed methods used to evaluate rice export promotion in this study are next addressed.

3.3 Econometric Model

In this study, an export demand equation for U.S. rice ($USEX_t$) is estimated in logarithmic form using annual data from 1984 through 2005. Ideally, a longer time series would be preferred, however, there was no U.S. rice export promotion program prior to 1984. The following export demand determinants are included to ascertain their impacts, if any, on annual export demand for U.S. rice [2]: deflated price of U.S. milled rice exports ($USMILPW_t$), deflated prices of Thai and Vietnamese milled rice exports ($THMILPW_t$, $VIETMILPW_t$ respectively), the summation of deflated GDP of major U.S rice importers [3] ($GDPSUMW_t$) and U.S. rice export promotion expenditures [4]($EXPROWS_t$) deflated by world price index and multiplied by Special Drawing Rights (SDR) [5].

The Thai and Vietnamese rice export prices are included because these two countries are the major rice exporters in the world and the chief competitors to U.S rice in different markets. The relationship between the competitors' deflated prices should be positive because they are a substitute for U.S. rice. The summation of the GDP of major U.S rice importers should have a positive impact on U.S. rice exports. Unlike previous studies, which only consider the USDA/FAS expenditures for U.S. rice export promotion due to lack of data, e.g. Dwyer (1995), Wang (2005), this research uses combined USDA/FAS- MAP and FMD expenditures as well as private cooperator expenditures to measure the total promotion impact. Because previous research (e.g. Kinnucan, 1982, 1983, 1985; Le, Kaiser, and Tomek, 1998; Pritchett, Liu, and Kaiser, 1998; Schmit and Kaiser, 1998) has indicated that the carryover effect of promotion is generally less than one year, the annual rice model does not

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[2] The following data sources are used for the variables: volume of U.S. rice exports comes from FAS, USDA and IRRI; export unit value for rice-paddy milled in the U.S., Thai and Vietnamese rice comes from FAO; the summation of GDP of major U.S rice importers comes from The Economist Intelligence Unit; annual export promotion expenditures from FAS, USDA; and SDR from IMF.

[3] The summation of GDP for Middle East and Africa countries include: Iran, Iraq, Saudi Arabia, Turkey, Jordan, South Africa, Ghana, and Nigeria, Latin Americas and Caribbean - including Mexico, Brazil, Peru, Haiti, Cuba, Costa Rica, Nicaragua, Jamaica, Republic of Dominican, and Honduras, Canada, Japan, South Korea, EU-25.

[4] The export promotion expenditure levels partially depend on exchange rates since, for example, when the U.S. dollar devalues, export promotion expenditures will have lower purchasing power.

[5] Created by the IMF in 1969, the SDR was redefined as a basket of currencies, today consisting of the Euro, Japanese Yen, Pound Sterling, and U.S. dollar. It is calculated as the sum of specific amounts of the four currencies valued in U.S. dollars, on the basis of exchange rates quoted at noon each day in the London market.

include lagged export promotion. Furthermore, preliminary regression with one and two year lags resulted in statistically insignificant coefficients for the lagged variables.

To address the problem of price endogeneity, an instrumental-variable regression approach is used, where the U.S. export price is regressed on a set of exogenous variables. Hence, the model consists of two equations: equation 3.1: a price equation [6] to be used as an instrumental variable for the endogenous U.S. export price, and equation 3.2: the demand equation for U.S. rice exports:

$$(3.1) \quad USMILP_t = \alpha_0 + \alpha_1 GDPSUM_t + \alpha_2\, WPI_t + \alpha_3\, SDR_t + \alpha_4\, EXPRO_t + \alpha_5\, USMILP_{t-1} + \alpha_6\, THMILP_t + \alpha_7\, VIETMILP_t$$

$$(3.2) \quad \log(USEX_t) = \beta_0 + \beta 1 \log(USMILPWIV_t) + \beta_2 \log(THMILPW_t) + \beta_3 \log(VIETMILPW_t) + \beta_4 \log(GDPSUMW_t) + \beta_5 \log(EXPROWS_t),$$

where WPI is the world price deflator, SDR is special drawing rights, and USMILPWIV is the predicted value from equation 3.1, deflated by world price index.

3.4 Econometric Results

The estimated price instrumental variable equation is:

$$(3.3) \quad USMILP_t = \underset{(-2.28)}{-\,250.353} + \underset{(1.39)}{0.000028}\, GDPSUM_t - \underset{(-2.15)}{1.435}\, WPI_t + \underset{(1.31)}{144.266}\, SDR_t + \underset{(3.401)}{0.00000445}\, EXPRO_t + \underset{(7.43)}{0.740605}\, USMILP_{t-1} + \underset{(0.95)}{0.188102}\, THMILP_t + \underset{(4.82)}{0.687075}\, VIETMILP_t$$

$R^2 = 0.79$; Durbin-h = -1.24,

[6] All exogenous variables used for a price equation are nominal (not deflated by world price index (WPI) nor multiplied by special drawing rights (SDR))

where the values in parentheses under the coefficients are their respective t-values, R^2 is the adjusted coefficient of determination. The instrumental equation fits the data well with an adjusted coefficient of variation of 0.79. The Breusch-Godfrey's serial autocorrelation test identified statistically significant high-order autocorrelation[7]. An AR (3) process was used to remove autocorrelation from the error structure. Durbin-h statistic was -1.24, which is less than a Durbin-h critical value at the 5% significant level (-1.96). Thus we fail to reject the null hypothesis that there is no-autocorrelation. The predicted value for this equation is used as an instrument for the U.S. rice price for equation 3.4.

The estimated export demand equation for U.S. rice (equation 3.2) is:

$$\text{(3.4)} \quad \log(USEX_t) = \underset{(1.71)}{3.425} - \underset{(-3.57)}{1.028} \log(USMILPWIV_t) + \underset{(2.86)}{0.637} \log(THMILPW_t)$$

$$+ \underset{(1.84)}{0.461} \log(VIETMILPW_t) + \underset{(5.90)}{1.047} \log(GDPSUMW_t)$$

$$+ \underset{(2.85)}{0.143} \log(EXPROWS_t) \qquad R^2 = 0.80 \text{ , } DW=2.29$$

Because autocorrelation is detected, a moving average error term is appended to the regression, and the resulting equation is subsequently free from autocorrelation. The equation fits the data well; the adjusted R-squared indicates that the equation explains about 80% of the variations in U.S. rice export demand. It has elasticity signs, which are consistent with economic theory, and all estimated coefficients are statistically significant at conventional confidence levels (95% and 90%). No multicollinearity was detected in the equation.[8]

[7] The Bresuch-Godfrey's serial autocorrelation test identified a high-order autocorrelation which is at 10% significant level with p-value 0.06.

[8] Variance Inflation Factor (VIF) is employed in this case to test multicollinearity. It measures the impact of collinearity among the X's in a regression model on the precision of estimation. It expresses the degree to which collinearity among the predictors degrades the precision of an estimate. Typically a VIF value greater than 10 is of concern. In this paper, VIF, on average, is 2.91 which indicate no multicollinearity.

The estimated equation indicates that the price of U.S. rice is an important factor in explaining annual variations in its own rice export demand. The estimated own-price elasticity is – 1.028. Unlike domestic demand, it is common to find elastic own price elasticities for export demand (e.g., Kaiser, Liu, and Consignado found elastic price elasticities for export raisin demand).

The prices of rice exports from other countries, which compete with the United States, are also found to be important factors in the equation. The cross-price elasticity of U.S. rice export demand with respect to Thai and Vietnamese rice export prices are estimated at 0.637 and 0.461, respectively. These results suggest that while both countries are major competitors of the United States, Thailand is slightly more important in terms of impacting export demand for U.S. rice.

The summation of deflated GDP of the major U.S. rice importers is an important determinant of the export demand for U.S. rice. The coefficient associated GDP in countries, which are top U.S. rice importers, is 1.047, indicating the U.S., rice is a normal good.

Finally, the coefficient associated with the rice export promotion variable is positive and statistically different from zero. The statistical evidence supports the notion that U.S rice export promotion programs, which are a public-private contribution, have the effect of increasing the export demand for its rice. The estimated export promotion elasticity is 0.143.

3.5 Simulation Analysis

Based on the econometric results, it is clear that rice promotion expenditures have a positive and statistically significant impact on U.S. rice exports to the world market. Next, the estimated equation is simulated to address the remaining objectives of this study. Two scenarios are of interest: (1) a baseline scenario with U.S. rice export promotion expenditures at historical levels – export promotion programs are in effect; and (2) a counterfactual scenario with no U.S. rice export promotion. In the first scenario, all rice export demand determinants are set equal to their historic levels. The second scenario is identical to the first, except U.S. rice export promotion expenditures are set to a small amount.[9] The difference between the two scenarios gives the total impact of the U.S. rice export promotion programs on the U.S. rice exports to all trading partners.

Figure 3.1 illustrates the simulation result for U.S. rice exports. From 1984-2005, FMD and MAP expenditures increased U.S. rice exports by 24,269,361.55 metric tons in total, or an average of 1,103,152.798 metric tons per year. Hence, U.S. rice export promotion has had a very large impact on total U.S. rice exports.

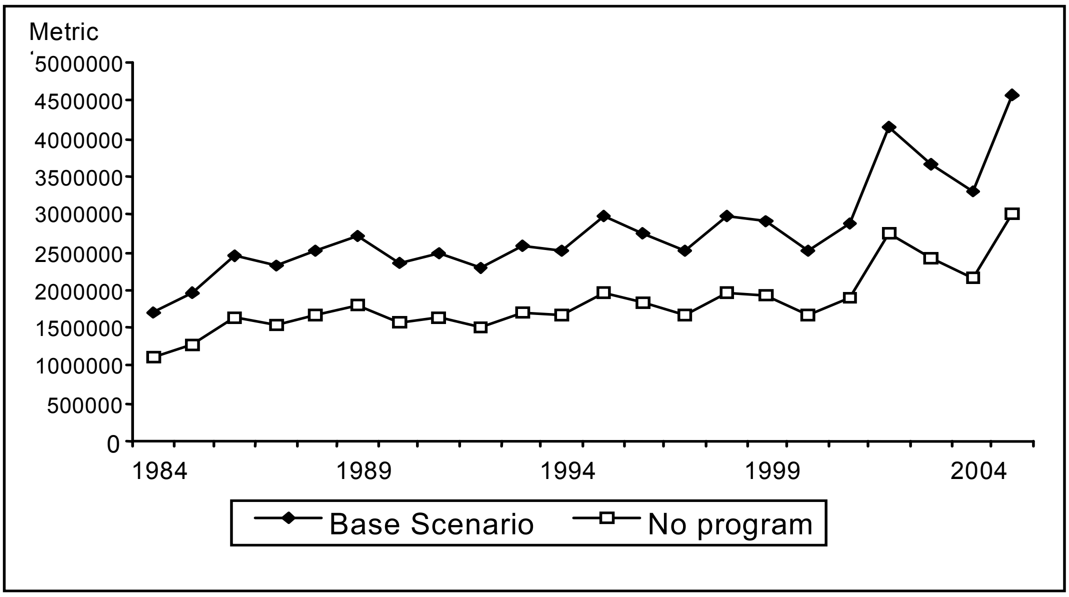

Figure 3.1: Simulated U.S. Rice Exports with and without Export Promotion.

[9] Due to the logarithmic functional form, export promotion expenditures are set proportionally to 2 percent of historic level of export promotion expenditure in this scenario, assuming no export promotion programs because log of zero is undefined.

3.5.1 Average Benefit-Cost Ratio

While these results indicate a positive impact of export promotion on U.S. rice exports, what remains a key concern is the impact promotion has on industry producer surplus compared with promotion costs. The increase in export demand due to export promotion described above assumes that all other demand determinants, including price, would remain constant. However, as argued earlier, generally an increase in demand will cause price to increase as well, provided that the demand increase is not perfectly offset by an increase in quantity supplied (as in the infinite supply response case). Hence, in order to evaluate the full effect of U.S. rice export promotion programs on quantity and price, one needs to incorporate an excess supply response for U.S. rice into the model.

An approach similar to that by Alston et al. (1996) is followed. In this approach, the excess supply response is incorporated using a constant elasticity form, and sensitivity analysis is conducted on a range of assumed own-price supply elasticities. The simulation procedure begins on the export demand side, where predicted quantities of rice export demand (Q_t^D) are simulated from the estimated export demand equation. Then, using the procedure discussed by Alston et al. (1996), excess supply is defined in constant elasticity form and equated with the predicted export demand quantities. Changes in export demand due to U.S. rice export promotion then affect the level of production and price. Specifically, the excess supply function is defined as:

(3.5) $Q_t^{ES} = A_t P_t^{\epsilon}$,

where $A_t = Q_t^D / P_t^{\epsilon}$ and ϵ is the price elasticity of excess supply. P_t is the U.S. export rice price in year t. A_t is varied from year to year to ensure that, given the actual values of prices and the other export demand determinants each year, the excess supply equation passes through the point defined by the predicted quantity from the export demand model and actual U.S. rice price. The change in net benefits due to export promotion programs is computed for each year from 1984 to 2005 as the difference in producer surplus (ΔPS) between the two scenarios, which mathematically is equal to

(3.6) $\Delta PS_t = (P_t Q_t - P_t' Q_t') / (1+ \epsilon)$,

where $P_t Q_t$ represents the scenario with export promotion programs and $P_t' Q_t'$ represents the scenario without export promotion programs.

By equating the equations for excess supply and export demand and solving for world market equilibrium, U.S. actual prices and predicted quantities (from the export demand model) are obtained given the historical values for the explanatory variables. The counterfactual scenario is then simulated assuming no export promotion expenditures by setting its value close to zero. Excess supply elasticities are chosen between 1 and 10 to examine a broad range of benefit-cost ratios.

Table 3.1 presents the average annual impacts and BCRs (from 1984 to 2005) for U.S. rice export promotion efforts for the various assumed own-price elasticities of excess supply. U.S. rice export promotion has had a positive impact on the U.S rice export price over this period under all supply response scenarios. The average increase in price ranges from $84.21, in the case of the most inelastic supply response (ε= 1.0), to $17.28 per ton, in the case of the most elastic supply response (ε= 10.0). The reason the positive price impacts become lower as the assumed supply response gets larger is that under the larger supply response scenarios, producers are dampening the positive price impacts of the increased export demand by increasing quantity supplied to the world market relative to the lower supply response scenarios. The average impact over all supply responses is $36.33 per ton. In other words, had there not been U.S. rice export promotion, the average rice export price would have been $36.33 per ton lower from 1984 to 2005 than it actually was.

U.S. rice export promotion has had a positive impact on producer surplus over this period as well. The average increase in producer surplus due to export promotion range from $204.37 million per year, in the case of the least elastic supply response (ε= 1.0), to $37.5 million per year, in the case of the most elastic supply response (ε= 10). The reason for the negative relationship between supply elasticities and producer surplus is identical to that described above for supply elasticities and price. The average increase in producer surplus over all supply responses is $83.25 million per year. Hence, it is clear that U.S. export promotion has had a significant and positive impact on industry profits since 1984.

How does the gain in producer surplus compare with the costs of export promotion? To answer the question, an average benefit-cost ratio is computed (see the bottom row of Table 3.1). The average BCR exceeds 1.0 for every supply response considered in the simulation. For the least elastic supply response (ε= 1.0), the average BCR is 30.05. This implies that, on average over the period 1984-2005, the benefits of the promotion programs have been over 30.05 times greater than the costs. At the opposite end of the spectrum in supply response ($\varepsilon = 10$), the average BCR is computed to be 5.51, implying that the benefits of the USHBC are 5.51 times greater than the costs. Given the wide range of supply responses considered in this analysis, and the fact that the BCR is above 1.0 in all cases, there is significance evidence that U.S. rice export promotion has been profitable for the U.S. rice industry. The average BCR over all supply responses is 12.20, i.e., the benefits of U.S. rice export promotion exceed the costs by 12.2.

Questions often arise about the accuracy of these BCR estimates in economic evaluations of commodity checkoff programs. BCRs are generally large because promotion expenditures are very small relative product value, and therefore only a small demand effect is needed to generate positive and large returns. For example, average U.S. rice export promotion expenditures in 2005 were less than 0.013 percent of the farmer value of rice marketing. Still, this relatively small investment in U.S. rice export promotion increased producer surplus by over $83.25 million per year since 1984 (average of all excess supply elasticities). The resulting benefit-cost ratio is therefore quite large.

Table 3.1: Average annual world market impacts and benefit-cost ratios due to U.S. rice export promotion, 1984-2005

	Own-Price Elasticity of Excess Supply									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Change in Producer Price ($/ton)	84.2	58.9	45.3	36.7	30.9	26.7	23.5	20.9	18.9	17.3
Change in Producer Surplus(million $)	204.4	136.7	102.7	82.3	68.6	58.8	54.5	45.8	41.2	37.5
Change in Promotion Cost (million $)	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87
Benefit-Cost Ratio	30.05	20.11	15.11	12.1	10.1	8.65	7.57	6.73	6.06	5.51

To make allowances for the error inherent in any statistical estimation, a 95 percent confidence interval is calculated for the above average BCRs. Table 3.2 presents the lower bound on the BCR for the 95 percent confidence interval. The estimated lower bound of the average BCR for the lowest assumed supply response for the period 1984-2005 is 15.09. This result demonstrates that one could be confident 95 percent of the time that the true average BCR for this assumed supply response is not lower than 15.09.The lower 95 percent confidence bound for the average BCR in the highest assumed supply response for this period is 2.79. Hence, it is reasonable to conclude that the above confidence lower bound gives credence to the previous finding that the benefits of the promotion programs have been considerably greater than their cost.

Table 3.2: Lower-bound 95 percent confidence interval for benefit-cost ratios due to U.S. rice export promotion, 1984-2005

	Own-Price Elasticity of Excess Supply									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Benefit-Cost Ratio – Lower Bound	15.09	10.04	7.52	6.01	5.00	4.29	3.75	3.34	3.00	2.79

3.5.2 Marginal Benefit-Cost Ratio

In order to explore the "optimality" of the rice export promotion expenditure levels, marginal simulation analysis is also conducted. The estimated demand equation is used to simulate the outcome of an additional scenario and the results are compared with the baseline scenario. In the third scenario, export promotion expenditures are increased by 1 percent above baseline scenario levels, while all other exogenous variables are the same as before.

Table 3.3: Marginal benefit-cost ratios [a] due to rice export promotion, 1984-2005

	Own-Price Elasticity of Excess Supply									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Change[b] in Producer Price ($/ton)	0.67	0.45	0.34	0.27	0.12	0.10	0.09	0.08	0.07	0.06
Change[b] in Producer Surplus(million $)	0.67	0.45	0.34	0.27	0.23	0.19	0.17	0.15	0.34	0.12
Change[b] in Promotion Cost (million $)	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Marginal[b] Benefit-Cost Ratio	9.61	6.44	4.84	3.88	3.23	2.77	2.43	2.16	1.94	1.76

[a] The marginal impact of a 1 percent increase in export promotion expenditures on U.S. rice exports.
[b] The change in producer prices, producer surplus, promotion costs and marginal benefit-cost ratio in a particular own-price elasticity of excess supply is an average from 1984 to 2005.

The estimated marginal BCRs are presented in Table 3.3. The marginal BCRs are well above 1.0 for every assumed own price elasticity of supply. For example, for the least elastic supply response (ε = 1.0), the marginal BCR is 9.61 indicating that an incremental $1.00 increase in promotion would yield $9.61 in producer surplus to the rice industry. For the most elastic supply response (ε= 10.0), the marginal BCR is 1.76, which is still well above 1.0. These high marginal BCRs imply that the rice industry should explore the option of raising more money for export promotion since doing so would return benefits that are substantially greater than costs. These high marginal BCRs are also very common among agricultural checkoff programs, which indicate that these collective action programs are under-funded from an economic optimality point of view (see Table 3.4 for marginal BCRs for other commodities).

3.6 Conclusions

The objectives of the study were to measure the responsiveness of U.S. rice export demand with respect to U.S. rice export promotion, evaluate the overall effectiveness of the promotion programs, and investigate the optimality of export promotion expenditure levels.

An econometric export demand equation in double logarithmic function was estimated to measure the export promotion elasticity, while controlling for other demand determinants such as own price, price of competing countries, income, and exchange rates. The results support the hypothesis that the export promotion programs have had a positive impact on the U.S. rice export demand. The export promotion elasticity was computed to be 0.143, which was statistically significantly different from zero.

Table 3.4: Key results from economic impact studies on U.S. export promotion.

	California raisins	US orange juice	US orange juice	US fresh grapefruit	US apples	US apples	CA table grapes	US frozen potatoes
Study	Kaiser, Liu, and Consignado (2005)	Lee and Brown (1986)	Armah and Epperson (1997)	Fuller, Bello, and Capps (1992)	Rosson, Hammig, and Jones (1986)	Richards and Patterson (1997)	Alston et al. (1997)	Lanclos, Devodoss, and Guenthner (1997)
Activities evaluated	Industry and FAS programs	Three Party program	Industry and FAS programs	FAS Three Party and TEA programs	Industry and FAS programs	Industry and FAS programs	Industry and FAS programs	Industry and FAS programs
US export promotion in:	Japan and UK	13 European countries	France, UK, Germany, Japan Netherlands	Japan, Canada, France, and Netherlands	All countries US has programs in	Singapore and UK	Asian countries	Japan, Mexico, Philippines, Thailand
Period of estimation	1965-98	1973-82 (panel data)	1984-92 (panel data)	1969-88 quarterly	1972-81	1962-93	1976-94	1978-93
Type of model	Import demand, single equations	Import demand, single equations	Export demand, single equation	Import demand, single equations	Export demand single equations	Import demand, LES/AIDS demand systems	Single equation, export demand	Import demand, single equations
Estimated promotion elasticities	Japan=0.029* UK=0.133*	Promotion elastitcities not given	France=0.014 Germany=0.044* Japan=0.014 Netherlands=0.302* UK=0.014*	Japan=0.109* Netherlands=0.153* France=0.234*	Apples=0.51*	Singapore=0.055* UK=0.016*	0.21*	Third Party: Japan=0.03* Philippines=0.53* Thailand=0.87*
Estimated benefit-cost ratio	Japan: AGBCR=5.13 MGBCR=0.42 UK: AGBCR=15.29 MGBCR=3.19	For all countries, MGBCR=5.51	MGBCRs: France=7.44 Germany=37.10 Japan=5.61 Netherlands=51.92 UK=7.64	MGBCR:Japan=5.02 Netherlands=6.65 France=4.13 Canada=no promotions	MGBCR=60.0	NA	ABCR: 4.1-9.4 MBCR: 4.1-4.2	Third Party MGBCRs: Japan=1.29 Philippines=11.77 Thailand=16.36
Assumed no promotion price impact	Yes	Yes	Yes	Yes	Yes	NA	No	Yes
Peer reviewed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 3.4 (continued)

	US pecans	US walnuts	US almonds	US cotton	US red meat	US red meat	US soybeans	All US food exports
Study	Onunkwo and Epperson (2000)	Weiss, Green, and Havenner (1996)	Halliburton and Henneberry (1995)	Solomon and Kinnucan (1993)	Le, Kaiser, and Tomek (1998)	Comeau, Mittelhammer, and Wahl (1997)	Williams et al. (1998)	Dwyer (1995)
Activities evaluated	Industry and FAS programs	Industry and FAS programs	FAS FMD and MPP programs	FAS programs	FAS FMD and TEA programs	FAS MPP and TEA programs	Industry and FAS programs	FAS programs
US export promotion in:	Asia and EU	Japan	Japan, Taiwan, Hong Kong, Singapore, South Korea	6 countries in the Pacific Rim	S. Korea, Taiwan, Hong Kong, Singapore	Japan	EU, Japan, and Rest of the World	World
Period of estimation	1986-96 (panel data)	1986-96 (monthly data)	1986-92 (panel data)	1965-85	1984-94 (panel data)	1973-94	1969-96	1975-92
Type of model	Export demand, single equation	Event analysis	Import demand, single equations	Armington trade model	Import demand, single equations	Inverse Almost Ideal Demand System	SOYMOD world market model	Armington trade model
Estimated promotion elasticities	Asia=0.98* EU=0.06*	$1000 in promotion increased exports by 4.5 tons	3 models range from -0.2788 to 0.85	Japan=0.53* S. Korea=0.045* Hong Kong=0.21* Philippines=0.26* Thailand=0.045 Taiwan=-0.54	Korea=0.598* HK=-0.019 Taiwan=0.047 Singapore=0.034	Japan price flexibilities wrt promotion ranged from 0.11* to 0.128*	Soybeans: EU=0.0234* Japan=0.0367* ROW=0.068* Soymeal: EU=0.0445* Japan=0.0733* ROW=0.0516* Soyoil: EU=0.0446* Japan=0.0323* ROW=0.0156*	Short-run=0.0135* Long-run=0.15*
Estimated benefit-cost ratio	Asia: MGBCR= 6.45 EU: MGBCR= 6.75	MGBCR=5.85	MGBCRs: Japan=4.95 Taiwan=5.94 HongKong=3.69	NA	MGBCR= 15.62 to 47.32 for all 4 countries	MGBCR for beef ranged from 15.56 to 18.11	ABCR: 13.5 (1978-89) 5.3 (1990-94) 11.3 (1978-94)	AGBCR=16.0
Assumed no promotion price impact	Yes	Yes	Yes	NA	Yes	Yes	No	Yes
Peer reviewed	Yes	No	Yes	Yes	Yes	Yes	Yes	No

Furthermore, simulation procedures were employed to estimate the magnitude of the impact of export promotion programs on total rice exports. The simulation indicated that U.S. rice export promotion programs increased U.S. rice export quantities by an average of 1,103,152.798 metric tons per year. Thus, we can conclude that U.S. rice export promotion programs have been effective in enhancing foreign market demand for U.S. rice.

Average benefit-cost ratios were also computed for U.S. rice export promotion based on a range of excess supply own price elasticities (from 1 to 10). The BCRs ranged from 30.05 for the most inelastic estimate, to 5.51 for the most elastic. Since all of these values were well above 1.0, the main policy conclusion was that the benefits of export promotion programs in terms of enhancing producer welfare have been much greater than the costs of the programs.

Finally, marginal simulation analysis was conducted to explore the optimality of rice export promotion. The marginal BCRs over the period of study were estimated between 9.61 and 1.76 given the own-price elasticity of excess supply between 1 and 10. Thus, all results indicate that the U.S. is under-investing in rice export promotion from an optimality standpoint.

REFERENCES

Alston, J.M. and Carman, H.F. and Chalfant, J.A. and Crespi, J.M. and Sexton, R.J. **Evaluation of Prune Promotion by the California Dried Plum Board**. In: Kaiser, H.M., Alston, J.M., Crespi, J.M. and Sexton, R.J. (eds). *The Economics of Commodity Promotion Programs: Lessons from California*. Peter Lang, New York (2005). Chapter 6. pp. 109-136.

Alston, J.M. and Chalfant, J.A. and Christian, J.E. and Meng, E. and Piggott, N.E. (1997). **The California Table Grape commission's Promotion Program: An Evaluation.** *Berkeley CA: University of California Division of Agriculture and Natural Resources*, Giannini Foundation Monograph 43, November.

Alston, J.M. and Crespi, J.M. and Kaiser, H.M. and Sexton, R.J. **Introduction to the Economics of Commodity Promotion Programs**. In: Kaiser, H.M., Alston, J.M., Crespi, J.M. and Sexton, R.J.(eds). *The Economics of Commodity Promotion Programs: Lessons from California*. Peter Lang, New York (2005). Chapter 1. pp. 3-12.

Armah, B. and Epperson, J. (1997). **Export Demand for U.S. Orange Juice: Impacts of U.S. Export Promotion Programs**. *Agribusiness*(13). pp. 1-10.

Childs, N.W. and Burdett, A. (2000). **The U.S. Rice Export Market**. Rice Situation and Outlook/RCS - 2000/November 2000. pp. 48-54.

Crespi, J.M. and Sexton. R.J. **Evaluating the Effectiveness of California Almond Promotion: How Much Did the Litigation Cost Producers?**. In: Kaiser, H.M., Alston, J.M., Crespi, J.M. and Sexton, R.J.(eds). *The Economics of Commodity Promotion Programs: Lessons from California*. Peter Lang, New York (2005). Chapter 8. pp. 167-190.

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

Jakus, P.M. and Jensen, K.L. and Davis, G.C. (2003). **Revenue Impacts of MPP Branded Funds: A Firm-Level Analysis**. *Agricultural and Resource Economics Review* (32). pp. 184-197

Kaiser, H.M. and Liu, D.J. and Consignado, T. (2003). **An Economic Analysis of California Raisin Export Promotion**. *Agribusiness19*(2). pp. 189-201.

Kaiser, H.M. **An Economic Analysis of Domestic Impacts of the Walnut Marketing Board's Marketing Programs**. In: Kaiser, H.M., Alston, J.M., Crespi, J.M. and Sexton, R.J.(eds). *The Economics of Commodity Promotion Programs: Lessons from California*. Peter Lang, New York (2005). pp 191-208.

Kinnucan, H.W. and Zheng, Y. (2005). **National Benefit-Cost Estimates for the Dairy, Beef, Pork, and Cotton Promotion Programs**. In: Kaiser, H.M., Alston, J.M., Crespi, J.M. and Sexton, R.J.(eds). *The Economics of Commodity Promotion Programs: Lessons from California*. Peter Lang, New York (2005). Chapter 12. pp. 255-284.

Kinnucan, H.W. and Myrland, ϕystein (2001). **A Note on Measuring Returns to Nonpirce Export Pormotion**. *Agribusiness: An Internaional Journals*(17). pp. 423-433.

Lanclos, D. and Devadoss S. and Guenthner, J. (1997). **Impacts of Foreign Direct Investment and Advertising on the Export Demand for U.S. Frozen Potatoes**. *Agribusiness*(13). pp. 273-284

Le, C.T. and Kaiser, H.M. and Tomek, W.G. (1998). **Export Promotion and Import Demand for U.S. Red Meat In Selected Pacific Rim Countries**. *Agribusiness*14(2). pp. 95-105.

Onunkwo, I.M. and Epperson, J.E. (2000). **Export Demand for U.S. Pecans: Impacts of U.S. Export Promotion Programs**. *Agribusiness: An International Journal*(16). pp. 253-266.

Richards, T.J. and Patterson, P.M. (1998). **Dynamic Complementarity in Export Promotion : The Market Access Program in Fruits and Vegetable** . *Journal of Agricultureal and Resource Economics*(23).pp. 319-337.

Rosson, C. and Hammig, M. and Jones, J. (1986). **Foreign Market Promotion Programs: An Analysis of Promotion Response for Apples, Poultry, and Tobacco**. *Agribusiness*(2), pp. 33-42.

Schmit, T. and Kaiser, H.M. (1998). **Egg Advertising, Dietary Cholesterol Concerns, and U.S. Consummer Demand**. *Agricultural and Resource Economics Review*(27). pp. 43-52.

Solomon, H. and Kinnucan, H.W. (1993). **Effects of Non-price Export Promotion: Some Evidence for Cotton**. *Australian Journal of Agricultural Economics* (37). pp.1-15.

U.S. Department of Agriculture, Economics and Statistics Service. **Rice Situation and Outlook**. Washington DC, 1960-2005.

Wang, Yiqian (2005). **An Examination of U.S. Rice Export Promotion Programs**. *Master Thesis of The Department of Agricultural Economics and Agribusiness.* Louisiana State University and Agricultural and Mechanical College.

Weiss, K.R. and Green, R.D. and Havenner, A.M. (May, 1996). **Walnuts in Japan: A Case Study of Generic Promotion Under the USDA's Market Promotion Program**. *In Agricultural Commodity Promotion Policies and Programs in the Global Agri-Food System.* Proceedings of NEC-63 Conference. Ithaca, New York. NICPRE, Cornell University. pp. 47-80.

Williams, G.W. and Shumway, C.R. and Love, H.A. and Ward, J.B. (May,1998). **Effectiveness of the Soybean Checkoff Program**. *Texas Agricultural Market*

Research Center Report. Department of Agricultural Economics. Texas A & M University.

CHAPTER 4

THE HALO EFFECTS OF U.S. GRAIN EXPORT PROMOTION

4.1 Introduction

The U.S. government funds export promotion programs for agricultural and food commodities through partnerships with nonprofit commodity trade associations. The two most prominent government programs operated by USDA's Foreign Agricultural Service are the Market Access Program (MAP) in 1985 and the Foreign Market Development Program (FMD) in 1955. In the 2002 Farm Bill, these two programs experienced a large increase in their annual budgets of $250 million. Currently, annual funding for MAP and FMD exceed $500 million. Because of the large amount of money invested, these programs have been studied extensively in terms of their economic impacts (see Alston et al. for a thorough review). Almost all previous studies have focused on the direct effects of export promotion for a specific commodity on that commodity's exports, with the majority finding that promotion has a statistically significant impact on exports.

However, these programs remain highly controversial with opponents claiming they amount to "corporate welfare". Proponents contend that export promotion programs enable U.S. exporters to be competitive in the global market and level the playing field with other countries who also have government funded export promotion. From an economic point of view, government's role in funding export promotion can be rationalized only if market failure exists. One type of market failure is positive externalities produced by export promotion of one commodity in terms of increases in export demand for other U.S. commodities. For example, a trade shows with the objective of promoting rice may also promote other food grain or feed grain exports or, perhaps, other entirely different commodities. Since these indirect or "halo effects" are not considered by the private firm doing the promoting, the level of export promotion is likely lower than optimal from a social point of view (Dwyer).

Unfortunately, there have been few studies that have empirically examined whether a halo effect actually exists. To our knowledge, there are only two studies that have explored this issue, and both focused only on four horticultural commodities: apples, almonds, wine, and grapes. Richards and Patterson (1998) used a dynamic dual model of U.S. export supply for these four commodities, which included FAS promotion expenditures (TEA and MAP funds) as explanatory variables. Estimation was based on time series data from 1984-95 pooled with country-level data for Mexico, Sweden, Norway, Finland, the United Kingdom, France, Germany, Malaysia, Singapore, the Philippines, and Japan. The authors estimated both direct and cross effects of U.S. export promotion for all four commodities, and all estimated elasticities were statistically significant. The authors found that cross effects were important, and in some cases were as large as direct effects.[10] In terms of the cross effects, the elasticities were also all statistically significant, and the majority of them were positive indicating a halo effect among the four commodities.

Global Insight updated the Richards and Patterson study using data from 1985-2004 with a demand system for the same four commodities. This study found eight of the cross-promotion elasticities to be positive and statistically significant (compared with four negative cross promotion elasticities). This is consistent with Richards and Patterson's findings regarding the cross promotion effects of U.S. promotion. Similar to Richards and Patterson, the magnitude of the cross effects were generally larger

[10] Richard, Ispelen, and Kagan (R-I-K) (1997) indicated that promotion is more effective the less elastic is demand. The empirical results of the study also show that the effects of export promotion by one country have larger spillover effects the more inelastic is demand for a rival's product. In other words, the free-rider effect of export promotion will be greatest when other countries are able to successfully differentiate their product. If the product is inherently difficult to brand, the benefit from promotion will flow to those who are most able to achieve some measure of differentiation.

than the own effects. However, unlike Richards and Patterson, the cross promotion elasticities were smaller and more plausible in magnitude, ranging in value from 0.099 to 0.883.

In somewhat related research, Richards, Ispelen and Kagan (1997) examined whether foreign market promotion constitutes a type of "international public good". Export promotion is considered an international public good when it has positive cross effects that dominate country-specific effects, i.e., halo effect on other countries. In other words, when promotion impacts total exports to a country, but not a specific country's share, then promotion has public good aspects and thus individual countries have no incentive to promote. Very little research has been conducted on these cross effects of promotion in an integrated framework. Failing to take these cross effects into account tends to generate results that overstate returns from promotion and only partially measure the full promotion impact (Kinnucan and Zheng 2005).

The majority of economic evaluation studies on U.S. export promotion have relied on the single equation approach, which specifies a single demand equation for a specific commodity as a function of export promotion and other demand factors. Cross effects are more properly evaluated using a demand system approach rather than with single-equation demand models. For instance, a single demand equation for U.S. rice exports cannot measure the impacts of U.S. rice export promotion on other related grains and competing rice from other countries. The few studies that have examined these cross effects have used multi-equation systems as an integrated framework such as the Rotterdam model, i.e., Xiao, Kinnucan and Kaiser (1999) and the Almost Ideal Demand Systems (LA/AIDS), i.e., Richard, Ispelen, and Kagan (1997).

The objective of the research reported in this article is to examine both the own and cross effects of U.S. export promotion for U.S. and non-U.S. grains. We focus on two previously neglected dimensions of the cross-effects. First, we examine whether a halo effect for U.S. commodities exists. Second, we look at whether U.S. grain export promotion has public goods characteristics, i.e., does U.S. grain promotion have a halo effect on grain demand for other countries? We use a linear approximation of an Almost Ideal Demand System (LA/AIDS) model for U.S. and non-U.S. rice, wheat, and sorghum that include U.S. export promotion as one of the explanatory variables. Our goal is to provide further empirical evidence for the halo effect issue by using U.S. grains as a case study since this sector has not been previously explored. In addition to estimating own and cross export promotion elasticities, the magnitude of cross effects on U.S. market share for grain commodities are simulated for several policy scenarios involving alternative export promotion levels.

4.2 The Linear Approximation/Almost Ideal Demand System Model (LA/AIDS)

The Rotterdam model, a major rival of the almost ideal demand system (AIDS), is less preferred in the present context because it explains the level of demand as opposed to market share. Given the FAS programs are intended to enhance the U.S.'s competitive position in the global market place, having market share rather than quantity as the dependent variable has certain advantages in exposition

In this study, we focus on U.S. grain export demand to the international market rather than to specific countries. We select the major grain exporting country combination instead of the aggregation of the rest of the world to be representative of non-U.S. grain exporting competitors. Thus, U.S. grain market share in this study is not as small of a proportion relative to non-U.S. grain market shares compared to using all U.S. competitors.

The almost ideal demand system (AIDS) introduced by Deaton and Muellbauer (1980) has become a popular method for modeling demand systems. The

AIDS model is consistent with homogeneity, adding-up, and symmetry restrictions from consumer demand theory. Theoretically, the AIDS specification is derived explicitly from a consumer cost minimization problem. It provides an arbitrary first order approximation to any demand system and satisfies the axioms of choice (Deaton and Muellbauer (1980)).

A popular alternative to this model is the linear approximation AIDS (LA/AIDS). While some authors have pointed out some undesirable properties of LA/AIDS such as biased parameter estimates of the Stone price index (e.g., Green and Alston), Hanh concludes that LA/AIDS is a reasonable approximation for a demand system. Its popularity is due to the simplicity of its estimation, and feasibility of testing restrictions on homogeneity and symmetry (Hayes, Wahl, and Williams). Satyanarayana, Wilson and Demcey argue that even though LA/AIDS model results in biased parameter estimates for the Stone price index, the bias is less severe for demand systems using aggregate data compared with micro-level data. This study uses aggregate data. The following presents an overview of the dynamic LA/AIDS model used in this study.

The demand system consists of three major grain commodities: rice, wheat, and sorghum, and two regions: U.S. and non-U.S. The i^{th} equation in a dynamic AIDS model can be specified as

(4.1) $$w_{it} = \mu_i + \sum_{j=1}^{6} \gamma_{ij} \ln p_{jt} + \beta_i \ln(M_t / P) + \psi_i w_{it-1} + \varepsilon_{it},$$

where $M_t = \sum_{i=1}^{6} p_{it} q_{it}$ is the nominal total expenditure on the group of goods being analyzed which includes U.S. and non-U.S. rice, wheat, and sorghum exports in year *t*. M_t is assumed an exogenous variable because in the first stage, consumers first decide how much to spend on agricultural imports such as horticultures, and grains. In the second stage, fixed expenditure on grains (M_t) was allocated across supply sources and products including U.S. and non-U.S. rice, wheat and sorghum. The interpretation of the estimated export demand elasticities for grains is "conditional" (on the total U.S. and non-U.S. grain expenditures). Therefore, the grain system we estimated is conditional on U.S. expenditures on grains as a group with the implicit assumption that grains are a weakly separable group[11]. P is the price index for the group; p_{jt} is the price of the j^{th} good within the group in year t; w_{it} is the conditional budget share of total expenditure allocated to the i^{th} good in year t ($w_{it} = p_{it}\, q_{it} / M_t$). Note that the model is dynamic since it includes a lagged dependent variable for market share, and thus both short- and long-run elasticities can be derived. The price index in the AIDS model is defined as

(4.2) $$\ln P = \alpha_0 + \sum_{j=1}^{6} \alpha_j \ln p_j + 1/2 \sum_{j=1}^{6} \sum_{i=1}^{6} \gamma_{ij} \ln p_i \ln p_j$$

Using the price index in equation (4.2) often raises empirical difficulties, especially when aggregate annual time –series data are used, and it is common to use Stone's (geometric) price index (P^s) instead of P, Green and Alston (1990).

(4.3) $$\ln P^s = \sum_{i=1}^{6} w_{it} \ln p_{it}$$

The LA/AIDS model uses Stone's price index; Blanciforti and Green (1983a). Green and Alston (1990) suggest that if prices are highly collinear, P may be approximately proportional to P^s, i.e., $P \cong \zeta P^s$. If P is exactly (linearly) proportional to

[11] Weak separability is the necessary and sufficient conditions for the second stage of two-stage budgeting (Deaton and Muellbauer (1980), pp. 122-124)

P^s, the LA/AIDS model can be used to estimate the parameters of the AIDS model and can be written as

$$(4.4) \qquad w_{it} = \alpha_i + \sum_{j=1}^{6} \gamma_{ij} \ln p_{jt} + \beta_i [\ln M_t - \ln P^s] + \psi_i w_{it-1} + \varepsilon_{it},$$

where α_i = (μ_i - β_i lnζ). The LA/AIDS model is a semi-log functional form. The expenditure variable in the model is deflated by world price index (WPI), but all the prices are in nominal form. Export promotions of rice, wheat, and sorghum, and other demand shifters i.e. trend can be incorporated by modifying the intercept as

$$(4.5) \qquad \alpha_i = \alpha_i' + \theta_i RPROM_t + \delta_i WPROM_t + \phi_i GPROM_t + \tau_i T_t,$$

where α'_i = (μ_i - $\beta_i$lnζ) ; $RPROM_t, WPROM_t$ *and* $GPROM_t$ are annual rice, wheat and grain export promotion expenditures in year *t*, respectively. The export promotion expenditures were deflated by world price index and multiplied by special drawing rights (SDR) to reflect the impact of changes in exchange rates on the purchasing power of U.S. promotion; T_t is a trend term to capture steady movements of unmodelled variables.

We posited the following LA/AIDS model to fit the time-series data by substituting equation 4.3 and 4.5 into equation 4.4. Thus it generates the following LA/AIDS model:

$$(4.6) \qquad w_{it} = \alpha_i + \sum_{j=1}^{6} \gamma_{ij} \ln p_{jt} + \beta_i [\ln M_t - \sum_{i=1}^{6} w_{it} \ln p_{it}] + \theta_i RPROM_t + \delta_i WPROM_t$$
$$+ \phi_i GPROM_t + \tau_i T_t + \psi_i w_{it-1} + \varepsilon_{it},$$

for i = 1, 2, 3, 4, 5, and 6, which correspond to the three U.S. and three non-U.S. commodities and w_{it-1} is a lagged i^{th} market share to calculate the long-run impact.

Adding up, homogeneity, and Slutsky symmetry can be imposed on this system as follows:

(4.7) $$\sum_{i=1}^{6}\alpha_i = 1;\ \sum_{i=1}^{6}\gamma_{ij} = 0;\ and\ \sum_{i=1}^{6}\beta_i = 0;$$

(4.8) $$\sum_{j=1}^{6}\gamma_{ij} = 0, \qquad \text{for } i = 1,2,\ldots,n;$$

(4.9) $$\gamma_{ij} = \gamma_{ji} \quad \text{for all } i \neq j$$

Demand theory employs three sets of restriction on consumer demand: adding up in equation 4.7, homogeneity (of degree zero in prices and expenditure) in equation 4.8, and Slutsky symmetry in equation 4.9. These three conditions are imposed in the empirical model estimated here.

4.3 Data

The models were estimated using annual time-series data from 1975 to 2005 (see Table 4.1 for average values for some of this data). The price and export value data were obtained from the Food and Agriculture Organization (FAO). The U.S. has exported many grain varieties; however, wheat and sorghum are two of the largest in terms U.S. export grain markets. Barley, for example, is comparatively smaller in terms of U.S. market share accounting for only 2% of world barley exports in 2005. Corn markets are by far too big to include in the system since the United States is the largest corn exporter in the world and most of it is used as animal feed or industrial use rather than human consumption as rice, wheat and sorghum is.

For non-U.S. rice, wheat, and sorghum, we chose the top exporters in term of export values to be representative of U.S. competitors. For milled rice, the sum of Thailand, Vietnam, China, Pakistan, and India export values were used, which accounts for 74% of the rest of the world export values. For non-U.S. wheat market share, the EU, Canada and Australia are aggregated, which accounts for 74% of the rest of the world export values. Australia and Argentina account for 67 % of the world export values for sorghum, and these two countries were combined to represent non-U.S. sorghum exports.

Table 4.1: An average export volumes and values of major exporters, rest of the world and world, 1975-2005.

	Rice		Wheat		Sorghum	
	Volume (ton)	Value ($1,000)	Volume (ton)	Value ($1,000)	Volume (ton)	Value ($1,000)
U.S.A	1,794,207.81	658,346.85	32,587,388.73	4,790,756.82	6,054,612.67	688,211.65
Thailand	4,369,689.77	1,225,870.17	-	-	-	-
Vietnam	1,518,895.13	339,627.87	-	-	-	-
China	1,320,463.27	293,139.77	-	-	-	-
Pakistan	1,346,693.68	412,179.46	-	-	-	-
India	1,440,506.39	505,153.61	-	-	-	-
EU	-	-	27,629,325.28	4,220,559.05	-	-
Canada	-	-	17,291,997.99	2,747,669.80	-	-
Australia	-	-	12,511,210.33	1,857,572.52	446,684.06	52,221.78
Argentina	-	-	-	-	1,894,664.33	181,316.84
Non-U.S. [1]	9,996,248.24	2,775,970.88	57,432,533.59	8,825,801.37	2,341,348.38	233,538.63
ROW [2]	12,655,889.45	3,772,673.43	77,704,976.91	11,950,754.89	3,155,308.38	350,530.76
World	14,450,097.26	4,431,020.27	110,292,365.64	16,741,511.71	9,209,921.05	1,038,742.4
% * [1/2]	0.79	0.74	0.74	0.74	0.74	0.67

* the percentage of Non-U.S. exporting to the world exporting
[1] the summation of the combination of Non-U.S. exporters.
Source : FAO Statistics

Annual export promotion expenditures for rice, wheat and sorghum including both government and private contributions were obtained from FAS. U.S. Wheat Associates, a private sector firm, have contributed funds to FMD since 1975 and MAP since 1986 to expand U.S. wheat export markets. U.S.A. Rice Federation/U.S. Rice Producers and U.S. Grains Council joined the programs and started contributing funds to FMD in 1984 and MAP in 1986. U.S. Grains Council mainly develops export markets for U.S. barley, corn, and sorghum. We use these expenditures as a proxy for U.S. sorghum export promotion even though it also includes expenditures for corn and barley (hereafter, we refer to this as sorghum export promotion). Six jointly estimated equations in a demand system including U.S. and non-U.S. rice, wheat and sorghum, are estimated simultaneously from 1975 through 2005. Special Drawing Rights (SDRs) were obtained from International Monetary Fund (IMF). Definition of variables and summary statistics for the data are reported in Table 4.2.

Table 4.2: Variable definitions and summary statistics, 1975-2005

Variable	Definition	Mean	Minimum	Maximum	s.d
w_1	Market share for U.S. rice exports	0.0375	0.0242	0.0623	0.009
w_2	Market share for non-U.S. rice exports	0.1491	0.0797	0.2833	0.059
w_3	Market share for U.S. wheat exports	0.2692	0.1896	0.3907	0.063
w_4	Market share for non-U.S. wheat exports	0.4908	0.3763	0.5890	0.055
w_5	Market share for U.S. sorghum exports	0.0390	0.0237	0.0581	0.010
w_6	Market share for non-U.S. sorghum exports	0.0142	0.0013	0.0410	0.013
p_1	Nominal export price for U.S. rice, $/ton	367.94	241.50	529.15	59.14
p_2	Nominal export price for non-U.S. rice, $/ton[1]	282.31	211.11	416.04	46.31
p_3	Nominal export price for U.S. wheat, $/ton	146.03	99.64	202.74	23.19
p_4	Nominal export price for non-U.S. wheat, $/ton[2]	155.60	121.63	200.16	21.84
p_5	Nominal export price for U.S. sorghum, $/ton	113.04	81.03	154.51	15.48
p_6	Nominal export price for non-U.S. sorghum, $/ton[3]	98.92	70.27	167.42	19.57
q_1	Volume of U.S. rice exports, ton	1,794,207.81	1,359,597.00	2,399,030.00	278,803.44
q_2	Volume of non-U.S. rice exports, ton[4]	9,947,251.63	3,419,045.00	19,968,028.59	5,094,302.86
q_3	Volume of U.S. wheat exports, ton	32,587,388.73	25,104,457.83	45,106,672.00	5,886,270.23
q_4	Volume of non-U.S. wheat exports, ton[5]	57,432,533.59	31,132,997.18	77,732,717.81	12,944,444.60
q_5	Volume of U.S. sorghum exports, ton	688,211.64	389,411.00	1,173,796.00	173,935.47
q_6	Volume of non-U.S. sorghum exports, ton[6]	233,538.62	27,557.00	701,496.00	207,440.66
RPROM[*]	Nominal Export promotion expenditures for U.S. rice, $	8,167,991.00	2,268,496.00	14,632,490.00	3,443,029.60
WPROM[*]	Nominal Export promotion expenditures for U.S. wheat, $	13,781,393.00	6,151,000.00	20,811,097.00	4,776,134.70
GPROM[*]	Nominal Export promotion expenditures for U.S. sorghum, $	12,773,844.00	1,399,959.00	17,970,408.00	4,480,967.40
SDR	Special Drawing Right (SDR)	1.36	0.98	1.55	0.12
WPI	World Price Index (WPI)	94.86	61.66	122.63	16.38

[1,4] Average export prices and volumes of rice exported from Thailand, Vietnam, China, Pakistan and India during 1975-2005.

[2,5] Average export prices and volumes of wheat exported from EU, Canada, and Australia during 1975-2005.

[3,6] Average export prices and volumes of sorghum exported from Australia and Argentina during 1975-2005.

4.4 Econometric Results

The model was estimated using the seemingly unrelated regression (SUR) method. Given that the U.S. such a large exporter in the grain market, the endogeneity of nominal price was examined using Hausman test. The results indicated no endogeneity occurred[12]. The grain demand system includes U.S. and non-U.S. rice, wheat, and sorghum. The model suggests the existence of first-order autocorrelation (AR(1)). The Bresuch-Godfrey's serial autocorrelation test identified statistically significant first-order autocorrelation in non-U.S. rice, U.S. wheat, non-U.S. wheat equations. When estimated without AR processes, the Durbin-h values of U.S. and non-U.S. rice and wheat were -5.32, 4.73, -6.54 and 2.6, indicating an autocorrelation. When an AR(1) term was included in the regression, its coefficient was -0.41 statistically significant at the 1% level (p-value is 0.012). Therefore, we estimated the LA/AIDS model with an AR(1) process:

(4.10) $\varepsilon_{i,t} = \rho_{i1}\varepsilon_{it-1} + \upsilon_{i,t}$,

where ρ_{i1} is the first-order autoregressive parameters and υ_{it} is a white-noise disturbance. None of six equations generated statistically significant heteroscedasticity using White's test [13].

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[12] Wu-Hauman test for six individual equations. U.S.wheat and non-U.S. wheat price were tested for endogeneity because the suspicion of big market shares in the system. Each U.S wheat and non U.S wheat price were regressed on all exogenous variables including extra variables i.e. world GDP, SDR, and WPI to be as an instrumental variable. The coefficient of residual calculated previously from U.S. wheat price equation was not statistically significant in all 6 equations with p-value 0.55, 0.5, 0.35, 0.47, 0.23, and 0.52 respectively indicating no endogeneity. For non-U.S. wheat price, the p-values were 0.65, 0.25, 0.59, 0.29, 0.23, and 0.63 respectively.

[13] The White's test showed that there is no heteroskedasticity occurred in six equations. P-values of six equations were 0.44, 0.87, 0.43, 0.206, 0.39 and 0.46 respectively. Thus, all equations failed to reject the null hypothesis that there is no heteroskedasticity.

Since $\sum_{i=1}^{6} w_{it} = 1$, only five equations are necessary to estimate the system.

The AR(1) LA/AIDS model was estimated imposing price homogeneity (equation 4.7 and 4.8) and symmetry (equation 4.9). The parameter estimates are reported in Table 4.3, Table 4.4 and Table 4.5.

The adjusted R^2 of U.S. and non-U.S. rice, wheat and sorghum equations is 0.69, 0.81, 0.61, 0.42, 0.43 and 0.81, respectively. Five of the six own-price coefficients and five of the fifteen cross-price coefficients are statistically significant at the 5% or 10% level. Eleven of the eighteen export promotion coefficients are significant at the 5% or 10% level. Own export promotion coefficients for rice, wheat and sorghum were all positive and statistically significant in terms of increasing own U.S. market share, however, cross export promotion coefficient signs are varied.

The trend term was found to be statistically significant for most grains except non-U.S. wheat and non-U.S. sorghum. U.S. rice, wheat and sorghum have a negative trend, while non-U.S. rice has a positive trend. Expenditure coefficients are statistically significant at the 5% or 10% level on U.S. and non-U.S rice, non-U.S. wheat and non-U.S. sorghum.

Table 4.3: Price coefficients of LA/AIDS for U.S. grains, 1975-2005.

Equations	Market Share	Price Coefficients					
		γ_{i1}	γ_{i2}	γ_{i3}	γ_{i4}	γ_{i5}	γ_{i6}
U.S.Rice	0.0487	0.039*** (3.16)					
Non-U.S.Rice	0.0978	-0.018 (-1.52)	0.065* (1.96)				
U.S. Wheat	0.3251	0.053** (2.38)	-0.072* (-1.74)	0.199* (1.82)			
Non-U.S.Wheat	0.4614	-0.052** (-2.39)	0.016 (0.37)	-0.170* (-1.72)	0.201* (1.74)		
U.S. Sorghum	0.0533	-0.013 (-1.09)	0.003 (-0.19)	-0.023 (-0.889)	0.018 (0.690)	0.031* (1.756)	
Non-U.S.Sorghum	0.0136	0.013 (0.945)	-0.018 (-1.44)	-0.038* (-1.68)	0.001 (0.07)	0.014 (0.791)	0.014 (1.44)

Table 4.4: Promotion coefficients of LA/AIDS for U.S. grains, 1975-2005.

Equations	Promotion Coefficients		
	U.S. Rice Promotion θ_i	U.S. Wheat Promotion δ_i	U.S. Sorghum Promotion ϕ_i
U.S.Rice	0.009*** (2.66)	0.0067 (0.74)	-0.0085*** (-2.67)
Non-U.S.Rice	-0.017* (-1.76)	-0.019 * (-1.76)	0.015 (1.42)
U.S. Wheat	0.017 (1.11)	0.093* (1.69)	-0.011 (-0.66)
Non-U.S.Wheat	0.024* (1.78)	-0.027 (-0.51)	-0.026* (-1.69)
U.S. Sorghum	-0.006** (-2.06)	0.004 (0.37)	0.008 ** (2.11)
Non-U.S.Sorghum	-0.004* (-1.687)	-0.015* (-2.14)	0.0005 (0.18)

Table 4.5: Intercept, expenditure, trend, Adjusted R^2 and Durbin – h value of LA/AIDS for U.S. grains, 1975-2005.

Equations	Intercept	Expenditure	Trend	Adj. R^2	Durbin - h[14]
	α_i	β_i	τ_i		
U.S.Rice	0.51* (1.92)	-0.04*** (-2.74)	-0.002** (-3.55)	0.69	-0.775
Non-U.S.Rice	1.47 (1.48)	-0.12** (-2.63)	0.004* (1.89)	0.81	1.63
U.S. Wheat	-1.26 (-0.79)	0.02 (0.27)	-0.005** (-2.08)	0.61	-1.62
Non-U.S.Wheat	-0.29 (-0.19)	0.099* (1.67)	0.002 (1.06)	0.42	0.77
U.S. Sorghum	-0.09 (-0.27)	0.005 (0.32)	-0.0009** (-1.92)	0.43	-0.02
Non-U.S.Sorghum	0.04 (0.19)	0.016* (1.67)	0.0002 (-0.57)	0.81	0.40

Based on the parameter estimates in Table 4.3, Table 4.4 and Table 4.5, conditional own-price, cross price, expenditure and export promotion elasticities for the LA/AIDS model were calculated from formulas derived in the literature as follows [15]:

(4.11) $$\eta_i = \partial \ln q_i / \partial \ln M_i = 1 + \beta_i / w_i$$

(4.12) $$E_{ii} = \partial \ln q_i / \partial \ln p_i = -1 + \gamma_{ii} / w_i + w_i$$

(4.13) $$E_{ij} = \partial \ln q_i / \partial \ln p_j = \gamma_{ij} / w_i + w_j$$

(4.14) $$R_i = \partial \ln q_i / \partial \ln RPROM_t = \partial \ln w_i / \partial \ln RPROM_t = \theta_i / w_i$$

(4.15) $$W_i = \partial \ln q_i / \partial \ln WPROM_t = \partial \ln w_i / \partial \ln WPROM_t = \delta_i / w_i$$

(4.16) $$S_i = \partial \ln q_i / \partial \ln GPROM_t = \partial \ln w_i / \partial \ln GPROM_t = \phi_i / w_i,$$

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[14] When the regression includes lagged dependent variables the Durbin-Watson d-statistic is not valid as a test for autocorrelated residuals. The d-statistic tends to be biased towards 2. In this case, Durbin's h test is more proper. For a test of the null hypothesis of no autocorrelation against the 2-sided alternative of autocorrelated errors, at a 5% level, the decision rule is if -1.96 < h < 1.96 do not reject the null hypothesis.

[15] The elasticities are called "conditional" because they are computed under the hypothesis that group expenditure is exogenous. The formulas in equations (4.11) and (4.12) refer to compensated or Slutsky elasticities. Slutsky elasticities are used in preference to the Cournot or uncompensated elasticities because the formulas for the latter are more complicated, and the income effects of price changes are apt to be negligible owing to the fact grain products constitute a small portion of world income.

where i =1, 2, 3, 4, 5, and 6 indicating U.S rice, non-U.S. rice, U.S. wheat, non-U.S. wheat, U.S. sorghum, and non-U.S. sorghum respectively; η_i is expenditure elasticity; E_{ii} is compensated or Slutsky own-price elasticity; E_{ij} is compensated cross-price elasticity; R_i is rice export promotion elasticity; W_i is wheat export promotion elasticity; S_i is sorghum export promotion elasticity. The estimated short-run compensated price elasticities are given in Table 4.6, and estimated short-run promotion and expenditure elasticities are given in Table 4.7. The long-run elasticities of compensated price and promotion and expenditure are listed in Table 4.8 and Table 4.9 respectively. We focus here on the own and cross promotion elasticities, which are in Table 4.7 and Table 4.8 in the discussion that follows.

Table 4.6: Estimated short-run compensated price elasticities of U.S. and non-U.S. rice, wheat and sorghum, 1975 -2005

Equations	SR Price Elasticity					
	E_{i1}	E_{i2}	E_{i3}	E_{i4}	E_{i5}	E_{i6}
U.S. Rice	-0.14***					
Non-U.S.Rice	-0.29	-0.24 *				
U.S. Wheat	1.43 **	-0.41 *	-0.062 *			
Non-U.S.Wheat	-0.61 **	0.63	-0.063 *	-0.102 *		
U.S. Sorghum	-0.22	0.081	-0.017	0.094	-0.36 *	
Non-U.S.Sorghum	0.28	-0.174	-0.103 *	0.016	0.275	0.035

Table 4.7: Short-run compensated promotion and expenditure elasticities of U.S. and non-U.S. rice, wheat and sorghum, 1975 -2005

Equations	SR Promotion Elasticity			Expenditure Elasticity η_i
	U.S. Rice R_i	U.S.Wheat W_i	U.S.Sorghum S_i	
U.S. Rice	0.186***	0.138	-0.174***	0.197***
Non-U.S.Rice	-0.178 *	-0.202 **	0.154	-0.259 **
U.S. Wheat	0.052	0.287 *	-0.033	1.065
Non-U.S.Wheat	0.052 *	-0.059	-0.057 *	1.214 *
U.S. Sorghum	-0.115 **	0.082	0.148 **	1.105
Non-U.S.Sorghum	-0.298 *	-1.12 **	0.04	2.200*

Table 4.8: Long- run compensated price, export promotion and expenditure elasticities of U.S. and non-U.S. rice, wheat and sorghum, 1975 -2005.

Equations	LR Price Elasticity						
	Lagged Market share ψ_i [16]	E_{i1}	E_{i2}	E_{i3}	E_{i4}	E_{i5}	E_{i6}
U.S.Rice	0.096	-0.15 ***					
Non-U.S.Rice	0.54***	-0.63	-0.51*				
U.S. Wheat	0.53 ***	3.06 **	-0.87*	-0.13 **			
Non-U.S.Wheat	0.38***	-1.00**	-0.103	-0.103 *	-0.16 *		
U.S. Sorghum	0.45***	-0.41	0.15	-0.03	0.17	-0.65 *	
Non-U.S.Sorghum	0.28*	0.39	-0.24	-0.14 *	-0.02	0.38	0.048

Table 4.9: Long- run promotion and expenditure elasticities of U.S. and non-U.S. rice, wheat and sorghum, 1975 -2005.

Equations	LR Promotion Elasticity			LRExpenditure Elasticity η_i
	U.S. Rice R_i	U.S.Wheat W_i	U.S.Grains S_i	
U.S. Rice	0.205***	0.153	-0.192***	0.218***
Non-U.S.Rice	-0.389 *	-0.442	0.337	-0.567 **
U.S. Wheat	0.111	0.616 *	-0.071	2.286
Non-U.S.Wheat	0.085 *	-0.097	-0.092 *	1.986*
U.S. Sorghum	-0.209 **	0.149	0.269 **	2.000
Non-U.S.Sorghum	-0.414 *	-1.558 **	0.055	3.050*

[16] The long-run coefficient (λ_i) of each grain equation was calculated by one subtracted by the coefficient of each grain lagged market share variable (λ_i = 1- ψ_i) which, for U.S. and non U.S. grain, were equal to 0.904, 0.46, 0.47, 0.62, 0.55 and 0.72 respectively. Long-run elasticity of price and promotion was obtained by dividing short run elasticity (Table 4.6 and 4.7) by the long-run coefficient (λ_i,).

In Table 4.7 (short-run) and Table 4.9 (long-run), the own effects of U.S. export promotion for the three commodities are all positive and statistically significant. U.S. wheat promotion has the largest estimated direct effect, with a short-run elasticity of 0.287 and a long-run elasticity of 0.616. U.S. rice promotion has short- and long-run elasticities of 0.186 and 0.205, and U.S. sorghum promotion's impact on U.S. sorghum market share has a short-run elasticity of 0.148 and a long-run elasticity of 0.269 (note that since this promotion variable also includes corn and barley expenditures it may be biased downwards). Therefore, it appears that U.S. export promotion has been effective in increasing U.S. market share of wheat, rice, and sorghum. These own effects are consistent with the majority of previous studies that find a significant demand effect of export promotion (see Alston et al.).

Policy makers are also interested in whether there are "halo effects" of U.S. export promotion. Our results indicate that there is no halo effects of U.S. export promotion on other U.S. grains. U.S. rice export promotion has a positive impact, but not statistically significant on U.S. wheat market share, with a short-run cross elasticity of 0.052 (0.111, long-run) but a negative and statistically significant impact on U.S. sorghum market share with a cross elasticity of -0.115 (-0.209, long-run). These two short-run cross elasticities sum to -0.063 (-0.098 long-run), but are not statistically significant based on a Wald test (p-value is 0.7). U.S. wheat export promotion has no significant impact on either U.S. rice (0.138, short-run; 0.153, long-run) or U.S. sorghum (0.082, short-run; 0.149, long-run) market share. Again, a Wald test (p-value is 0.47) indicates no halo effect from U.S. wheat promotion on other U.S. grains. U.S. sorghum promotion has a negative and statistically significant impact on U.S. rice (-0.174, short-run; -0.192, long-run), but not statistically significant on U.S. wheat (-0.033, short-run; -0.071, long-run) market share. However, we fail to reject the null hypothesis that the two cross elasticities sum to zero (p-value in Wald test is

0.27). In terms of statistically significant cross elasticities, we found two negative impacts, and no positive impacts. Hence, our results are the opposite of Richards and Patterson's findings of a halo effect for horticultural commodities.

Another important policy issue in export promotion is whether other countries free ride off of U.S. promotion, i.e., whether there is a halo effect of U.S. promotion for other countries. Our results indicate that U.S. export promotion actually hurts competing country exports. U.S. rice export promotion has a negative and statistically significant impact on rice (-0.178, short-run; -0.389, long-run) and sorghum (-0.298, short-run; -0.414 long-run) market share for competing countries, and a positive and statistically significant impact on wheat (0.052, short-run; 0.085 long-run) market share for competing countries. Collectively, these three estimated cross elasticities sum to -0.424 (-0.718, long-run), indicating a negative halo effect of U.S. rice promotion on non-U.S. grain demand. Based on a Wald test, we reject the null hypotheses of no anti-halo effect at the 10 percent significance level (p-value is 0.08). U.S. wheat export promotion has a negative and statistically significant effect on rice (-0.202, short-run; -0.442, long-run) and sorghum (-1.12, short-run; -1.558, long-run) market share of non-U.S. countries, and a negative, but not statistically significant impact on wheat (-0.059, short-run; -0.097) market share of non-U.S. countries. Collectively, these three cross elasticities sum to -1.381 (-2.097 long-run), and, based on a Wald test, are statistically significant (p-value is 0.07). Consequently, there is an anti-halo effect of U.S. wheat promotion on the demand for grains of other countries. U.S. sorghum export promotion has a negative and statistically significant impact on wheat (-0.057, short-run; -0.092, long-run) market share of non-U.S. countries, and a positive, but not statistically significant impact on rice (0.154, short-run; 0.337, long-run) and sorghum (0.04, short-run; 0.055, long-run) market share of non-U.S. countries. Based on a Wald test, we could not reject the null hypothesis of no anti-halo effect at the 10 percent significance level (p-value is 0.58). In terms of statistically significant individual cross elasticities, there are five significant negative elasticities and only one significant positive elasticity. This provides empirical evidence of an anti-halo effect of U.S. grain export promotion on competing country grain exports.

In terms of the econometric results, there are three general conclusions. First, U.S. grain export promotion has a positive and significant direct impact on U.S. grain exports for rice, wheat, and sorghum. Second, while the direct effects are significant, there are no halo effects of U.S. grain export promotion on other U.S. grains. Finally, U.S. grain export promotion has an anti-halo effect on competing country grain exports. Hence, there is no international free riding off of U.S. grain export promotion.

4.5 Simulations

In order to examine the benefits and costs of grain export promotion, several simulations were performed. For each grain, the LA/AIDS model was used to simulate two scenarios: (1) a baseline scenario with U.S. grain export promotion expenditures at historical levels – export promotion programs are in effect; and (2) a counterfactual scenario with U.S. grain export promotion reduced by 50 percent. In the first scenario, all grain export demand determinants are set equal to their historic levels and simulated over the period 1990-2005. The second scenario is identical to the first, except U.S. grain export promotion expenditures are set to 50 percent of their historical amounts. These two scenarios are run separately for rice, sorghum, and wheat. The difference between the two scenarios for each grain gives the total impact of the U.S. grain export promotion programs on U.S. grain market share.

These results are then translated into a benefit-cost ratio using the following procedures. First, U.S. market share (w_{it}) for each grain and each scenario is transformed into gross value of U.S. exports (V_{it}) by multiplying market share by total U.S. and non-U.S. grain expenditures (M_t). The gross value is then translated into a net value (v_{it}) by multiplying each grain by a net margin factor equal to $(p_{it} - c_{it}) / p_{it}$, for i = rice, wheat, and sorghum for t = 1990-2005, and where: p_{it} is the unit price and c_{it} is the unit cost of grain i. Next, a "direct" benefit-cost ratio (*DBCR*) is calculated as follows:

(4.17) $$DBCR_{it} = (v_{it} - v_{it}^{'}) / (EPCOST_{it} - EPCOST_{it}^{'}),$$

where v_{it} is the U.S. export value of grain i for scenario 1 (i=rice, wheat, and sorghum); $v_{it}^{'}$ is the U.S. export value of grain i for scenario 2; $EPCOST_{it}$ is export promotion expenditures for grain i under scenario 1; and $EPCOST_{it}'$ is export promotion expenditures for grain i under scenario 2. $DBCR_{it}$ provides a measure of the direct benefit-cost ratio for export promotion for grain i.

We also compute an alternative benefit-cost ratio that captures the direct and the cross effects of promotion. This total BCR (*TBCR*) is calculated as follows:

(4.18) $$TBCR_{it} = (\sum_{j=1}^{3} v_{jt} - v_{jt}^{'}) / (\sum_{j=1}^{3} EPCOST_{jt} - EPCOST_{jt}^{'}),$$

where i = rice, wheat, and sorghum.

The *DBCR* is a useful measure for producers in each specific industry. However, for policy makers, the *TBCR* is probably a better measure since it gives the over all impact of a specific export promotion on the entire three grain industries.

The results are displayed in Table 4.10. U.S. rice export promotion is beneficial to both the rice industry, and to all three-grain sectors combined. On average over the period 1990-2005, the *DBCR* is equal to 5.34, indicating that each dollar invested in rice export promotion had resulted in $5.34 in net export revenue to the U.S. rice sector. The average *TBCR* for U.S. rice export promotion for this period of even higher at 5.46 indicating positive net revenue effects of U.S. rice promotion for all three grains combined.

Table 4.10: An average direct and total benefit-cost ratios for U.S. rice, wheat, and sorghum export promotion (1990-2005):

Grains	Direct Benefit-Cost Ratio	Total Benefit-Cost Ratio
Rice	5.34	5.46
Wheat	26.10	30.10
Sorghum	5.18	-0.72

U.S. wheat export promotion was also beneficial for both the wheat and combined three grain industries, and had the highest benefit-cost ratios. The *DBCR* for wheat over this time period was computed to be 26.10, i.e., each dollar resulted in $26.10 in additional net export revenue to the U.S. wheat industry. The *TBCR* was even higher at 30.10 indicating spill-over benefits to the three grain sectors combined.

U.S. sorghum promotion had mixed impacts. In terms of the *DBCR*, U.S. sorghum export promotion was beneficial to U.S. sorghum producers. Each dollar invested returned, on average, $5.18 in terms of net export revenue. However, U.S. sorghum export promotion actually had a negative impact on combined net revenue for the three grains. Each dollar invested in U.S. sorghum promotion resulted in a loss of net export revenue of $0.72.

In summary, in terms of BCRs, the direct effects of U.S. rice, wheat, and sorghum export promotion is benefiting grain producers in the United States. In terms of total effects, U.S. rice and wheat promotion is beneficial to rice, wheat, and sorghum producers combined, but U.S. sorghum promotion is not benefiting all three grains combined.

4.6 Summary and Conclusions

In this article, we investigated both the own and cross effects of U.S. export promotion for U.S. and non-U.S. grains. The focus was on two previously neglected aspects of the cross-effects, whether: (1) a halo effect for U.S. commodities exists, and (2) U.S. grain export promotion has a halo effect on grain demand for other countries? An LA/AIDS model for U.S. and non-U.S. rice, wheat, and sorghum that include U.S. export promotion as one of the explanatory variables was used to examine these issues.

U.S. grain export promotion was found to have a positive and significant direct impact on U.S. grain exports for rice, wheat, and sorghum. Wheat promotion was found to have the largest impact on U.S. market share, followed by rice, and sorghum promotion. Regarding indirect effects on U.S. grain demand on rice, wheat, and sorghum export promotion were not found to have a statistically significant positive, i.e., halo effect. On the contrary, in terms of statistically significant cross elasticities, we found two negative results, indicating anti-halo effect. Hence, our results are the opposite of Richards and Patterson's findings of a halo effect for horticultural commodities. U.S. grain export promotion was found to have an anti-halo effect on competing country grain exports. In terms of statistically significant individual cross elasticities, there were five significant negative elasticities and only one significant positive elasticity. This provides empirical evidence of an anti-halo effect of U.S. grain export promotion on competing country grain exports. Hence, there is no international free-riding off of U.S. grain export promotion.

In order to examine the benefits and costs of grain export promotion, several simulations were performed. For each grain, the LA/AIDS model was used to simulate two scenarios: (1) a baseline scenario with U.S. grain export promotion expenditures at historical levels – export promotion programs are in effect; and (2) a counterfactual scenario with U.S. grain export promotion reduced by 50 percent. The difference between the two scenarios for each grain gives the total impact of the U.S. grain export promotion programs. Two benefit-cost ratios were computed for each of the three grains.

First, a direct benefit-cost ratio on average over period 1990-2005 was computed, which provides a measure of the direct benefit-cost ratio for export promotion for each grain. For all three grains, the direct BCR was significantly higher than 1.0 indicating positive net benefits to producers in each of the three-grain industries. Wheat had the largest direct BCR at 26.10, followed by rice (5.34) and sorghum (5.18). Second, an alternative benefit-cost ratio that captures the direct and the cross effects of promotion were computed. Wheat and rice had total BCRs that were higher than the direct BCR indicating halo effects, while sorghum actually had a negative BCR indicating anti-halo effect of U.S. grain export promotion.

REFERENCES

Alston, J.M. and Crespi, J.M and Kaiser, H.M. and Sexton, R.J. **The Economics of Commodity Promotion Programs: Summary and Synthesis**. In: Kaiser, H.M., Alston, J.M., Crespi, J.M. and Sexton, R.J.(eds). *The Economics of Commodity Promotion Programs: Lessons from California*. Peter Lang, New York (2005). pp. 387-415.

Asche, F. and Wessells, C.R. (1997). **On Price Indices in the Almost Ideal Demand System**. *American Journal Agricultural Economics* (79). pp. 1182-1185.

Chang, Hui-Shung and Nguyen, C. **Elasticity of Demand for Australian Cotton in Japan**. *The Australian Journal of Agricultural and Resource Economics* 46(1). pp. 99-113.

Deaton, A. and Muellbauer, J. (1980a). **Economics and Consumer Behavior**. Vail-Ballou Press, New York.

Dwyer, M.J. (1995). **Evaluating the Effectiveness of the Market Promotion Program on U.S. High-Value Agricultural Exports**. *Final Regulatory Impact Analysis. FAS staff paper.* USDA, Washington, D.C. pp. 1-95.

Food and Agriculture Organization (FAO) of the United Nations. FAO statistics- Agriculture (2007).

Green, R. and Alston, J.M. (1990). **Elasticities in AIDS Models**. *American Journal of Agricultural Economics*(72). pp. 442-445.

Green, R. and Alston, J.M. (1991). **Elasticities in AIDS Models : A Clarification and Extension**. *American Journal of Agricultural Economics*(73). pp. 874-875.

Greene, W.H. **Econometric Analysis (5th edition)**. Pearson Education, Inc.,(2003). Time-series models. pp. 608-662.

Hahn, W.F. (1994). **Elasticities in AIDS models: Comment**. *American Journal of Agricultural Economics(76)*. pp. 972-977.

Hayes, D.J. and Wahl, T.I. and Williams, G.W. (1990). **Testing Restrictions on a Model of Japanese Meat Demand**. *American Journal of Agricultural Economics*72(3). pp. 556-566.

International Monetary Fund (IMF). International Financial Statistics.

Johnson, A.J. and Durham, C.A. and Wessells, C.R. (1998). **Seasonality in Japanese Household Demand for Meat and Seafood.** *Agribusiness*14(4). pp. 337-351.

Kinnucan, H.W. and Zheng, Y. (2005). **National Benefit-Cost Estimations for the Dairy, Beef, Pork and Cotton Promotion Programs**. In: Kaiser, H.M., Alston, J.M. , Crespi,J. and Sexton, R.J.(eds). *The Economics of Commodity Promotion Programs: Lessons from California*. Peter Lang, New York. pp. 255-284.

Richards, T.J. and Patterson, P.M. (1998).**Dynamic Complementarity in Export Promotion : The Market Access Program in Fruits and Vegetables.** *Journal of Agricultural and Resource Economics* 23(2). pp. 319-337.

Richard, T.J. and Ispelen, P.V. and Kagan, A.(1997).**A Two-Stage Analysis of the Effectiveness of Promotion Programs for U.S. Apples**. *American Journal of Agricultural Economics* 79(3). pp. 825-837.

Satyanarayana, V. and Wilson, W.W. and Johnson, D.D. (1999). **Import Demand for Malt in Selected Countries : A Linear Approximation of AIDS**. *Canadian Journal of Agricultural Economics* (47). pp. 137-149.

The U.S. Grains Council.

USDA Foreign Agricultural Service (FAS).

Xiao, H. and Kinnucan, H.W. and Kaiser, H.M. (1999). **Effects of Advertising on U.S. Non-Alcoholic Beverage Demand: Evidence form a Rotterdam Model**. *Journal of Agricultural and Resource Economics.*

CHAPTER 5

SUMMARY AND CONCLUSIONS

The objectives of this thesis were to: (1) to empirically measure the responsiveness of U.S. rice and other related grain exports in term of demand aspect and market share aspect with respect to U.S. grain export promotions, and (2) to assess the overall effectiveness of the U.S. grain export programs in the world market in term of benefits relative to costs. The thesis was comprised of two essays: (1) *Measuring the Effectiveness of U.S. Rice Export Promotion Programs* and (2) *The Halo Effects of U.S. Grain Export Promotion*.

The first essay – *" Measuring the Effectiveness of U.S. Rice Export Promotion Programs"* measured the export promotion elasticity by estimating U.S. rice export demand using an instrumental-variable regression approach and a single equation with double logarithmic function given other demand determinants such as own price, price of competing countries, income, and exchange rates and U.S. rice export promotion expenditures. There were three main objectives of the essay. The first objective was to econometrically investigate the responsiveness of U.S. rice export demand with respect to U.S. rice export promotion. The second objective was to evaluate the effectiveness of U.S. rice export promotion programs based on benefit-cost ratio (BCR) outline. The third objective was to estimate the optimality of U.S. rice export promotion expenditure levels by computing a marginal benefit-cost ratio (MBCR).

Over the period 1984–2005, the results support the hypothesis that U.S. rice export promotion programs have had a positive impact on the U.S. rice export demand. The export promotion elasticity was computed to be 0.143, which was statistically significantly different from zero.

To address the question of net return of export promotion investment, the simulated benefits of export promotion were compared against the costs of the programs and the associated benefit-cost ratios then were computed. The resulting average benefit-cost ratios of the U.S. rice export promotion expenditures were computed based on a range of excess supply own price elasticities (from 1 to 10). The average BCRs ranged from 30.05 for the most inelastic estimate, to 5.51 for the most elastic. All of these values were well above 1.0. Thus, the main policy conclusion was that the benefits of export promotion programs in terms of enhancing producer welfare have been much greater than the costs of the programs.

To explore the optimality of U.S. rice export promotion, the marginal BCRs were estimated between 9.61 and 1.76 given the own-price elasticity of excess supply between 1 and 10. All results were larger than 1.0 indicating that the U.S. is under-investing in U.S. rice export promotion from an optimality standpoint.

The second essay – *"The Halo Effects of U.S. Grain Export Promotion"* focused on spill-in and spill-over effects of U.S. grain export promotion and the characteristics of U.S. grain export promotion as a international public good over the period 1975-2005. Linear approximation AIDS (LA/AIDS) with seemingly uncorrelated regression (SUR) method was presented to estimate a demand system consisting of three major grain commodities: rice, wheat, and sorghum, and two regions: U.S. and non-U.S. The model is consistent with homogeneity, adding-up, and symmetry restrictions from consumer demand theory. There were two main objectives of the essay. The first objective was to examine both the own and cross effects of U.S. grain export promotion for U.S. and non-U.S. grains. The second objective was to evaluate the magnitude of cross effects on U.S. grain market shares by simulating several policy scenarios involving alternative export promotion levels and then computing direct and total benefit-cost ratios (DBCR, TBCR).

U.S. grain export promotion was found to have a positive and significant direct effect on U.S. grain market shares in rice, wheat, and sorghum; however, indirect effects on U.S. grain market shares were not found to have a statistically significant positive, i.e. no halo effect. On the contrary, in terms of statistically significant cross elasticities, we found two negative results, indicating an anti-halo effect.

In terms of international free riding, the results indicated that U.S. grain export promotion has an anti-halo effect on competing country grain exports indicating five significant negative elasticities and only one significant positive elasticity. Hence, there is no international free-riding off of U.S. grain export promotion.

Benefits and costs of U.S. grain export promotion were computed with several simulations. Baseline scenario with U.S. grain export promotion expenditures at historical levels and a counterfactual scenario – 50% reduction of U.S. grain export promotion expenditures were set. The difference gives the total impact of U.S. grain export promotion programs. Direct benefit-cost ratios (DBCR) of three-grain promotions were greater than one with wheat (26.10), rice (5.34) and sorghum (5.18). Total benefit-cost ratios (TBCR) gave higher value than DBCR in rice and wheat export promotion while sorghum export promotion had a negative total benefit-cost ratio. In conclusion, U.S. rice and wheat export promotion is benefiting grain producers, but U.S. sorghum export promotion is not.

In summary, both essays concluded that U.S. grain export promotion has a positive and statistically significant direct effect on rice, wheat and sorghum. Indirect effects which were estimated in the second essay indicated that there are no halo effects of U.S. export promotion on other U.S. grains. U.S. grain export promotion also provides empirical evidence of anti-halo effects of U.S. grain export promotion on competing country grain exports. In term of effectiveness of U.S. grain export promotion, direct benefit-cost ratios (DBCR) were greater than 1.0 for rice, wheat and sorghum export promotion; total benefit-cost ratios (TBCR) were positive in rice and wheat export promotion, but negative in sorghum export promotion.