TRADE ADJUSTMENT ASSISTANCE FOR FARMERS IN THE U.S.: PROGRAM PARICIPATION AND POLICY IMPACT

A Thesis

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by

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ABSTRACT

The Trade Adjustment Assistance (TAA) for Farmers program, first established by the Reform Act in 2002, assists farmers adversely affected by import competition through cash benefits and technical assistance. The Recovery and Reinvestment Act of 2009 re-authorized and modified the program. The program has been mostly underused, with petitions filed for only 0.8% of all the state-level field commodities for which price data is available. In Chapter 2, I address this puzzle of low program participation by using the rare events logistic regression method and find that access to information and farmers' incentives to file petitions, rather than factors from eligibility criteria, determine the program participation. Most notable changes in the Recovery Act of 2009 are the easing of eligibility criteria and the use of decoupled instead of coupled cash payments. In Chapter 3, using an inclusive model that allows for different policy settings—coupled and decoupled payments and different eligibility criteria—I find that the new seemingly "decoupled" TAA program, as well as the original "coupled" TAA program, distort prices and optimal outputs, and increase farmers' welfare.

BIOGRAPHICAL SKETCH

Yu Na Lee was born in Seoul, Korea. She majored Business Administration at Yonsei University in Seoul and received a master's degree in International Trade and Finance at Yonsei Graduate School of International Studies. After graduation, she worked at the Korea Development Institute for three years during which she decided to go back to school and study economics more seriously. After two years of graduate studies at the Dyson School of Applied Economics and Management at Cornell University, and studying at the UCLA and earning a master's degree in International Management, she is now a PhD student in Applied Economics at the University of Minnesota, Twin Cities. At Minnesota, she has been working as a teaching assistant to classes such as Principles of Microeconomics, Principles of Macroeconomics, and Intermediate Macroeconomics. Yu Na lives in Saint Paul, Minnesota. She loves traveling, cooking, learning foreign languages and culture, and listening to music.

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CHAPTER 1

AN INTRODUCTION TO THE TAA FOR FARMERS PROGRAM

I. An Overview

The Trade Expansion Act of 1962 first established the Trade Adjustment Assistance (TAA) programs for workers and firms dislocated by international trade liberalization, and the TAA for Farmers program was established by the TAA Reform Act of 2002[1]. The TAA for Farmers assists farmers adversely affected by import competition through cash benefits up to $10,000 a year and technical assistance provided by the U.S. Department of Agriculture. To certify for the TAA benefits, a group of farmers should meet the following criteria: (i) The commodity should be classified as *Agricultural Commodity*[2] defined by the Secretary of Agriculture. (ii) The price for the commodity in a given marketing year should be less than 80% of the national average price in the 5 preceding marketing years. (iii) The increases in imports of the commodity or like product contributed importantly to the price decline. The Secretary of Agriculture determines whether the group of producers meets these requirements. Once a group of farmers is certified, cash payment will be made to individual producers if they meet the following conditions: If (i) The producer produced the commodity in the most recent year; (ii) the producer's net farm income (as determined by the Secretary) for the most recent year is less than that for the latest year in which no adjustment assistance was received, and (iii) the producer has met with an Extension Service employee or agent to obtain information and technical assistance that will assist the producer in adjusting to import

[1] P.L. 107-210, Sections 141-142, approved August 6, 2002, 116 Stat.946 (19 U.S.C. 2401 et seq.).

[2] "The term 'agricultural commodity' means any agricultural commodity (including livestock) in its raw or natural state." (Trade Act of 2002, P.L. 107-210, Sec 291)

competition with respect to the adversely affected agricultural commodity. The funding for the program expired in December 2007.

The American Recovery and Reinvestment Act of 2009[3] (abbreviated ARRA, the "stimulus package") made a substantial change in the eligibility criteria. The act reauthorized the Trade Act for 2002, and provided an expanded definition of terms and more lenient group eligibility requirements for TAA petition. The major changes in ARRA of 2009 included the following: First, the eligibility requirements for groups of farmers to be certified and the criteria for individual farmers to be eligible for benefits became more lenient. The new Act required that the price of the most recent marketing year is less than 85% of the previous 3 year prices instead of 80% of the previous 5 year prices. Moreover, not only the national average price, but also quantity of production, or the value of production, or the cash receipts for the commodity may be used for eligibility assessment. Also, unlike the prior TAA for Farmers program, there was no such requirement for the farmers' net farm income to have decreased in order to be qualified for the cash payment. Another notable change was the way the financial assistance was given to farmers. Under the Reform Act of 2002, the cash payments to eligible farmers were calculated based on the formula involving the amount of production. However, the ARRA of 2009 abandoned such cash payment formula and stated that the cash benefits would be given to farmers to develop and implement business plans, with a maximum cap of $12,000. First, farmers need to complete intensive training courses aiming to improve the competitiveness of production and to develop the initial business plan. If the initial business plan is approved, a farmer can receive a maximum of $4,000 to implement the plan. The farmers whose initial plans are approved can develop a long-term business plan to adjust to import competition. The ARRA of 2009 included a sunset clause

[3] P.L. 111-5, Division B, Subtitle I, Sections 1856, 1881-1887, and 1891-1894, approved February 17, 2009

that the Act expires on December 31, 2010. Hence, the Act authorized the funding only through year-end 2010. However, eligible producers were able to access technical and financial assistance during calendar year 2011 if USDA had already approved their crops for TAA benefits. Program benefits were also available if producers filed a petition before January 1, 2011 and if the eligibility was established. Hence, the USDA received petitions for FY 2011 from May 21, 2010 to July 16, 2010.

Trade Adjustment Assistance Extension Act of 2011(TAAEA, P.L. 112-40) effective on October 21, 2011, extended the provisions of the TAA for Farmers program. TAAEA authorized, but did not appropriate, $90 million each for FY 2012 and FY 2013, and $22.5 million for the first quarter of FY 2014. No major change was made in the eligibility criteria. <Table 1.1> shows a comparison of the TAA for Farmers program under three different regimes.

<Table 1.1> TAA for Farmers program under three different regimes

	Reform Act of 2002	ARRA of 2009	TAAEA of 2011
Coverage	Agricultural commodity in its raw or natural state.	Any class of goods within an agricultural commodity and wild-caught aquatic species.	
Group Eligibility Requirements	(i) The national average price for the most recent marketing year is less than 80% of the average price for the 5 preceding marketing years, and (ii) increases in imports like or directly competitive commodity, produced by the group contributed importantly to the decline in price.	(i) The national average price, or the quantity, or the value of production of, or the cash receipts for the agricultural commodity for the most recent marketing year is less than 85% of the average of the 3 preceding marketing years, and (ii) the volume of imports of like or directly competitive products in the marketing year increased when compared to those of the 3 preceding marketing years; and (iii) the increase in imports contributed importantly to the decrease in those quantities	
Requirements for the benefits	(i) The producer produced the commodity in the most recent year; (ii) The producer's net farm income for the most recent year is less than that for the latest year in which no adjustment assistance was received; and (ii) The producer has met with an Extension Service agent for technical assistance.	(i) The producer produced the commodity in the marketing year when the petition is filed and in at least 1 of the 3 preceding marketing years; (ii) The quantity produced by the producer in the marketing year has decreased; or the price received for the commodity has decreased compared to the average price for the 3 preceding marketing years; and (iii) No cash benefit was received under other TAA programs (i.e., the TAA for Workers and TAA for Firms programs), nor were benefits received based on producing another commodity eligible for TAA for Farmers.	

<Table 1.1> TAA for Farmers program under three different regimes (continued)

	Reform Act of 2002	ARRA of 2009	TAAEA of 2011
Income limit for benefits	An applicant shall not be eligible to receive any cash benefit if the average adjusted gross non-farm income of the person or legal entity exceeds $500,000, or if the average adjusted gross farm income exceeds $750,000.		
Benefits	(i) Cash adjustment assistance: [{0.5 X (80% of the average price for the 5 preceding marketing years - The price for the most recent marketing year)} X The amount produced by the producer in the most recent marketing year] (ii) To receive the cash, the producer should get the technical training.	(i) Initial and intensive technical assistance (ii) Up to $4,000 to implement an initial business plan (iii) Up to $4,000 to develop a long-term business adjustment plan (if not received any funding for initial business plan). If USDA approves the plan, up to $8,000 to implement the long-term plan	
Maximum cash assistance	The maximum a producer may receive in any 12-month period shall not exceed $10,000	A producer may not receive more than $12,000 during the 36-month period following certification of the group petition.	
Applicable period	FY2003 through FY2007 (Oct. 1, 2002 – Sep. 30, 2007)	FY2009, FY2010, and the first quarter of FY2011	FY2012, FY2013, and the first quarter of FY2014
Annual maximum funding level	(i) $90 million per year available for FY2003 through FY2007 by the Trade Act of 2002. (ii) $9 million available for the first quarter of FY2008 (through Dec. 31, 2007), by Section 1(c) of P.L.110-89. (iii) No funding authorized for the remainder of FY2008.	(i) $90 million per year available for FY 2009 and FY2010. (ii) $22.5 million available for the first quarter of FY2011 (Oct. 1 -- Dec. 31 2010)	(i) Funding not to exceed $90 million per year for FY 2012 and FY2013. (ii) Funding not to exceed $22.5 million for the first quarter of FY2014 (Oct. 1 -- Dec. 31 2014) *The TAAEA approved, but did not appropriate the funds to support this authority.*

II. Program Activities

State-level annual price data for agricultural commodities of the U.S. from 1997 to 2008 was collected from the USDA (United States Department of Agriculture)'s NASS (National Agricultural Statistics Service) website[4]. The data includes field crops and not aquaculture products or wild-caught aquatic species. Data regarding the petition filing, such as petition and approval/denial date, and reasons for decision, were collected from the Federal Register[5]. Import data of agricultural commodities from 1997 to 2008 was also gathered from the GATS (Global Agricultural Trading System)[6], a new on-line U.S. agricultural trade system launched by the FAS (Foreign Agricultural Service) in August 2009 that has data on both the *volume* and *value* of imports[7].

The number of petitions filed declined gradually from 2003 to 2007, with aquaculture products showing no petition filing in 2006 and 2007. With the funding for the TAA program under the 2002 Reform Act terminating in 2007, no certification/re-certification occurred and only denial/termination occurred in calendar year 2007. After introduction of the ARRA of 2009, calendar year 2010 recorded the largest number of petitions. Also, the chances of being certified/re-certified are greater for aquaculture products (54%) than field crops (26%). There has been no petition filed after the calendar year 2010. The technical training assistance for the five commodities certified in 2010 -- asparagus, catfish, shrimp, lobster, and wild blueberries – continued until 2013 and ended as of September 29, 2013.

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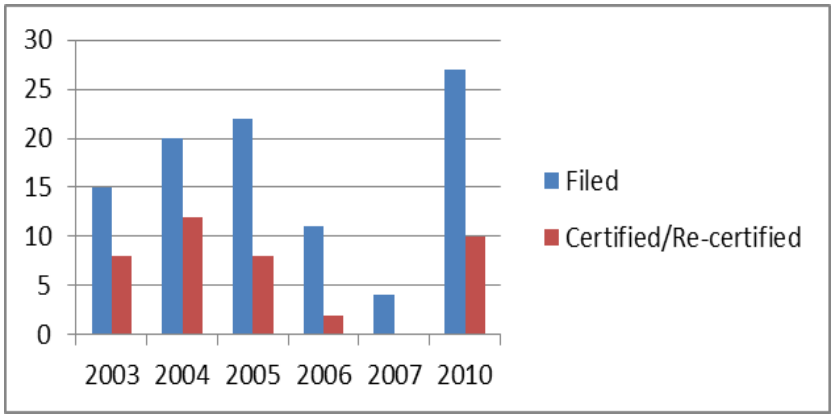
[4] http://www.nass.usda.gov/#top
[5] http://www.fas.usda.gov/info/fr/notices.asp
[6] http://www.fas.usda.gov/gats/default.aspx
[7] The group eligibility criterion in 2002 Reform Act requires that "increases in imports of articles like or directly competitive with the agricultural commodity, or class of goods within the agricultural commodity, produced by the group contributed importantly to the decline in price." However, in 2002 Reform Act, it is not clarified whether the "increases in imports" means increases in *value* of imports or in *volume* of imports.
On the other hand, the group eligibility criterion in ARRA of 2009 requires "the *volume* of imports of like or directly competitive products produced by the group in the marketing year increased compared to the average volume of such imports during the 3 marketing years preceding such marketing year."

<Table 1.2> All petitions filed and certified

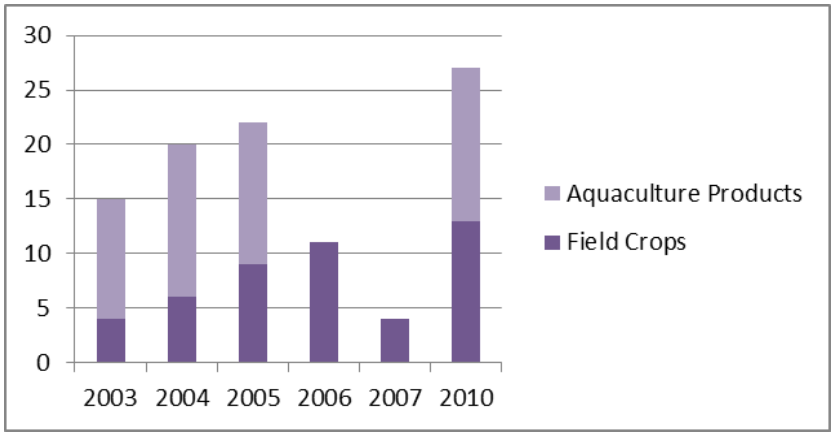
	Petitions filed (all)						
Year	2003	2004	2005	2006	2007	2010*	Sum
Filed	15	20	22	11	4	27	99
Certified	8	12	8	2	0	10	40 (40%)
	Petitions filed (field crops)						
Year	2003	2004	2005	2006	2007	2010*	Sum
Filed	4	6	9	11	4	13	47
Certified	1	1	6	2	0	2	12(26%)
	Petitions filed (aquaculture products)						
Year	2003	2004	2005	2006	2007	2010*	Sum
Filed	11	14	13	0	0	14	52
Certified	7	11	2	0	0	8	28 (54%)

*For petitions filed in 2010, ARRA of 2009 is applied.

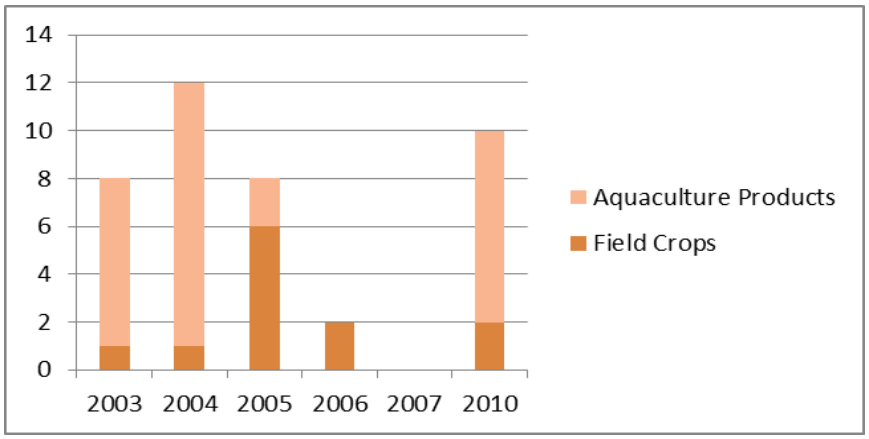
[Figure 1.1] All petitions filed and certified/re-certified



[Figure 1.2] All petitions filed for field crops and aquaculture products



[Figure 1.3] All petitions certified/re-certified for field crops and aquaculture products



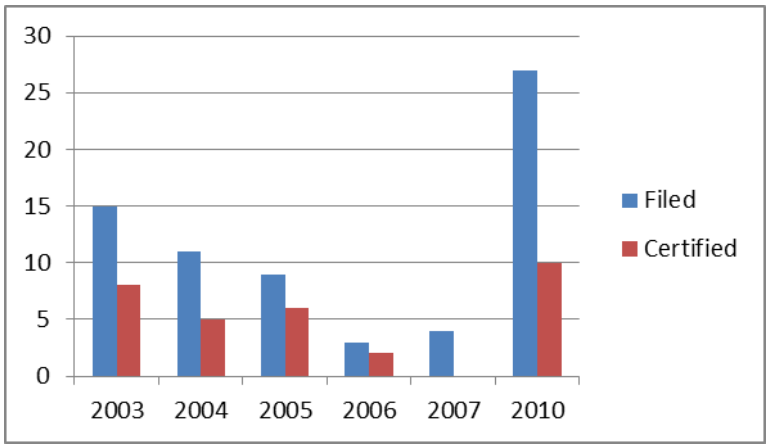
<Table 1.3> below shows the number of new petitions (excluding the continuing petitions for re-certification) filed and certified. Note that the petitions filed in 2010 are all new petitions as the new rules under the ARRA of 2009 were applied. There were 69 complete new petitions from 2003 to 2010, of which 31 (45%) were certified and 38(55%) were denied. Also, among the 69 new petitions, 37 (54%) were regarding field crops and 32 (46%) were regarding aquaculture products. As in the previous case, number of petitions filed increased much in 2010 with the new rules in 2009. When a new petition is filed, the chances of being certified were greater for aquaculture products (63%) than field crops (30%).

<Table 1.3> New petitions (excluding continuing petitions) filed and certified

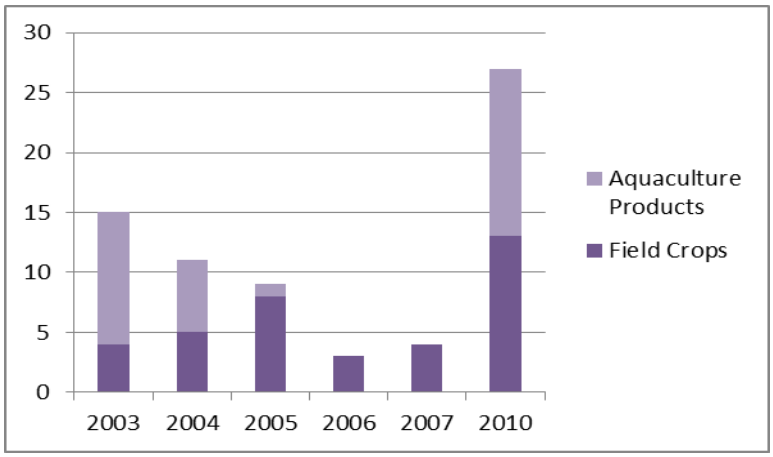
	New petitions filed (all)						
Year	2003	2004	2005	2006	2007	2010*	Sum
Filed	15	11	9	3	4	27	69
Certified	8	5	6	2	0	10	31 (45%)
	New petitions filed (field crops)						
Year	2003	2004	2005	2006	2007	2010*	Sum
Filed	4	5	8	3	4	13	37
Certified	1	1	5	2	0	2	11 (30%)
	New petitions filed (aquaculture products)						
Year	2003	2004	2005	2006	2007	2010*	Sum
Filed	11	6	1	0	0	14	32
Certified	7	4	1	0	0	8	20 (63%)

*For petitions filed in 2010, ARRA of 2009 is applied.

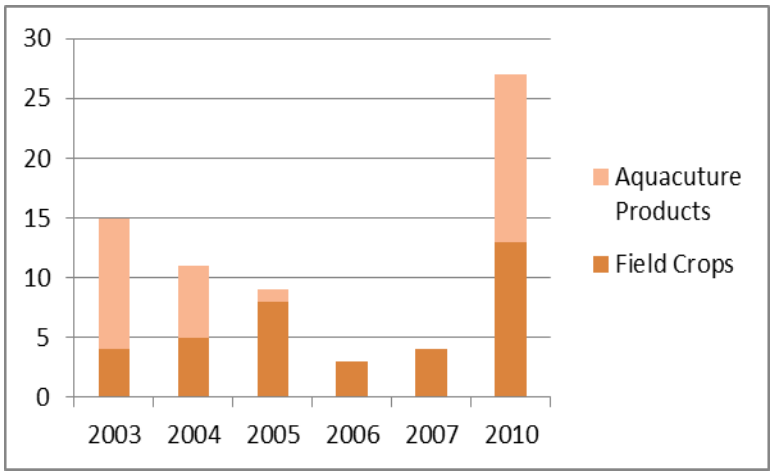
[Figure 1.4] New petitions filed and certified



[Figure 1.5] New petitions filed for field crops and aquaculture products



[Figure 1.6] New petitions certified for field crops and aquaculture products



Appendix I shows the petitions filed certified/re-certified, and **Appendix II** shows the petitions denied/terminated. Commodities for which petitions (including continuing petitions) were filed the most include Shrimp (29), Lobster (7), Salmon (7), Concord grapes (6), and Blueberries (4). States that filed the most petitions (including continuing petitions) include Florida (15), California (9), Ohio (6), Maine (6), and Idaho (6).

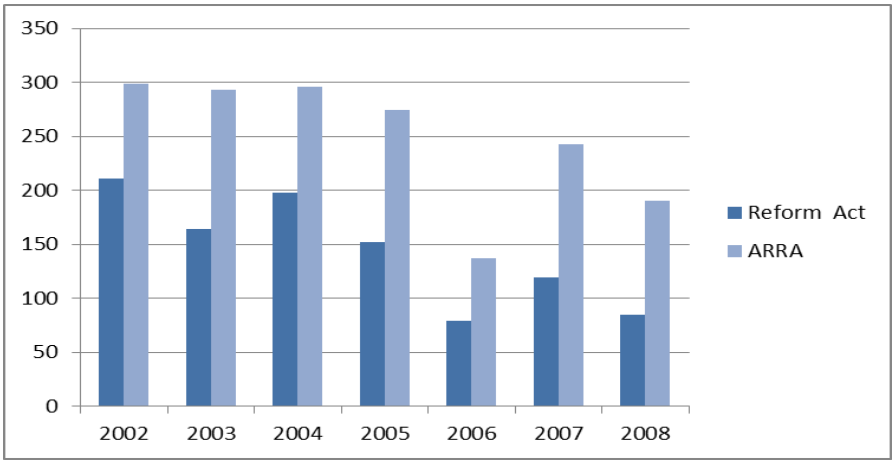
Some simple findings from the price data are as follows:[8] Petitions were ever filed for approximately 0.8% of all the commodities at state level for which price data is available: Among the 2,959 state-level field crops, petitions were ever filed for 23 commodities during 2002-2007. Revised group eligibility under the ARRA of 2009 is more lenient for producers to be qualified as eligible, and it is supported by the data gathered. Below is an approximate comparison of the numbers of eligible commodities under the two criteria – The Reform Act of 2002 and the ARRA of 2009. Looking at the number of states that produce the commodities that satisfy group eligibility, we can see that the numbers are always bigger using the eligibility criteria under the new Act.

<Table 1.4> Number of state-level commodities satisfying the group eligibility criteria for TAA

		2002	2003	2004	2005	2006	2007	2008
TAA Reform Act of 2002	Eligible (all obs.)	211 (2,352)	164 (2,691)	198 (2,644)	152 (2,591)	79 (2,578)	119 (2,524)	85 (1,528)
	Petitions filed (% of eligible)	-	4 (2.4%)	5 (2.5%)	8 (5.3%)	3 (3.8%)	4 (3.4%)	-
ARRA of 2009	Eligible (all)	299 (2,349)	293 (2,649)	296 (2,640)	274 (2,586)	137 (2,575)	243 (2,523)	190 (1,529)

[8] Note that, for some of the observations where petitions were filed, the price data is not consistent with the results from the petitions. Among the 23 observations of field crop commodities for which petitions were filed and data is available, 5 observations were inconsistent with the results of petitions. For instance, California naval orange producers filed a petition in 2004 and the petition was denied by the reason other than price, but the petitioned price actually did not decline by more than 20% from previous 5 years.
Some of this inconsistency is resulting from the fact that the petitioners submitted price data from local authorities such that the decision to file a petition is based on that data source, not based on the NASS data. For instance, the state of Idaho filed a petition regarding fresh potatoes in 2005. They submitted the price data from the Idaho Agricultural Statistics Office.

[Figure 1.7] Number of eligible commodities under the Reform Act of 2002 and the ARRA of 2009



III. Conclusion

Observations from this chapter is the following: First, the TAA for Farmers program has been mostly underused since the introduction in 2002, with petitions filed for only approximately 0.8% of all the state-level field commodities for which price data is available. Second, the eligibility criteria became more lenient with the new ARRA of 2009, and accordingly, the number of petitions filed increased substantially during the calendar year 2010. Third, the chances that petitions are approved are higher for aquaculture products (54%) than field crops (26%).

The first observation above motivates the Chapter 2 of this thesis. In Chapter 2, I try to attack the puzzle of low program participation considering factors such as access to information and incentives of farmers as well as eligibility criteria. Chapter 3 focuses on the impact of the TAA for Farmers program, using a generalized model that allows for both the coupled and decoupled government payment schemes. By making different assumptions on the eligibility criteria and the payment scheme, I aim to analyze the impact of the program on the optimal outputs, prices, and welfare. Thus, the second observation above and the implication of the lenient eligibility criteria will be revisited in Chapter 3. Due to the limitation of data, aquaculture products are not included in the analysis.

CHAPTER 2

DETERMINANTS OF PROGRAM PARTICIPATION

I. Introduction

The Trade Expansion Act of 1962 first established Trade Adjustment Assistance (TAA) programs for workers and firms dislocated by international trade liberalization, and the TAA for Farmers program was established by the TAA Reform Act of 2002 ("Reform Act"). The program assists farmers adversely affected by import competition through cash benefits up to $10,000 per year and technical assistance provided by the U.S. Department of Agriculture. To certify for TAA benefits, the price of the commodity in a given marketing year should be less than 80% of the national average price in the five preceding marketing years, and increases in imports of the commodity or like product must have demonstrably contributed importantly to the price decline. The American Recovery and Reinvestment Act of 2009 (abbreviated ARRA) revised the Reform Act, making the eligibility criteria less strict. With the new Act, the price of the commodity should be less than 85% of the average price of three preceding marketing years. Also, the volume or the value of imports should show an increase, and the causality between the increase and the decline in prices should be proved. Most recently, the Trade Adjustment Assistance Extension Act of 2011 (abbreviated TAAEA) reauthorized the program until the fiscal year 2014.

Data shows that, between 2003 and 2007, the TAA petitions were filed for only about 0.8% of all the commodities at state level. This chapter starts by questioning why farmers' participation in the TAA program had been meager, by investigating the various determinants of farmers' participation in the program. The chapter aims to evaluate the TAA for farmers program under the 2002 TAA Reform Act in terms of participation, to discuss the

appropriateness of its reform in ARRA of 2009, and to give policy implications on optimal design of future TAA policy.

There is a two-step decision making process in the TAA for Farmers program. First, farmers decide whether to file a petition or not. Once farmers file a petition, the USDA FAS (Foreign Agricultural Service) investigates the data to approve/deny the petition. I focus on the farmers' side of decision making and examine the factors affecting farmers' participation in the TAA program taking three groups of factors into account: eligibility criteria, access to information, and incentives. Hypothesis with respect to each of the factors is set and is empirically tested. Data on TAA petitions-- dates of petitions and approval/denial decisions, commodity and groups involved in filing petitions-- from year 2003 to 2007, commodity prices and imports, and state farm characteristics from 1997 to 2008 was collected from the USDA's NASS (National Agricultural Statistics Service), GATS (Global Agricultural Trade System) database, ERS (Economic Research Service), and the Bureau of Labor Statistics. A "Rare events logistic" estimator was used instead of the traditional logit model to account for the large disparity of 0s and 1s in the dependent variable – farmers' petition filing decisions. Robustness test is done in two ways, (i) using the fixed effect logistic regression that takes the commodity fixed effect into account, and (ii) using only the observations that price eligibility is satisfied. The results are mostly consistent. First, price, import, and income eligibility criteria are either insignificant to the petition-filing behavior or show signs contradictory to our hypotheses. Second, better access to information and know-how acquired by observing the previous cases of approval of similar commodity significantly increases the chances of petition filing. Third, incentives are significant in the decision making. Specifically, states that experienced a recent decrease in direct government payments are hypothesized to have higher financial incentives and thus file more petitions, and these hypotheses are supported. Also,

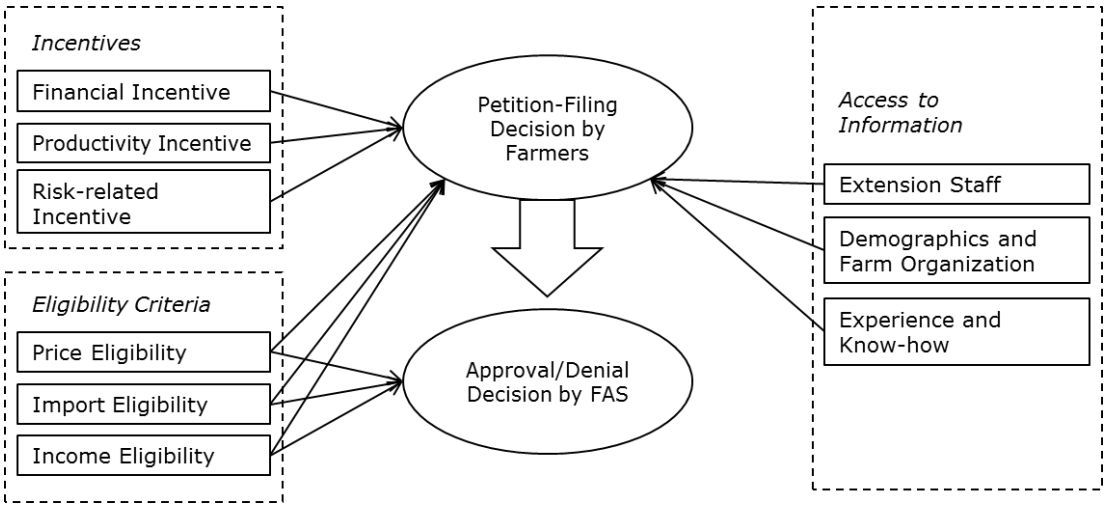
risk-related incentives are shown to be significant, with coefficient of variances of prices showing positive and significant impact on petition-filing.

There have been only a few studies on the TAA for Farmers program which have primarily focused on the issue of eligibility criteria. According to Bacho *et al.* (2008), out of 69 complete petitions reviewed from 2002 to July 2007, 41 (59.4%) turned out to be ineligible for program benefit by USDA FAS. The study points out failure to meet eligibility criteria as a major reason for ineligibility, and thus suggests to relax eligibility requirements. Another study conducted by the U.S. Government Accountability Office (GAO) (2006) also directs strict eligibility criteria as well as low cash payments as potential factors that discourage farmers from participating in the program. This study tries to answer whether it is the strict eligibility criteria that create the low participation of farmers.

The contribution of this chapter to the TAA literature is as follows: First, the data set which encompasses TAA petition, price, import, and farm characteristics of state-level commodity data can be used as a knowledge base for future TAA studies. Second, this study is the first rigorous attempt to answer the questions of TAA program participation using the rare events logistic estimator. Last but not least, the study uniquely examines the role of information and incentives, which were mostly ignored in the previous TAA literature. Rationale for including these factors could be found outside the TAA literature. I focus on the extension as a potential source of information based on Feder and Slade (1984) and Whitacre (2008), and on the role of education based on Mishra and Park (2005). Also, assuming risk-averse farmers influenced by Moscardi and Janvry (1977), Binswanger (1980), Dillon and Scandizzo (1978), risk-reducing effect of TAA benefits are used as a measure of incentives.

II. Hypotheses

[Figure 2.1] The conceptual framework



[Figure 2.1] provides the conceptual framework of the decision making processes related to the TAA program-- petition-filing decision by farmers as potential participants and approval/denial decision by the FAS (Foreign Agricultural Service). First, petition-filing decision is made by farmers who take into account eligibility criteria and incentives for filing petitions given available information. Once petitions are filed, the FAS decides whether to approve or deny the petitions based on the eligibility criteria. In this study, I focus only on the petition-filing decision making by farmers. I categorize three main groups of factors that I expect to affect farmers' petition filing behavior: Eligibility criteria, access to information, and motivation.

1. Eligibility Criteria

In order for a group of farmers who has filed a TAA petition to be eligible for the cash benefits, they should meet the following criteria: (i) the price of the commodity in a given marketing year should be less than 80% of the national average price in the 5 preceding

marketing years. (ii) There needs to be an increase in imports of like or directly competitive products[9] during the most recent 12 months period, and (iii) the increase in imports has demonstrably contributed to the price decline[10]. Once judged eligible by the FAS, cash payment will be made to the producers if: (iv) farmers' net farm income[11] for the most recent year is less than that of the latest year, and (v) the farmers have met with Extension officers and receive technical assistance. Hereafter, I call the criteria (i), (ii), and (iv) "the price criterion," "the import criterion," and "the income criterion" respectively[12]. Since these eligibility criteria are to be verified by the USDA for approval, I expect that farmers are more likely to file a petition for the commodities that meet the aforementioned three eligibility criteria.

H_1: Chances of petition filing will increase if the commodity and producers in consideration meet the (a) price, (b) import, and/or (c) income criteria.

[9] According to Sec. 1580.102 of the 7 C.F.R. (Code of Federal Regulations), "*like or directly competitive* generally means products falling under the same HTS number used to identify the agricultural commodity in the petition. A "like" product means substantially identical in inherent or intrinsic characteristics, and the term "directly competitive" means those articles which are substantially equivalent for commercial purposes, that is, are adapted to the same uses and are essentially interchangeable therefore."

[10] According Section 291 of the Trade Act of 2002 - 107 P.L. 210, "*contributed importantly* means a cause which is important, but not necessarily more important than any other cause," and is determined by the Secretary of Agriculture.

[11] According to the USDA's website, net farm income is "a value of production measure, indicating the farm operators' share of the net value added to the national economy within a calendar year, independent of whether it is received in cash or a noncash form such as increases/decreases in inventories and imputed rental for the farm operator's dwelling." It is also a "portion of the net value added by agriculture to the national economy earned by farm operators (i.e., the entrepreneurial earnings of those individuals who share in the risks of production and materially participate in the operation of the business)." Source:http://www.ers.usda.gov/briefing/farmincome/glossary/def_nfi.htm

[12] Since it is not easy both for the potential participants (producers) to address the causality between the surge in imports and decline in prices in the petition-filing stage and for me to come up with a measure for such causality, I do not include the criterion (iii) in the analysis. Also, criterion (v) is not included in the analysis because it is what farmers *will* have to fulfill in order to receive cash benefit once eligible for the benefit, not something which is determined *prior to* filing the petition.

2. Access to Information

Farmers may simply not know about the existence of the TAA program, or may not have an access to relevant information – such as administrative processes for petition-filing and/or related price and import data – which would potentially decrease farmers' participation. According to a study about the TAA for Workers program by the Schiller *et al.* (2009), many potentially eligible workers do not know if the program exists or how to petition for certification, which deters program participation. Brock *et al.* (2002) points out that simply not knowing about programs themselves or their benefits deterred participation to welfare-to-work programs during 1992-94, citing a study conducted by the National Evaluation of Welfare-to-Work Strategies. Also, Breakell (2011) argued that the lack of knowledge about the presence of the farmland protection programs is a potentially significant barrier to farmers' participation in these programs. To capture the effect of information access, or lack thereof, I will examine: (i) the role of extension staff, (ii) education and age of farmers, and (iii) experience and know-how.

2.1 Extension Staff

I expect the farmers in states with more cooperative extension staff per farmers are likely to have more opportunity to gain information about the program. Feder and Slade (1984) considered extension as a major source of information to farmers, and used the extension agents' visits to the village in which farmers reside as a measure of access to information. More recently, Whitacre (2008) emphasized the role of extension educators in encouraging broadband access and usage, thus access to information.

> H_2: Chances of petition filing will increase if farmers have better access to information. States with more extension staffs per number of farmers will have more information on the TAA program and thus will file more petitions.

2.2 Education and age of farmers

I focus on the role of education and age of farmers on obtaining the information on the TAA program, on the procedure for petitioning, and on relevant data. I expect more educated and younger farmers to have better access to internet, attend more workshops and seminars, contact more with extension officers and local government offices, etc., which might contribute to a better knowledge of TAA program. The evidences supporting this hypothesis can be found in previous studies. Jenkins *et al.* (2011) find that age, and education affect cotton farmers' decisions to select and search for precision farming information. Younger, well-educated cotton farmers use more extension services, media, and private sources to obtain farming information. Mittal and Mehar (2012) suggests that education level plays crucial role in farmer's decision to use different sources of information. Education level of farm operator is shown to have a positive and significant impact on the farmers' use of internet (Mishra and Park, 2005). A study by Whitacre (2008) also shows that education level is one of the factors that create major gaps in digital access and use. Shade (2002) also indicates that the factors such as income, education, gender, and age greatly affect the diffusion of digital technology and innovation.

> H_3: Chances of petition filing will increase if farmers have better access to information on TAA. States with: (a) younger and (b) better educated farmers will have better access to information, and thus will file more petitions.

2.3 Experience and know-how

Foster and Rosenzweig (1995) studied rural farmers in India and found that farmers' own experience and neighbors' experience with new technologies improved adoption and profitability of high-yielding seed varieties. As individuals learn from themselves, their neighbors, and their peers, the concepts "learning by doing" and "learning from others" can

not only be applied to production, but also to TAA petition behaviors. When farmers are considering a petition, previous cases of approval on the same or similar commodity in consideration will not only provide a useful benchmark but also reduce costs associated with getting necessary information and farmers' perceived risk of denial. Know-how and experience obtained by the course of the previous cases will act as a crucial factor for petition-filing decision.

H_4: Chances of petition filling will be higher for the commodities on which petition was approved before.

3. Incentives

Merely knowing about the program, having information on necessary procedures, and knowing whether the commodity meets the eligibility criteria may not be sufficient for farmers to *actually* file a petition considering the opportunity cost of filing the petitions. I postulate that there are three types of incentives -- financial, productivity-related, and risk-related -- for the TAA benefits that can actually motivate farmers to file a petition.

3.1 Financial incentives

Financial incentives are factors related to expected monetary gain from filing a petition and receiving a cash payment after being proved eligible. A crucial point about the TAA cash benefit is the existence of cash payment cap of $10,000 per year. Hence, for farmers producing and selling certain commodities at a very large scale, the marginal benefit from filing a petition and receiving not more than a $10,000 of cash payment may be very small or nonexistent compared to the large amount of revenue received by selling the commodity, and therefore there will be less petitions filed related to those commodities. Therefore I expect that average farm size has a negative effect on the petition filing.

Tenure of farmers may affect the farmers' financial incentives as well. I expect full owner, as opposed to part owner and tenant owner, are likely to have more direct monetary interests, and thus have higher motivation for filing petitions. Several previous studies of land tenure and investment can be a rationale for this idea. Smith (2004) finds a positive relationship between documentation of land title and fixed investments in Zambia. Graham and Darroch (2001) show that more security of tenure is related to higher demand for credit for agricultural investment financing. Other studies done by Gebremedhin and Swinton (2003), and Place and Otsuka (2002) also find evidence that tenure of farmers is positively related to incentives for investments.

Also, farmers with farming as their primary occupation are expected to have higher financial incentives. Previous researchers have examined the relationship between farming as a primary occupation and farmers' motivations to improve efficiency, to invest, etc. Lambert *et al*. (2006) find that farm operators whose primary occupation is farming are more likely to adopt practices that require extra time and expense than farm operators who focus on nonfarm occupations. Kibet *et al*. (2011) studied farmers in Kenya and show that farming as main occupation as one of the factors that significantly increases the adoption of high yielding and high value crops. In the context of TAA, states with higher percentage of farms owned by full owners and those with higher percentage of farmers with farming as their primary occupation are expected to invest more time and effort to file more TAA petitions that would possibly result in financial assistance.

Lastly, receipt of other types of direct government payments, such as counter-cyclical payments and marketing loan benefits, may affect the marginal benefit from the TAA cash payment. For farmers in states that experienced an increase in the receipt of other types of direct government payments are expected show less cases of petitions.

H_5: Chances of petition filing will increase if financial incentives related to cash benefit increase, and vice versa. Chances of petition filing will decrease (a) if the average farm size of a state is bigger. Chances of petition filing will increase in the states with (b) more farms owned by full owners and (c) more farmers with farming as their primary occupation, and in the states that (d) recently experienced a decrease in the receipts of other direct government payments.

3.2 Productivity incentives

Cash payment is not the only benefit that farmers can receive once they become eligible. Before TAA payments are made, farmers are expected to meet at least once with Extension officers to receive hand-on training. This mandatory technical assistance is not only a responsibility but also a privilege that farmers will take once eligible for cash benefit. For farmers with less education and technology, this technical assistance will act as an opportunity to enhance productivity and thus a motivation for filing petitions. Also, farmers in states with more cooperative extension specialists per farmers are expected to have more opportunity to gain education and information from sources other than TAA program, and hence less productivity incentive to file a petition.

H_6: Chances of petition filing will increase if productivity incentives are higher, and vice versa. States with (a) lower total factor productivity and (b) smaller percentage of farmers with some college or higher education are expected to have higher productivity incentive, and file more petitions. States with (c) more extension specialists per number of farmers are expected to have less productivity incentive, and thus file less petitions.

3.3 Risk-related incentive

By compensating for the half of the difference of the 80% of the price for the 5 years preceding the most recent marketing year ($0.8 \times P_a$) and the price in the most recent marketing year (P_r), TAA cash payment sets an effective lower bound for the commodity price. Hence, a farmer can reduce income volatility by participating in the TAA program and receiving the cash payment. I assume that farmers are risk-averse, following a number of previous studies that suggested the evidences— Moscardi and Janvry (1977), Binswanger (1980), Dillon and Scandizzo (1978) -- and expect that a risk-reducing effect of TAA payments will act as an incentive for farmers to file a petition. I use coefficient of variances of commodity price as a measure of such risk.

H_7: Chances of petition filing will increase if risk-related incentive of farmers is higher. Farmers will have more risk-related incentive to file a petition for a commodity with higher coefficient of variation of prices.

<Table 2.1> Summary of the hypotheses

Factor		Hypotheses	Related variables
Eligibility criteria	Price eligibility	H_1 (a)	Eligible in 5 year price criteria (+)
	Import eligibility	H_1 (b)	Eligible in 1-year import criteria (+), Eligible in 5-year import criteria (+)
	Income eligibility	H_1 (c)	Eligible in income criteria (+)
Access to information	Extension staff	H_2	Number of extension staff members per 1,000 farmers (+), Number of farm advisors per 1,000 farmers (+)
	Farm demographics and organization	H_3 (a)-(b)	Average age of farmers (-), Some college or upper education in rural population (+)
	Experience and know-how	H_4	Year dummy 04-07 (+), Previously approved commodity (+)

<Table 2.1> Summary of the hypotheses (continued)

Factor		Hypotheses	Related variables
Incentives	Financial incentive	H_5 (a)-(d)	Farm size (-), Farming as primary occupation (+), Full owner (+), Change in direct government payment from previous year (-)
	Productivity incentive	H_6 (a)-(c)	Total factor productivity (-), Some college or upper education in rural population (+), Number of farm advisors per 1,000 farmers (+)
	Risk-related incentive	H_7	Coefficient of variation of commodity prices (+)

1) Hypothesized effect on TAA petitions in parentheses

III. Data and Descriptive Statistics

1. Data

Data from different sources are compiled to construct the data set used for this study. The variable names and description is in **Appendix III.**

Petition-related data

Petition-related data includes both dependent variable (petition) and some independent variables (previously_approved, years). Petition-related data was collected from observing the Federal Register Notices on TAA for farmers posted on the USDA FAS (Foreign Agricultural Service) website[13]. The variables contain whether the petition was filed for a certain commodity produced in a certain state and a year, whether a filed petition for TAA is approved, whether a commodity had been petitioned and approved ever before, whether the petition is a new petition or a re-evaluation for those approved in the previous year, and whether the petition was filed by a single state or by multiple states.

Price data

State-level price data from 1997 to 2008 was collected for 388 field crop commodities. The data was obtained both from the Quick Stats[14] database and the *Agricultural Prices* reports[15] available at the USDA NASS (National Agricultural Statistics Service) website. Based on this data, I calculated average prices for 5 and 3 preceding years, and coefficient of variation using the 5 year price data.

[13] http://www.fas.usda.gov/info/fr/notices.asp
[14] http://www.nass.usda.gov/Data_and_Statistics/Quick_Stats/index.asp
[15] http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1002

Import data

Import data for agricultural products from 1997 to 2008 was collected from the GATS (Global Agricultural Trade System) database[16] in the USDA FAS. Data on both import quantity and import value are collected. BICO (HS-10) products grouping was used because the level of grouping was most comparable with the one in the commodity price data. Once all the import data was collected, HS-10 product code was then matched with the commodity categories in the price data. I collapsed import data by summing up the imports of related commodity categories. Then, variables on percentage changes of import quantity and value, and import eligibility are calculated.

State farm characteristics

Data on farm demographics and farm characteristics of each state for 1997, 2002, and 2007 (number of farmers, average farm size, tenure of farmers, average age of farm operators, education of rural population, percentage of farm operators with farming as their primary occupation) are collected from the State Fact Sheets database[17] available on the USDA ERS (Economic Research Service) website. Data on net farm income (1997-2008), government payments (2000-2008), total factor productivity (2000-2004), and number of extension staff (1997) for each state are also collected from the data sets obtain at the USDA ERS. Variable in income eligibility was calculated from the net farm income data. Number of farm or home management advisors (2000-2008) used as an alternative for the number extension staff was obtained from the Occupational Employment Survey (OES)[18] from the Bureau of Labor Statistics, Department of Labor.

[16] http://www.fas.usda.gov/gats/default.aspx
[17] http://www.ers.usda.gov/StateFacts/
[18] http://stat.bls.gov/oes/home.htm

2. Descriptive Statistics

<Table 2.2> reports descriptive statistics on petition-related variables. From 2003 to 2007 during when the first round of the TAA for Farmers program was effective, only 105 among 13,161 observations (0.8%) satisfy all three criteria (price, import, and income criteria) for the TAA benefit based on our data. In 2004 there is only one observation that satisfies all three criteria. Moreover, there is no such observation in 2005. Looking at the last column of the table, we can see that 151 petitions were filed during the period 2003-2007, and among those, 39 were approved.

In this study, "5-year price criterion" refers to price decrease in the petition year by more than 20% compared to previous 5-year average price, as provided in the TAA Reform Act of 2002. The "3-year price criterion" refers to price decrease by more than 15% compared to previous 3-year average, as given in the ARRA (American Recovery and Reinvestment Act) of 2009. The number of observations that satisfy 5-year and 3-year price criterion varies from year to year. As expected, the number of eligible commodities increases when the more lenient 3-year price criterion is used.

Due to lack of precision of the import criterion - "Increases in imports of the commodity or like product" - in the TAA Reform Act of 2002[19], I used several alternative measures. "1-year import criterion" and "5-year import criterion" are defined as increases of import quantity in the petition year compared to the previous year and the previous 5-year average, respectively. In our data, the number of eligible observations that satisfy the 5-year import criterion is slightly higher each year than the number of observations that satisfy the 1-year import criterion, except for the year 2007. Also, using either criteria, the number of eligible

[19] "Imports" could mean import *quantity* or import *value*. Also, "increases" could mean increase in imports compared to the previous year, or to the previous 5-year average, etc.

observations by import criterion increases in every year, meaning that more and more commodities each year show increases in import quantity.

Unlike price and import criteria, there is a huge volatility in the number of eligible observations by income criteria (producers' net farm income for the most recent year is less than that for the latest year). This in turn creates a large variation in the number of commodities satisfying all three criteria. Income criterion is expected to show the largest gap between this collected data and the data actually used by USDA. Due to limitation of data, I used the average net farm income of each state in each year, not the net farm income of the farmers actually producing specific commodity in each state in each year. This could explain why there is zero commodity that satisfies all three criteria in 2005 based on the data, but the number of approved commodities in 2006 is not zero.

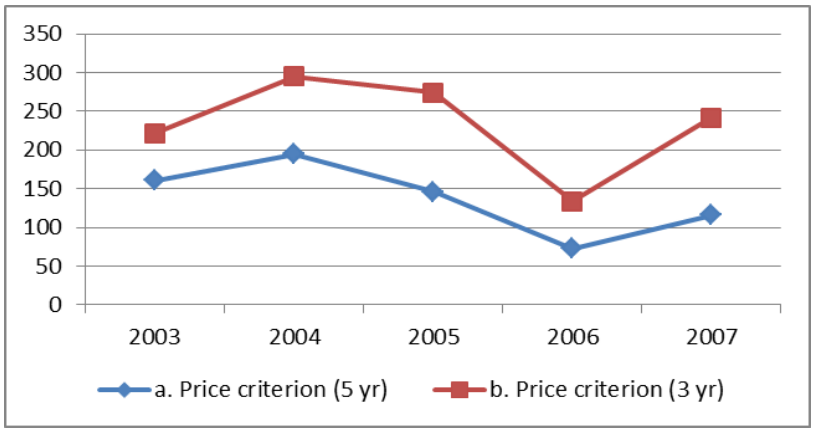
<Table 2.2> Descriptive statistics: Petition-related variables

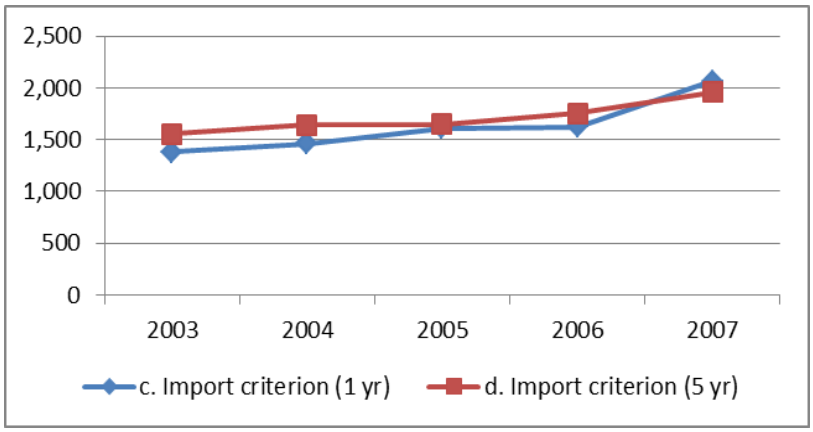
		2003	2004	2005	2006	2007	Sum
Observations		2,671	2,680	2,623	2,647	2,541	13,162
Eligibility	a. Price criterion (5 yr)	161	195	146	73	116	691
	b. Price criterion (3 yr)	222	295	274	134	242	1,167
	c. Import criterion (1 yr)	1,379	1,461	1,609	1,625	2,067	8,141
	d. Import criterion (5 yr)	1,552	1,642	1,650	1,752	1,960	8,556
	e. Income criterion	768	197	16	1,457	2,114	4,552
	All three criteria (a, c, e)	14	1	0	26	64	105
Petitions		21	23	32	39	36	151
New petitions		21	20	32	11	28	112
Re-petitions		9	0	9	11	16	36
Petitions by multiple states		0	8	14	14	26	71
Number of approvals		3	0	28	8	0	39

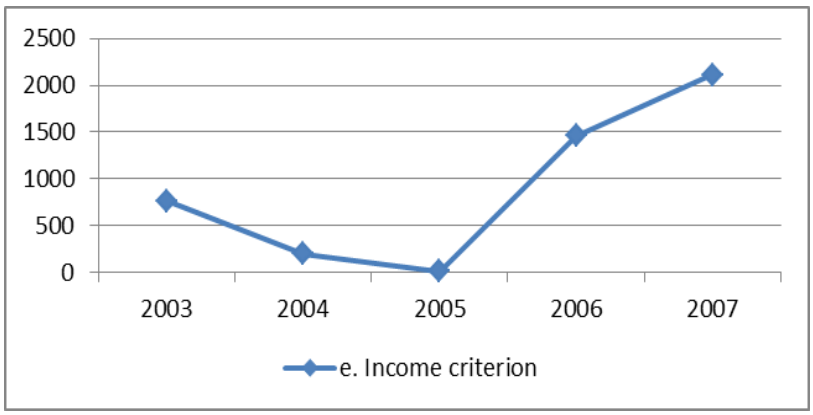
In the [Figure 2.2] below, the top, middle, and bottom panels show the number of eligible commodities in price, import, and income criteria, respectively. In the first panel, we can find that the 3-year price criterion employed by ARRA of 2009 is easier to be met than the 5-year price criterion by the Reform Act of 2002 in all years. In the second panel, we can see that the number of commodities satisfying the import criteria is increasing, based on either criterion. The third panel shows the number of commodities satisfying the income criterion.

The graph is U-shaped, and the number is 16 in 2005, meaning that the farmers' income in the states producing the respective commodities tended to increase until 2005. In 2006 and in 2007, there is a sharp increase in the number of state commodities for which farmers' income have declined.

[Figure 2.2] Number of commodities eligible in price, import, and income criteria

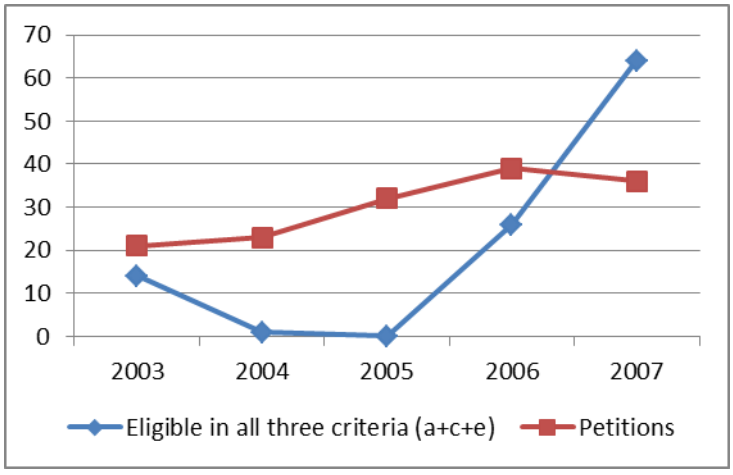






Looking at [Figure 2.3], it is interesting to note that the number of petitions filed exceeds the number of observations that actually satisfy all three criteria, except for the year 2007. A small number of petitions filed along with even smaller number of commodities that satisfy all three criteria for eligibility is consistent to the claims made by a previous study by the U.S. Government Accountability Office (GAO) (2006) that the eligibility criteria for TAA benefits are too strict.

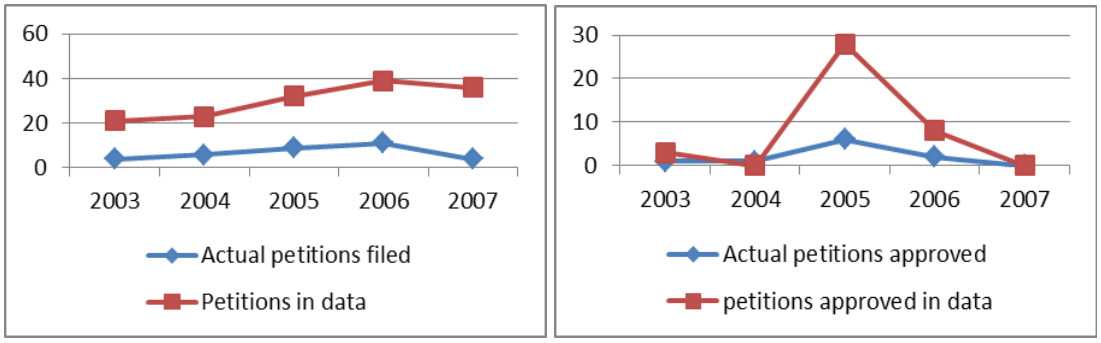
[Figure 2.3] Number of eligible observations and number of petitions filed



The number of petitions and approvals counted in our data differs from the *actual* number of petitions filed and approved due to several reasons[20]. [Figure 2.4] compares the actual number of petitions filed and approved on field crops and number of petitions filed and approved counted in our data. Although the numbers differ, the shapes resemble each other.

[20] Number of petitions and approvals in our data differs from the actual number of petitions filed and approved, because of the three main reasons: i) Scope of analysis - In this study, only field crops are considered and fisheries and marine products are excluded. ii) Definition of commodities - Definition and scope of a certain product in the actual petition case could be different from those in our study. For example, if petition was filed on "black olives," it is not quite clear whether this means "fresh olives," "processing olives," or both. In this study, I treated this kind of cases as though it means both. iii) Limitation of data - Some petition cases could not be included in our analysis due to a lack of data. These cases include: Florida fresh longans (2004), Florida lychees (2004), Indiana snapdragon (2005)

[Figure 2.4] Numbers of petitions filed (left) and approved (right)



<Table 2.3> Descriptive statistics: State-level variables

Variable	All (12,948 Obs.)[1]		Petitioned (151 Obs.)[2]		Approved (39 Obs.)[3]	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Farm size (acre)	570.9	763.4	326.1	366.7	271.7	113.84
Average age	55.65	1.42	55.57	1.46	54.74	1.43
Some college or upper (%)	44.26	7.55	45.11	8.57	45.17	8.2
Primary occupation	55.16	6.82	54.82	6.63	57.05	4.04
Net farm income (million $)	10,095	22,414	4,255	8,763	2,636	2,641
Full owner (%)	69.65	7.66	71.63	4.63	71.65	4.44
Individual (%)	87.29	4.12	86.34	3.98	87.04	3.84
Change of government payment	0.13	0.68	-0.04	0.4	0.36	0.43
Extension staff ratio	9.1	6.24	7.71	4.57	8.1	4.75
Farm advisors ratio	7.7	7.41	8.11	7.59	7.76	6.92
Hours worked per week	39.7	3	40.39	2.77	40.62	2.83
Total factor productivity	1.21	0.29	1.29	0.32	1.32	0.29

1) For farm advisors ratio, 9,342 obs.
2) For farm advisors ratio, 137 obs.
3) For farm advisors ratio, 35 obs.

<Table 2.3> shows descriptive statistics for state-level variables associated with all, petitioned, and approved observations, respectively. Compared to all observations, on average, petitioned observations tend to show smaller farm size, lower average age of farm operators and lower percentage of farmers with farming as their primary occupation, smaller net farm income and percentage of individual operators, and extension staff ratio. Petitioned

observations show on average 4% decrease in the amount of direct government payment between the petition year and the year before, whereas all observations show a 13% increase. Compared to all cases, petitioned cases on average show higher level of education (higher percentage of rural population with some college or upper education), higher percentage of full owner, higher farm advisors ratio, more hours worked per week, and higher total factor productivity. <Table 2.4> below shows which of the hypotheses are supported based on simple comparison of means.

<Table 2.4> Results from comparing the mean of state characteristics

Factor		Hypothesis[1)]	Results
Access to information	Extension staff	H_2: Extension staff ratio (+)	Contradictory
	Demographics and farm organization	H_{3a}: Average age of farmers (-)	**Supported**
		H_{3b}: Some college or upper education (+)	**Supported**
	Experience and know-how	H_{4b}: Previously approved (+)	-
Incentives	Financial	H_{5a}: Farm size (-)	**Supported**
		H_{5b}: Farms owned by full owners (+)	**Supported**
		H_{5c}: Farming as primary occupation (+)	Contradictory
		H_{5d}: % Change in government payment (-)	**Supported**
	Productivity	H_{6a}: Total factor productivity (-)	Contradictory
		H_{6b}: Some college or upper education (-)	Contradictory
		H_{6c}: Extension staff ratio (-)	**Supported**

1) Anticipated effect on petition filing decision in parentheses.

Compared to petitioned cases, on average, approved cases show smaller farm size and average age, and lower farm advisors ratio. Also, approved cases show higher percentage of rural population with some college or upper education, higher percentage of farmers with farming as their primary occupation, higher net farm income, higher percentage of full owners and individual farm operators, higher extension staff ratio and total factor productivity, and more hours worked per week.

<Table 2.5> below shows the correlation coefficients among independent variables. The variance inflation factors (VIFs) from ordinary-least-squares regressions have a mean value of 2.23, ranging from 1.00 (cv) to 3.77 (primary), which are presented in <Table 2.6>. VIF is a

measure of severity of multicollinearity. Based on the common rule of thumb of 10 (O'brien, 2007), I conclude that the multicollinearity among the variables are not so severe in this study.

<Table 2.5> Correlation among variables (obs=10,713)

	extension_ratio	Avg age	Some college	prev~ approved	Farm size	primary	full owner	chg_govpmt	cv	tfp
extension_ratio	1									
avg_age	-0.033	1								
somecollege	0.104	-0.052	1							
prev~approved	-0.001	0.04	0.019	1						
farmsize	0.24	-0.079	0.246	-0.026	1					
primary	-0.075	-0.504	0.268	-0.057	0.287	1				
full owner	0.234	0.462	-0.028	0.018	-0.077	-0.489	1			
chg_govpmt	0.115	-0.081	-0.063	-0.08	-0.009	0.093	0.004	1		
cv	-0.012	0.01	0.006	0	0.002	0.006	0.006	-0.003	1	
tfp	0.058	0.192	0.238	0.03	-0.2	0.145	0.376	-0.031	0.006	1

<Table 2.6> Variance Inflation Factors of variables

Variable	VIF	1/VIF
primary	3.77	0.26503
tfp	3	0.33322
full_owner	2.66	0.3764
farmsize	2.32	0.43031
somecollege	2.22	0.45046
chg_govpmt	2.13	0.47014
avg_age	1.89	0.52891
previously_approved	1.06	0.94775
cv	1	0.99678

IV. Empirical Strategy

Since the dependent variable is dichotomous, I use the binary logistic regression approach to test the hypotheses. In binary logistic regressions, the dependent variable Y has a value of 1 with probability π and 0 with probability 1- π.

$$\pi = \frac{e^z}{e^z + 1} = \frac{1}{1 + e^{-z}}$$

where $z = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3$.

X_1, X_2 , and X_3 are the vectors of variables related to the four factors affecting the petition-filing decision – namely, eligibility criteria, access to information, and incentives, respectively.

In our data, only 151 petitions are filed, which accounts for only about 1.1% of the total of 13,161 observations. Because of this large disparity between the numbers of 0s 1s in the dependent variable, application of the standard logit regression method may result in biased coefficients and underestimate rare events (King and Zeng, 2001a, 2001b), in this paper, petition-filing. Hence, I apply the method of relogit (rare events logistic regression), an unbiased estimator developed by King and Zeng (2001a, 2001b) for rare events and small samples. Relogit estimates the same model as a traditional logit regression but corrects for possible coefficient biases by producing lower mean square error in case of rare events (King and Zeng, 2001b).

V. Hypothesis Tests

I run relogit models to test the impact of the three groups of factors – eligibility criteria, access to information, and incentives– on farmers' petition filing behavior. <Table 2.7> reports the relogit results with binary variable "petition" (petition =1, non-petition =0) as a dependent variable. I start from Model 1 and successively augment the model until Model 6. I do so to see the robustness of the results (i) when adding the time-related variables such as year dummies, and (ii) when alternative variables are used to test certain hypotheses. Model 1 in column (1) shows the relogit result without any time-related variables included. Model 2 in column (2) augments the Model 1 by including the factor "previously_approved." Model 3 in column (3) includes both the variable "previously_approved" and the year dummies. Let us call the Model 3 our "main model." Model 4 through Model 6 in columns (4) to (6) modifies the main model by using various alternative measures. Model uses the total factor productivity ("tfp") instead of some college or upper education ("somecollege") as a measure of productivity and opportunity cost for filing a petition. Model 5 uses 5-year import criterion instead of 1-year import criterion by using the variable "eligible_import5" instead of "eligible_import." Model 6 uses the variable "farm_advisor_ratio" instead of "extension _ratio."

1. Eligibility Criteria

Eligibility criteria show either insignificant or contradictory results. Price eligibility (eligible_price5) is shown to have a positive effect on petition filing as expected, but is insignificant, in all six models. Import eligibility (eligible_import) is showing a negative and significant coefficient in Models 1 through 3, meaning that satisfying the import eligibility criterion lowers the chances that the commodity is petitioned. However, the levels of

significance decreases as more time-related variables are added in the model. Moreover, the sign of the coefficient flips to positive when 5-year import criterion is used in Model 5. Income eligibility (eligible_income) is shown to be insignificant in all models except for Model 2, where the variable was negative and significant, contrary to our expectation. Also, the signs flip from negative to positive according to different specifications. Hence, it is hard to find an evidence to support hypotheses from H_{1a} to H_{1c}. These counter-intuitive or insignificant results on eligibility criteria imply the following: First, farmers do not tend to respond well to the import surge or decline in price and income by filing TAA petitions. Also, some factors other than eligibility criteria may be more significant in determining TAA participation. Second, the results show a high sensitivity to different criteria used, which means that a lack of clearly-defined criteria can be a loophole in the policy. For example, when we use the 5-year import criterion in Model 5 instead of 1-year criterion, the sign on the import criterion flips from negative to positive. The Reform Act of 2002 sets out that the "increases in imports like or directly competitive commodity…contributed importantly to the decline in price" as one of the eligibility criteria, but it does not specify how the "increases in imports" is measured – whether the value or quantity of imports is used, and the reference point to measure the "increase," etc.

2. Access to information

2.1 Extension staff

Ratio of the number of cooperative extension staff members to the number of farmers (ext_ratio) shows a negative and significant coefficient in Models 1 through 5, contradicting the H_2 which expected that higher extension staff ratio will decrease the chances of petition filing. When I use the ratio of farm and home management advisors to the number of farmers (adv_farmers) instead (Model 6), the coefficient is still negative, although insignificant. Hence

hypothesis H_2 is not supported by our data. One possible explanation for this might be that the states with larger number of extension staff members to the number of farmers already enjoy other types of government support programs and are better equipped with new information and technology such that the financial assistance and technical training from the TAA program is not adding much of values. It may also be due to the data. The most recent data of the extension staff members was as of 1997. Therefore, the time frame of the variables does not exactly match, and there might have been some change in the number since 1997.

2.2 Demographics and farm organization

The coefficient on average age of farm operators is negative and significant in all six models, supporting H_{3a} which proposed that states with younger farmers with better access to information are more likely to file more petitions. Some college or upper education has a positive and significant impact on petition filing only in Model 1, and positive and insignificant impact in other models. In Model 4, education factor is not included. Hence, the hypothesis H_{3b} is supported only on Model 1.

2.3 Experience and know-how

Previous cases of approval (previously_approved) have a positive and highly significant impact on the petition-filing in all specifications, as predicted in H_4. Therefore, the experience and know-how accumulated from previous approval of the same state commodity does seem to raise the possibility of filing petitions on the same state commodity.

3. Incentives

3.1 Financial incentive

"Farmsize" shows negative impacts on petition as expected in H_{5a}, but the impacts are insignificant in all specifications except for Model 4. "Full_owner" shows positive and highly significant impacts on petition filing in all specifications, which means that chances of petition filing increased in the states with more farms owned by full owners. Hence, the hypothesis H_{5b} is supported. "Primary" shows positive and significant coefficients in Models 2-6, and positive and insignificant in Model 1. Hence, H_{5c} is supported. "Chg_govpmt" showed negative effects in all six models with 1% level of significance, except for in Model 2 where the coefficient was not significant. Hence, hypothesis H_{5d} is supported, suggesting that the chances of petition filing increases in the states that experienced recent decreases in direct government payments.

3.2 Productivity incentive

"Tfp" showed a negative and insignificant impact on petition filing. Hence, there is not enough evidence to support the hypothesis H_{6a}. "somecollege" was positive and insignificant in Models 2, 3, 5, and 6, thus failing to support both H_{3b} and H_{6b}. However, the hypothesis H_{6c} is supported, based on the negative and significant impact of extension staff ratio in Models 1-5. When the farm advisor ratio is used in Model 6 instead of the extension staff ratio, the coefficient was negative and insignificant. Note that the hypotheses H_2 and H_{6c} cannot be supported simultaneously from the outset, since they expect the opposite effects of extension staff ratio on petition filing decision. Based on our results, we can infer that the impact of higher extension staff ratio is generally negative, with lower productivity incentives created from the higher extension staff ratio outweighing its positive impact on access to information.

3.3 Risk-related incentive

"Cv" showed positive effect on the petition-filing decision in all specifications, significant in 1% level in Models 2-6, and in 5% level in Model 1. Therefore, the hypothesis H_7 that

expected higher variances of commodity prices to increase risk-related incentives of farmers and thus increase the chances of petition filing is supported.

<Table 2.7> Relogit results[1), 2)]

Variables	(1)	(2)	(3)	(4)	(5)	(6)
eligible_price5	0.130	0.437	0.338	0.416	0.308	0.488
	(0.368)	(0.409)	(0.411)	(0.421)	(0.407)	(0.424)
eligible_import	-0.738 ***	-0.394 **	-0.321 *	-0.311		-0.216
	(0.190)	(0.180)	(0.187)	(0.189)		(0.195)
eligible_import5					0.216	
					(0.240)	
eligible_income	0.078	-0.543 ***	-0.178	0.032	-0.147	0.123
	(0.193)	(0.201)	(0.241)	(0.241)	(0.241)	(0.252)
extension_ratio	-0.053 **	-0.058 **	-0.047 **	-0.051 ***	-0.047 **	
	0.022	(0.021)	(0.020)	(0.019)	(0.020)	
farm_advisor_ratio						-0.009
						(0.014)
avg_age	-0.165 **	-0.159 *	-0.246 ***	-0.201 **	-0.246 ***	-0.255 ***
	(0.082)	(0.089)	(0.091)	(0.087)	(0.092)	(0.085)
somecollege	0.027 **	0.014	0.0003		0.00007	0.003
	(0.011)	(0.012)	(0.012)		(0.012)	(0.018)
tfp				-0.255		
				(0.465)		
primary	0.067	0.039 **	0.074 ***	0.069 ***	0.072 ***	0.060 **
	(0.020)	(0.019)	(0.023)	(0.026)	(0.023)	(0.027)
farmsize	-0.001	-0.001	-0.001	-0.001 *	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
full_owner	0.052 ***	0.060 ***	0.084 ***	0.073 ***	0.083 ***	0.071 ***
	(0.015)	(0.017)	(0.018)	(0.017)	(0.018)	(0.023)
chg_govpmt	-0.698 ***	-0.141	-1.984 ***	-1.879 ***	-1.980 ***	-1.707 ***
	(0.192)	(0.143)	(0.396)	(0.383)	(0.400)	(0.365)
cv	0.239 **	0.241 ***	0.275 ***	0.279 ***	0.281 ***	0.305 ***
	(0.079)	(0.073)	(0.070)	(0.071)	(0.072)	(0.091)
previously_approved		3.923 ***	4.523 ***	4.558 ***	4.574 **	4.472 ***
		(0.224)	(0.359)	(0.352)	(0.315)	(0.363)
yr04			-0.712 *	-0.502	-0.734 *	-0.487
			(0.383)	(0.392)	(0.387)	(0.397)
yr05			1.515 ***	1.635 ***	1.466 ***	1.551 ***
			(0.395)	(0.417)	(0.395)	(0.418)
yr06			-1.855 ***	-1.675 ***	-1.989 ***	-1.720 ***
			(0.461)	(0.459)	(0.456)	(0.457)
yr07			-0.800	-0.833	-0.910 *	-0.961 *
			(0.513)	(0.511)	(0.524)	(0.527)
cons	0.752	-1.965	-0.118	-1.348	-0.235	1.487
	(4.648)	(4.773)	(4.374)	(4.915)	(4.435)	(4.148)
Obs.	12,131	12,137	12,137	10,179	12,137	8,881

1) *, **, ***: significant in 10%, 5%, and 1% level, respectively. Standard errors in parentheses.
2) Relogit is not a maximum likelihood estimator. Therefore, relogit does not provide log likelihood or pseudo R^2.

VI. Robustness Tests

1. Controlling for Commodity Fixed Effects

For robustness check, I first control for the commodity fixed effects to account for the variations within the groups of different commodities. That way, I try to mitigate the unobserved heterogeneity among commodities that are constant among time, and potential correlation of commodities and independent variables. I use the "xtlogit" command in STATA to estimate commodity fixed-effects logistic regression models. Columns (1) - (6) in <Table 2.8> show the results from the fixed-effects logistic regression using the identical variables used in each model in the relogit analysis. All six models are highly significant, and results are mostly consistent with those from the relogit analysis. Note that, in each model, number of observations in xtlogit analysis shrinks down to about 10% of relogit analysis, because STATA automatically drops a number of groups based on all positive or all negative results.

Let us focus only some noticeable differences between the two sets of results. First, there are some discrepancies in the results on the eligibility criteria. In xtlogit, coefficients on price eligibility are showing negative signs, although none of them is significant. The signs are all positive in relogit analysis, although all insignificant. This is mainly due to the large standard errors involved. Also, import eligibility which consistently showed negative signs in all specifications in relogit becomes insignificant in xtlogit analysis except for Model 1. Second, except for price eligibility and "primary," xtlogit results mostly preserves the signs of the coefficients in the relogit analysis, although the level of significance varies. Variable "somecollege" preserves positive sign and becomes highly significant in all specifications in xtlogit analysis, whereas in relogit the variable was significant only in Model 1. "Farmsize" also preserves negative sign, but becomes significant in Modes 1, 2, 3, and 5 in xtlogit analysis. "Extension_ratio" and "cv" both preserve their signs in xtlogit. However, they lose

significance in Models 3-6 of xtlogit analysis. "Primary" shows the most notable differences in two analyses. It was positive and significant in Models 2-6 of relogit analysis. However, the variable becomes negative and significant in Models 1 and 6 in xtlogit. One possible explanation for this inconsistency is the relatively high correlation with other independent variables and the high VIF that the variable "Primary" shows.[21] Possible multicollinearity problem might have caused the flipping signs of the coefficient.

<Table 2.8> Xtlogit results[1)]

Variables	(1)	(2)	(3)	(4)	(5)	(6)
eligible_price5	-0.381	-0.123	-0.315	-0.363	-0.350	-0.199
	(0.399)	(0.401)	(0.419)	(0.426)	(0.421)	(0.435)
eligible_import	-0.672 ***	-0.305	-0.286	-0.308		-0.237
	(0.216)	(0.233)	(0.241)	(0.256)		(0.259)
eligible_import5					-0.617 *	
					(0.332)	
eligible_income	-0.232	-0.669 **	-0.505 *	-0.327	-0.518 *	-0.240
	(0.239)	(0.266)	(0.296)	(0.302)	(0.299)	(0.304)
extension_ratio	-0.034 *	-0.040 *	-0.032	-0.028	-0.030	
	(0.021)	(0.021)	(0.022)	(0.023)	(0.022)	
farm_adv~_ratio						0.017
						(0.017)
avg_age	-0.362 ***	-0.366 ***	-0.449 ***	-0.408 ***	-0.443 ***	-0.631 ***
	(0.104)	(0.106)	(0.118)	(0.106)	(0.117)	(0.129)
somecollege	0.065 ***	0.064 ***	0.057 ***		0.056 ***	0.075 ***
	(0.017)	(0.018)	(0.019)		(0.019)	(0.023)
tfp				-0.235		
				(0.635)		
primary	-0.043 *	-0.022	0.009	0.002	0.011	-0.084 **
	(0.023)	(0.023)	(0.033)	(0.037)	(0.033)	(0.038)
farmsize	-0.001 *	-0.001 *	-0.001 **	-0.0003	-0.001 *	-0.0001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
full_owner	0.038	0.043 *	0.064 **	0.031	0.065 **	0.002
	(0.024)	(0.024)	(0.026)	(0.028)	(0.026)	(0.027)
chg_govpmt	-0.506 **	-0.281	-2.283 ***	-2.088 ***	-2.269 ***	-1.793 ***
	(0.229)	(0.217)	(0.551)	(0.546)	(0.551)	(0.523)
cv	0.830 **	0.736 **	0.572	0.556	0.549	0.575
	(0.376)	(0.372)	(0.370)	(0.372)	(0.371)	(0.386)
prev~_approved		1.607 ***	2.231 ***	2.287 ***	2.420 ***	2.316 ***
		(0.329)	(0.454)	(0.470)	(0.434)	(0.495)
yr04			-1.189 **	-0.943 *	-1.173 **	-0.733
			(0.489)	(0.495)	(0.490)	(0.487)
yr05			1.408 ***	1.541 ***	1.362 ***	1.492 ***
			(0.428)	(0.453)	(0.425)	(0.454)
yr06			-1.732 ***	-1.498 ***	-1.878 ***	-1.421 **
			(0.565)	(0.571)	(0.568)	(0.582)
yr07			-0.812	-0.785	-0.893	-1.384 *
			(0.691)	(0.705)	(0.688)	(0.721)
Log likelihood	-340.70	-328.06	-313.92	-288.26	-312.91	-259.25
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Obs.	1812	1812	1812	1621	1812	1322

1) *, **, ***: significant in 10%, 5%, and 1% level, respectively. Standard errors in parentheses.

[21] "Primary" had a VIF of 3.77, and it is the second highest among the variables. "Indiv" had VIF of 5.02, and it was dropped based on the concern of multicollinearity.

2. Using Only the Eligible Commodities

Next results show the robustness check using only the commodities that satisfy the five-year price eligibility. Note that the number of observations shrinks down to 657, only about 5% of that of the original data. Among 657 observations, petitions were filed for only 9 observations, which accounts for only 1.3%. Here the squared average age of farmers (ave_age_squared) is also included to consider the nonlinear effects of age and standard ordinary least squres (OLS) method is used. Columns (1) through (6) in <Table 2.9> shows the results. Variables are mostly insignificant possibly due to the shrinkage of observations and also due to highly disproportionate dependent variable. However, "primary" is positive and highly significant in Models 1-6, and "farmsize" is negative and significant in Models 1-5, supporting the original relogit results. Besides, the year dummies for 2004 and 2006 are negative and significant. Although insignificant, the sign on the farmers' age is preserved to be negative. The sign on the squared average age is positive. Therefore, state commodities with younger farmers tend to show more cases of petition. However, the effect becomes less pronounced as the average age of farmers decreases further.

<Table 2.9> OLS results with only the eligible (5-year price criteria) commodities[1)]

Variables	(1)	(2)	(3)	(4)	(5)	(6)
extension_ratio	0.001	0.0010	0.0012	0.0011	0.0012	
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	
farm_adv~ratio						-0.0015
						(0.001)
avg_age	-0.3011	-0.3064	-0.2795	-0.2873	-0.2795	-0.3802
	(0.239)	(0.240)	(0.273)	(0.322)	(0.273)	(0.464)
ave_age_sq.	0.0027	0.0027	0.0024	0.0025	0.0024	0.0033
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)
somecollege	0.0001	0.0001	-0.0001		-0.0001	-0.0020
	(0.000)	(0.000)	(0.000)		(0.000)	(0.001)
tfp				0.0184		
				(0.031)		
primary	0.0027 ***	0.0026 ***	0.0029 ***	0.0020 **	0.0029 **	0.0051 **
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.002)
farmsize	-0.0001 **	0.0001 **	-0.0001 **	-0.0001 **	-0.0001 **	-0.0001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
full_owner	0.0009	0.0010	0.0012	0.0005	0.0012	0.0034 *
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)
chg_govpmt	0.0038	0.0037	-0.0148	-0.0139	-0.0148	-0.0031
	(0.007)	(0.007)	(0.010)	(0.011)	(0.010)	(0.016)
cv	-0.0003	-0.0003	-0.0001	-0.0002	-0.0001	-0.0031
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.005)
prev~approved		-0.0133	-0.0120	-0.0158	-0.0120	-0.0189
		(0.044)	(0.044)	(0.053)	(0.044)	(0.062)
yr04			-0.0329 **	-0.0371 **	-0.0329 **	-0.0426 *
			(0.014)	(0.016)	(0.014)	(0.022)
yr05			0.0064	0.0057	0.0064	-0.0013
			(0.014)	(0.017)	(0.014)	(0.025)
yr06			-0.0394 **	-0.0456 **	-0.0394 **	-0.0565 *
			(0.018)	(0.022)	(0.014)	(0.031)
yr07			-0.0145	-0.0276	-0.0145	0.0083
			(0.024)	(0.029)	(0.024)	(0.044)
cons	8.1899	8.3366	7.6248	7.9395	7.6248	10.5283
	(6.680)	(6.702)	(7.626)	(9.005)	(7.626)	(12.94)
Prob > F	0.0824	0.1181	0.0511	0.0967	0.0511	0.1120
R squared	0.0233	0.0234	0.0358	0.0384	0.0358	0.0506
Adj. R squared	0.0097	0.0083	0.0147	0.0132	0.0147	0.0166
Obs.	657	657	657	551	657	406

1) *, **, ***: significant in 10%, 5%, and 1% level, respectively. Standard errors in parentheses.

<Table 2.10> below summarizes the results from the main model (Model 3) in the original relogit analysis and robustness checks using xtlogit and OLS (eligible only) analyses. Hypotheses H_{3b} and H_{5a} that failed to be supported in relogit analysis due to insignificance are supported in xtlogit analysis, whereas hypotheses H_{5c} and H_{6c} that are supported in relogit

failed to be supported in xtlogit analysis and the OLS using the eligible cases. Hypothesis H_{5c} that were supported in relogit but was insignificant in xtlogit was also supported in the OLS.

<Table 2.10> Comparison of relogit and xtlogit results in the main model (Model 3)

Factor		Hypothesis[1)]	Relogit	Xtlogit	Eligible (OLS)
Eligibility criteria	Price eligibility	H_{1a}: Price eligibility (+)	Insignificant	Insignificant	-
	Import eligibility	H_{1b}: Import eligibility (+)	Contradictory	Insignificant	-
	Income eligibility	H_{1c}: Income eligibility (+)	Insignificant	Contradictory	-
Access to information	Extension staff	H_2: Extension staff ratio (+)	Contradictory	Insignificant	Insignificant
	Demographics and farm organization	H_{3a}: Average age of farmers (-)	**Supported**	**Supported**	Insignificant
		H_{3b}: Some college or upper education (+)	Insignificant	**Supported**	**Supported**
	Experience and know-how	H_{4b}: Previously approved (+)	**Supported**	**Supported**	Insignificant
Incentives	Financial	H_{5a}: Farm size (-)	Insignificant	**Supported**	**Supported**
		H_{5b}: Farms owned by full owners (+)	**Supported**	**Supported**	Insignificant
		H_{5c}: Farming as primary occupation (+)	**Supported**	Insignificant	**Supported**
		H_{5d}: % Change in government payment (-)	**Supported**	**Supported**	Insignificant
	Productivity	H_{6a}: Total factor productivity (-)	Insignificant	Insignificant	Insignificant
		H_{6b}: Some college or upper education (-)	Insignificant	Contradictory	Insignificant
		H_{6c}: Extension staff ratio (-)	**Supported**	Insignificant	Insignificant
	Risk-related	H_7: Coefficient of variance of prices (+)	**Supported**	Insignificant	Insignificant

1) Anticipated effect on petition filing decision in parentheses.

VII. Conclusion

This study questions the reasons why farmers' participation in the TAA program has been meager. I examined the factors affecting farmers' participation in the TAA program taking three groups of factors into account – eligibility criteria, access to information, and incentives. To do that, petition data from year 2003 to 2007, and price and import data from 1997 to 2008 was collected. Data on state farm characteristics is collected for different time frame for different variables. Considering the large disparity of 0s and 1s in the dependent variable, "rare events logistic" estimator ("relogit" command in STATA) developed by King and Zeng (2001a, 2001b) was used instead of traditional logit model. Robustness of the result was checked by (i) using the fixed effect logistic regression (using "xtlogit" command in STATA) that takes commodity fixed effect into account, and (ii) using only the commodities that satisfy price eligibility.

The results are mostly consistent in xtlogit analysis. First, in both relogit and xtlogit analyses, price, import, and income eligibility criteria are either insignificant to the petition-filing decision making or are showing signs contradictory to our expectation. Possible explanations are as follows: (i) Farmers may not be responding well to the decline in prices and income, and surges in import by participating in the TAA program. Lack of information and data related to the program, and cost in terms of time and efforts to file a petition might be a reason. (ii) It may be simply due to the extremely strict eligibility criteria-- only a handful of observations actually meet the criteria and thus it is hard to explain the petition-filing behavior of farmers with those extremely small number of observations. This point adds to the argument that the TAA eligibility criteria have been too strict (United States Government Accountability Office (GAO), 2006), and in this context, revisions in ARRA (American Recovery and Reinvestment Act of 2009) that made group eligibility requirements more

lenient is expected to increase not only farmers' participation in the program but also the role of eligibility criteria as a factor of petition-filing decision making.

Second, access to information significantly affects the petition-filing behaviors. I considered the role of education and technology such as internet as factors affecting the access to information. States with better educated and younger rural population filed more petitions as expected. Also, know-how acquired by observing the previous cases of approval of similar commodity also significantly increases the chances of petition filing. Hence, helping farmers acquiring information on the TAA program itself, administrative procedures, or related data may increase the participation in the program. I also examined the role of extension staff in providing necessary information to farmers. However, the results were either contradictory or insignificant. This might be due to the mismatch of time period of data. Another possibility is that the states with higher extension staff ratio may already be enjoying the benefits from other types of government support programs, which may make participation in the TAA program unnecessary.

Third, incentives are also shown to be a significant factor in the decision making. States with smaller farm size, states with higher percentage of farms owned by full owners, states with higher percentage of farmers with farming as their primary occupations, and states that experienced a recent decrease in direct government payments file more petitions. Also, risk-related incentives are shown to be significant in the relogit analysis, with coefficient of variances of prices showing positive and significant impact on petition filing decision. This implies that policy makers may increase farmers' participation in the program by increasing the remuneration and risk-reducing effect expected from the program. Thus, adjustment made by ARRA of 2009 in the cash payment cap from $10,000 to $12,000 is expected to increase farmers' incentive and participation in the program. Productivity incentive, hypothesized to be less for states with higher extension staff ratio, is also shown to have an effect on petition

filing behavior. Hence, in order to increase program participation, policymakers need to better incentivize farmers to actually participate –for example, providing more information to farmers with farming as their primary occupation, to farmers whose crops are subject to higher price volatility, and to those in more dire need of technical assistance may increase program participation.

Some limitations remain. First, although I used price data from USDA ERS expecting that the FAS is using the same data, there are still some discrepancies between the eligibility results from FAS and results from my data. Also, actual data farmers use when filing a petition may be different from what I used in the study. Second, the time period of data differ among variables. For example, some data such as the price, import, income, and petition data are collected in yearly basis. However, some farm characteristics such as farm size or average age of farmers were available only in 5-year terms. Also, there may be a gap between calendar year and marketing year of each commodity. The price criterion uses the marketing year. However, the data collected on price and imports, and on other farm characteristics are based on calendar year. This mismatch might have affected the results. Third, there are still econometric concerns. Although I tried to control for possible endogeneity and multicollinearity problems concerning the variables, finding better instruments for factors such as access to information, incentives, and opportunity costs and dealing with potential multicollinearity problem remain as main concerns of further analysis.

CHAPTER 3

POLICY IMPACT

I. Introduction

According to the Reform Act of 2002, a group of agricultural producers is eligible for TAA benefits – cash payment and technical training-- if: (i) the national average price of the commodity for the most recent marketing year is less than the 80% of the average price for the five preceding marketing years, and if (ii) increases in imports of like or directly competitive commodity contributed importantly to the decline in prices. Once producers are approved to be eligible by the USDA, the amount of cash adjustment assistance given to the producers follows the formula for a payment related to the amount of production. The American Recovery and Reinvestment Act of 2009 (abbreviated ARRA, Pub. L. 111-5) under the Obama administration amended the Reform Act. The ARRA appropriated $90 million per year of funding in fiscal years 2009 and 2010, and $22.5 million for the first quarter of fiscal year 2011. It also revised the eligibility criteria. A group of producers is eligible for TAA benefits if (i) the national average price for the most recent marketing year is less than 85% of the average price for the three preceding years, and if (ii) the volume or the value of imports has increased and has caused the decline in prices. Producers, once proven eligible, are paid lump sum cash payments that do not follow the formula. The Trade Adjustment Assistance Extension Act of 2011 (TAAEA) reauthorized the program until the fiscal year 2014. However, since the Act did not appropriate any funding, the USDA can only continue to provide funding for the certified commodities under ARRA of 2009 and cannot accept additional petitions for certification.

In this paper, I examine the impact of the TAA program. How do different TAA regimes affect optimal output, producer prices, and welfare of farmers? For example, how differently

do the “coupled” TAA regime under the Reform Act of 2002 and the new “decoupled” TAA regime under the ARRA of 2009 distort prices and output? What if they amended the eligibility criteria?

These questions are important given the recent preferences of policy makers towards the decoupled government support programs. The point of going from coupling to decoupling is to sever the linkage between the level of production and the amount of support. That way, production distortion that might cause inefficiency is mitigated. However, even with the decoupled program, if the optimal production decision is affected, we cannot say that the whole purpose of decoupling-- mitigating production distortion and promoting efficiency-- is served. Also, the decoupled program still might affect the producer prices and the welfare of farmers. Delving upon this question might help design a better TAA program in the future, a program that better helps farmers to adjust to import competitions, promotes their welfare, and minimizes potential inefficiency that can result from government supports.

As an introductory step, basics of the TAA programs of first and second rounds and their impact on producer prices are discussed. Next, using a model where producers maximize expected utility from profit, a comparative statics analysis is done to figure out the impacts of the TAA programs on (i) the mean of producer prices, (ii) spread of producer prices, (iii) optimal output, and (iv) welfare of farmers. We take an extensive approach that allows a discussion of both rounds of TAA programs, and their possible modifications by simple change of parameters. Use of a mathematical model and an extensive approach to analyze the impact of TAA programs in different dimensions will be a major contribution of this chapter.

II. Literature Review

This chapter is related to three streams of literature-- i) the TAA for Farmers program, iii) impacts of government agricultural support programs on production, and iii) decision making under uncertainty.

Previous studies on the TAA were mostly on the TAA for Workers program. There has been a very thin literature on the TAA for Farmers program, most of which focused on the eligibility criteria for the program benefits. Studies have pointed out that the eligibility criteria for the TAA for Farmers program under the Reform Act of 2002 were too strict. According to Bacho *et al.* (2008), out of 69 complete petitions reviewed from 2002 to July 2007, 41 petitions (59.4%) turned out to be ineligible for program benefit. The study points out the failure to meet the eligibility criteria (such as proving that increased import significantly contributed to a decline in commodity's price and proving that price declined more than 20 percent) as a major reason for such phenomenon, and suggests to relax the eligibility requirements. Another study conducted by the U.S. Government Accountability Office (GAO) (2006) also directs strict eligibility criteria as well as small amount of cash payments as potential factors that discourage farmers from participating in the program. It also pointed out that financial and technical assistance provided to producers are too limited and of short-term basis. A report for Congress by Jurenas (2010) provides an overview of the TAA for Farmers program and the program activities up to 2010. The ARRA of 2009 mandated the GAO to submit a report on the effectiveness of the TAA for Farmers program. As a result, a very recent report by GAO (2012) provides an update of the program—what commodities were certified and what proportion of applicants received payments after the reauthorization of the TAA for Farmers by the ARRA of 2009. According to the report, the USDA certified relatively few commodities after the reauthorization—5 out of 18 commodities -- but once the commodities are certified, about 90 percent of the producers who produce certified

commodities were approved for TAA payments. The report also argues that the USDA FAS' performance measures on the TAA program do not measure long term effectiveness or outcomes of technical assistance. Ruan *et al*. (2007) focused on a particular commodity to address the eligibility issue. They constructed an econometric model to distinguish domestic from foreign impacts on the U.S. prices, and used this model to find out that the U.S. raspberry producers will infrequently be qualified for the benefits from the TAA. So far, no study has used a mathematical model to consider the impact of the TAA program. We take an inclusive approach that allows, by a simple change of parameters in the model, a discussion of the both TAA regimes and possible modifications, which will be a major difference of this study from other studies on the TAA.

This chapter is also expected to contribute to the literature on the impact of agricultural support programs of the U.S. Government. There has been a wide discussion on the topic. The actual and/or potential impacts of the programs have been analyzed in many angles – impacts on crop decision making, on farm consumption, and on off-farm labor participation. Among those, this chapter is relevant the most to the potential impacts of the government farm support program on production. Most of the literature on the topic has recently focused on the impacts of "decoupled" payment programs on agricultural production. Under the Uruguay Round of the General Agreement on Trade and Tariffs (GATT), trade distorting effect of agricultural subsidies has been an issue of regular disputes. Agricultural subsidy programs classified as "green box" subsidies that do not have, or have minimal, trade distorting effect tend to be not related to -- are "decoupled" from -- current production levels and prices, or particular products[22]. Under Federal Agriculture Improvement and Reform (FAIR) Act (1996-2002), the United States introduced a decoupled payment program named "Production Flexibility

[22] Please refer to the WTO website for more information: http://www.wto.org/english/tratop_e/agric_e/agboxes_e.htm.

Contracts" (PFC) that pays lump-sum payments to farmers based on historical program crop production (Ahearn *et al*., 2004). Under the Farm Security and Rural Investment (FSRI) Act of 2002 that replaced FAIR Act, PFC payments were renamed as "direct payments." Hence, a number of studies have focused on the effect of these decoupled programs to see if they are truly "decoupled." A stream of research has focused on producer risk and risk-related incentives to produce to analyze that. Chavas and Holt (1990) developed an acreage supply response model and found out that government price support has a cross-commodity risk-reducing effect – that is, increase in the support price for corn will result in more acres planted to soybeans. Hennessy (1998) decomposed the production impacts of income support programs into wealth, insurance, and coupling effects, and found out that the wealth and insurance effects increase optimal input levels even for supposedly decoupled programs. Likewise, a study by Anton and Mouël (2004) on the loan deficiency programs (LDPs) and counter-cyclical payments (CCPs) also showed that the programs create risk-related incentives to produce. Young and Westcott (2000) conducted an empirical study on four of the U.S. agricultural support programs and found out that PFC payments have a potential to distort production decisions, although it depends largely on the strength of the wealth effects. However, Burfisher *et al*. (2000) analyzed the effect of direct payment program in the U.S., Canada, and Mexico, and concluded that the effect on production varies by country and commodity, and are relatively small.

Other studies analyzed the effect of decoupled payments by directly looking at their impact on planted acreage. The result from these studies tend to be largely consistent: The effects of direct payments on acreage are modest. Adams *et al*. (2001) found weak empirical evidence that PFCs and market loss assistance (MLA) programs increase acreage, based on the evidence in eleven states in the U.S. between 1997 and 2000. Goodwin and Mishra (2006) also found a small but statistically significant effect of PFC and MLA payments on the acres

used for production of corn, soybeans, and wheat. Also, a recent study by Key and Roberts (2008) found small but statistically significant effects of decoupled payments on production, by studying the case of Iowa farmers in 1997 and 2002. Chau and de Gorter (2005) developed a theoretical model of cross-subsidization and conducted an empirical analysis. They showed that a removal of decoupled payments (LDPs and PFCs in their analysis) can have a large impact on exit decision of low-profit farms, but its impact on aggregate output can remain limited.

In the context of TAA for Farmers, the TAA program before the ARRA of 2009 is "coupled," or related to current production levels, because the amount of cash payment is proportional to production levels. On the other hand, the TAA program after the ARRA of 2009 is "decoupled" because the amount of cash payment is unrelated to the level of production. By parameterizing the eligibility criteria and the cash payment formula, we can examine the potential impact of both coupled and decoupled TAA programs on production. Lastly, this chapter is also related to the theory of decision making under uncertainty. Later in the chapter, we analyze the potential impact of the TAA program on optimal level of production and welfare of producers. The discussion is based heavily on the expected utility hypothesis developed by von Neumann and Morgenstern (1944-53) and on the notion of relative risk aversion formulated by Arrow (1965) and Pratt (1964). Moschini and Hennessy (2001) give an overview of the theory of decision making under uncertainty and static models under risk aversion in the context of agricultural productions. An important part of implications of the analyses done in this chapter depends on the magnitude of farmers' relative risk aversion, especially whether the magnitude is less than unity. Relative risk aversion being greater than or less than unity has been used widely in propositions by authors such as Hahn (1970) and Rothchild and Stiglitz (1971). However, empirical studies to estimate the magnitude of the relative risk aversion were done later by many other authors. The estimates

show a very wide range: According to a survey of previous studies by Choi and Menezes (1985), the magnitude range from 0.05 to over 1,000. According to a more recent survey by Conniffe and O'Neill (2012), the estimates from previous studies range from -142 to +11. Choi and Menezes (1992) showed that, according to have a relative risk aversion less than one, the individual must be almost risk neutral. Therefore, the implication of the TAA program on optimal production decision in this chapter depends on the risk preferences of farmers.

III. Modeling the TAA Reform Act of 2002

Let us first consider a farmer producing a single output. $\tilde{p}$ is the national average price of the commodity in the most recent marketing year and is assumed to be a random variable with known distribution. Let $\bar{p}$ denote the average of the national average price of the commodity for the five years preceding the most recent marketing year. $\tilde{m}$ is the amount of the TAA cash payment, which is a random variable that is determined by $\tilde{p}$ and $\bar{p}$. Also, q is the amount of production by the producer in the most recent marketing year. Finally, let $\tilde{p}_{TAA}$ denote the corresponding price of the commodity that the farmer receives based on the TAA program.

How is $\tilde{p}_{TAA}$ determined under the TAA Reform Act of 2002? According to the criterion for eligibility stated above, the TAA cash payment ($\tilde{m}$) is made to the farmer only when $\tilde{p}$ is below $0.8\bar{p}$. Once producers are approved to be eligible by the USDA, the amount of cash adjustment assistance given to the producers is half the difference between the current price and the 80% of the average price for last five years, multiplied by the amount of production according to the formula given. Hence, there are two possible cases for the amount of the cash adjustment ($\tilde{m}$) and the producer price, $\tilde{p}_{TAA}$:

Case 1: If $\tilde{p} < 0.8\bar{p}$, then the producers are eligible for TAA benefits and the TAA cash payment ($\tilde{m}$) follows the formula:

$$\tilde{m} = 0.5 \times (0.8\bar{p} - \tilde{p}) \times q.$$

Thus, the unit price $\tilde{p}_{TAA}$ that a farmer actually receives under TAA program is,

$$\tilde{p}_{TAA} = \frac{\tilde{p} \times q + \tilde{m}}{q}$$

$$= \tilde{p} + 0.5(0.8\bar{p} - \tilde{p})$$

$$= 0.5\tilde{p} + 0.5 \times 0.8\bar{p}.$$

Case 2: If $\tilde{p} \geq 0.8\bar{p}$, then the producers are not eligible for TAA benefits, so the amount of TAA cash payment is zero:

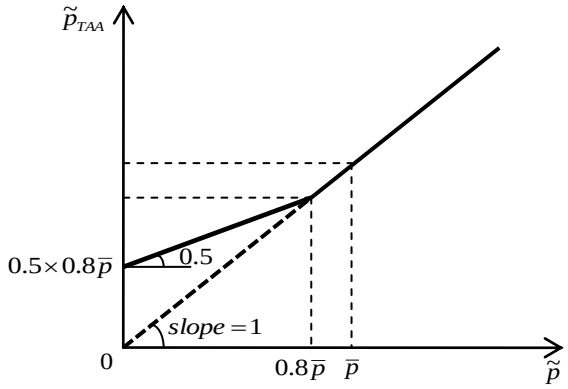
$\tilde{m} = 0$, and therefore,

$$\tilde{p}_{TAA} = \frac{\tilde{p} \times q + \tilde{m}}{q}$$

$$= \tilde{p}.$$

From the above, when $\tilde{p}$ is less than 80% of $\bar{p}$ (Case 1), the farmer receives the weighted-average of $\tilde{p}$ and the 80% of $\bar{p}$. This way, the TAA cash payment compensates for the difference between the 80% of $\bar{p}$ and $\tilde{p}$. The [Figure 3.1] below depicts this averaging-out effect of the producer price resulting from the TAA program. Without the TAA program, the producer price ($\tilde{p}_{TAA}$) is just equal to the current price ($\tilde{p}$). The solid line stands for the producer price with TAA program ($\tilde{p}_{TAA}$). The kink at $\tilde{p} = 0.8\bar{p}$ shows the point where an eligible commodity becomes ineligible, or vice versa. We can see that, in Case 1 where the farmer is eligible for the TAA payment, $\tilde{p}_{TAA}$ is bounded from below by $0.5 \times 0.8\bar{p}$.

[Figure 3.1] Producer price ($\tilde{p}_{TAA}$) with the TAA program



What is the implication of the discussions above in terms of returns and risk of producer prices? We will now show that the payoff distribution with the TAA benefit yields an

unambiguously higher return and bears less risk than that without the TAA payment, by discussing the first- and second-order stochastic dominance introduced by Hadar and Russell (1969).

First-order stochastic dominance

We can think of the probabilities of different realizations of the random variable $\tilde{p}$ as payoffs of a simple lottery. Let F(p): $\mathbb{R}_+ \rightarrow [0, 1]$ denote the cumulative distribution function (CDF) of the payoffs. In other words, F(p) is a probability (denoted as "*Prob*" below) ranging from 0 to 1 that the realized payoff of the lottery, or $\tilde{p}$, is less than or equal to p. Let us also define a TAA-payment-inclusive payoff distribution of F(p), which is the CDF of $\tilde{p}_{TAA}$, and denote it as G(p). The payoff distribution G(p) first-order stochastically dominates F(p) if we have

G(p) $\leq$ F(p) for every p in the support of G(p) and F(p).

Also, G(p) $\leq$ F(p) for every p if and only if

$$\int u(p)dG(p) \geq \int u(p)dF(p)$$

for every non-decreasing utility function u: $\mathbb{R} \rightarrow \mathbb{R}$.[23]

<u>*Proposition 1*</u>: The CDF of $\tilde{p}_{TAA}$, G(p), first-order stochastically dominates CDF of $\tilde{p}$, F(p).

<u>*Proof*</u>: It is sufficient to show that G(p) $\leq$ F(p) for every p.

In Case 1 ($\tilde{p} < 0.8\bar{p}$),

$$G(p) = Prob\{\tilde{p}_{TAA} \leq p\}$$

$$= Prob\{0.5\tilde{p} + 0.5 \times 0.8\bar{p} \leq p\}$$

[23] For definition of first-order stochastic dominance and the proof of this equivalence, I follow Definition 6.D.1 and Proposition 6.D.1, respectively, in Mas-Colell, A., M.D. Whinston, and J.R. Green, 1995, *Microeconomic Theory*, Oxford University Press, USA (June 15, 1995), p.194-195.

$$= Prob\{0.5\tilde{p} \leq p - 0.5 \times 0.8\bar{p}\}$$

$$= Prob\{\tilde{p} \leq 2p - 0.8\bar{p}\}$$

$$= F(2p - 0.8\bar{p})$$

$$= F(p + p - 0.8\bar{p}).$$

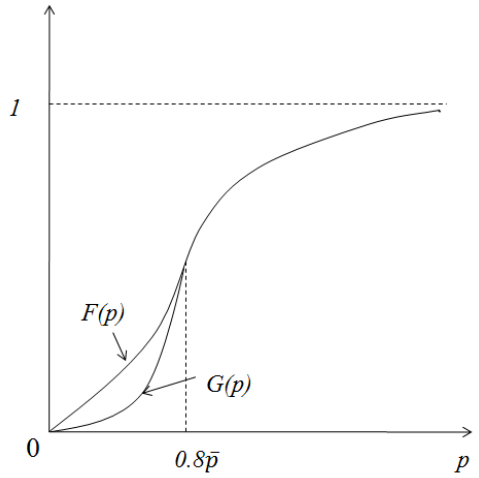
Since we only consider the case where $\tilde{p} < 0.8\bar{p}$, we actually look at only the *p*'s that are smaller than $0.8\bar{p}$. Therefore, $p - 0.8\bar{p} < 0$ in this case. Therefore, G(*p*) is F(*p*) shifted to the right by $|p - 0.8\bar{p}|$. Hence, G(*p*) $\leq$ F(*p*).

In Case 2 ($\tilde{p} \geq 0.8\bar{p}$),

$$G(p) = Prob\{\tilde{p}_{TAA} \leq p\} = Prob\{\tilde{p} \leq p\} = F(p).$$

By Cases 1 and 2, G(*p*) $\leq$ F(*p*) for every *p*, and therefore G(*p*) first-order stochastically dominates F(*p*). **(*Q.E.D.*)**

[Figure 3.2] Payoff distribution of $\tilde{p}_{TAA}$ first-order-stochastically dominates that of $\tilde{p}$



The above proposition showed that G(*p*) first-order stochastically dominates F(*p*), i.e., for every non-decreasing utility *u*: $\mathbb{R} \to \mathbb{R}$, $\int u(p)dG(p) \geq \int u(p)dF(p)$, the price distribution with TAA yields unambiguously higher returns than the price distribution without

TAA. Equivalently, expected utility is higher with TAA for any given non-decreasing utility function *u*. Therefore, any farmer with non-decreasing utility will prefer probability distribution of prices with TAA to probability distribution without TAA.

Second-order stochastic dominance

Whereas the first-order stochastic dominance is concerned with the effect of the TAA on the mean price, second-order stochastic dominance is about risk effects. By definition, when distributions G(*p*) and F(*p*) have the same mean, G(*p*) second-order stochastically dominates F(*p*) if and only if, $\forall x \in \mathbb{R}$, $\int_{-\infty}^{x} G(p)dp \leq \int_{-\infty}^{x} F(p)dp$. If G(*p*) first-order stochastically dominates F(*p*), i.e., when the mean of G(*p*) is higher than the mean of F(*p*), then G(*p*) second-order stochastically dominates F(*p*), since first-order stochastic dominance implies second-order stochastic dominance (Davidson, 2013). Since price distribution with TAA (G(*p*)) first-order stochastically dominates that without TAA (F(*p*)) as shown above, G(*p*) second-order stochastically dominates F(*p*).

Proposition 2: CDF of $\tilde{p}_{TAA}$, G(*p*), second-order stochastically dominates CDF of $\tilde{p}$, F(*p*).

Proof:

In Case 1 ($\tilde{p} < 0.8\bar{p}$),

$$\begin{aligned} G(p) &= Prob\{\tilde{p}_{TAA} \leq p\} \\ &= Prob\{0.5\tilde{p} + 0.5 \times 0.8\bar{p} \leq p\} \\ &= Prob\{0.5\tilde{p} \leq p - 0.5 \times 0.8\bar{p}\} \\ &= Prob\{\tilde{p} \leq 2p - 0.8\bar{p}\} \\ &= F(2p - 0.8\bar{p}) \\ &= F(p + p - 0.8\bar{p}). \end{aligned}$$

Since $\tilde{p} < 0.8\bar{p}$, $p - 0.8\bar{p} < 0$ in Case 1. Therefore, G(p) is F(p) shifted to the right by $|p - 0.8\bar{p}|$. Hence, G(p) $\leq$ F(p).

In Case 2 ($\tilde{p} \geq 0.8\bar{p}$),

$$G(p) = Prob\{\tilde{p}_{TAA} \leq p\} = Prob\{\tilde{p} \leq p\} = F(p).$$

By Cases 1 and 2, G(p) $\leq$ F(p) for every p, and therefore G(p) first-order stochastically dominates F(p).

Hence, $\forall x \in \mathbb{R}$, $\int_{-\infty}^{x} G(p)dp \leq \int_{-\infty}^{x} F(p)dp$. Therefore G($p$) second-order stochastically dominates F(p).

(*Q.E.D.*)

Since $\int_{-\infty}^{x} G(p)dp \leq \int_{-\infty}^{x} F(p)dp$ if and only if, for every non-decreasing and concave U : $\mathbb{R} \rightarrow \mathbb{R}$, $\int u(p)dG(p) \geq \int u(p)dF(p)$ (Tesfatsion, 1976), so expected utility is larger with price distribution with TAA. Therefore, any risk-averse farmer will prefer probability distribution of prices with TAA to the probability distribution of prices without TAA.

So far, we have learned that the price distribution with TAA first-order and second-order stochastically dominates the price distribution without TAA, i.e., provides higher mean prices and lower risk in terms of prices, and in turn, a higher expected utility. We assume that the cost for participation -- time and effort spent gathering information and preparing paperwork – is zero. Then, a reasonable prediction is that farmers will participate in the program. Hence, from now on, we assume that farmers will participate in the TAA program. In other words, farmers always apply for the TAA benefits and whenever approved eligible, they receive TAA cash payments.

IV. The Generalized Model

The foregoing discussion assumes specific numbers and formula for eligibility criteria and cash payment. In the following, I propose a parameterized model of TAA. The objective is to allow a more general model that compares both the actual and the hypothesized TAA programs with different eligibility criteria, different amount of coupled or decoupled cash payments.

1. Assumptions on Preferences

Assume that the representative farmer producing only one output has a von Neumann-Morgenstern utility function *U*: $\mathbb{R}_+ \rightarrow \mathbb{R}_+$ which is strictly increasing in profits $\tilde{\pi}(\tilde{p}_{TAA})$, strictly concave (the farmer is risk-averse), and twice continuously differentiable. Hence, $U'(\tilde{\pi}) > 0$ and $U''(\tilde{\pi}) < 0$.

2. Definition of Variables and Parameters

Assume that the farmer maximizes expected utility (EU) derived from profit $\tilde{\pi}(\tilde{p}_{TAA})$, which is a random variable defined as follows:

$$\tilde{\pi} = \tilde{p}_{TAA} \times q + D - TC(q),$$

where $\tilde{p}_{TAA}$ is the producer price (price that the farmer actually receives) in the presence of the TAA program of a given commodity in a given year. q is the quantity produced by the farmer in that given year. $D \geq 0$ is the amount of the decoupled TAA cash payment.
We also assume a linear total cost (TC) function as follows:

$$TC(q) = c_0 + cq,$$

where c≥0 is a unit cost of production, and $c_0 \geq 0$ is a fixed cost.

$\tilde{p}_{TAA}$ is a random variable that depends on $\tilde{p}$ and $\beta\bar{p}$, the price of the commodity in the most recent marketing year and the average price of the commodity for the five years preceding the most recent marketing year, respectively. Call $\beta\bar{p}$ the "threshold price" for convenience. $\beta \in (0,1]$ is a value given by the eligibility criterion. The payments are made to the farmer only when $\tilde{p}$ decreases below the threshold price, $\beta\bar{p}$. Hence, depending on the relative magnitude of the threshold price and $\tilde{p}$, there are two possibilities for the coupled and decoupled TAA cash adjustments ($\tilde{m} \geq 0$ *and* $D \geq 0$, respectively), the producer price $\tilde{p}_{TAA}$, and farmer's profit $\tilde{\pi}$:

Case 1: If $\tilde{p} < \beta\bar{p}$, then the farmer is eligible for TAA cash payment, and according to the cash payment formula,

$$\tilde{m} = \alpha(\beta\bar{p} - \tilde{p}) \times q,$$

where $\alpha \in (0,1]$ is a multiplier given by the cash adjustment assistance formula[24].

Denote $\tilde{p}_{TAA}$ as the producer price that a farmer actually receives under TAA program, or

$$\tilde{p}_{TAA} \times q = \tilde{p} \times q + \tilde{m}$$

$$= \tilde{p} \times q + \alpha(\beta\bar{p} - \tilde{p}) \times q.$$

Cancelling-out q's in both sides, we get,

$$\tilde{p}_{TAA} = \tilde{p} + \alpha(\beta\bar{p} - \tilde{p})$$

$$= (1-\alpha)\tilde{p} + \alpha\beta\bar{p}.$$

Note that the producer price ($\tilde{p}_{TAA}$) takes the form of a weighted-average of the price of the most recent marketing year ($\tilde{p}$) and the threshold price ($\beta\bar{p}$).

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[24] According to the TAA payment formula given in the TAA Reform Act of 2002, the multiplier α is 0.5 and the decoupled payment D is zero. According to the ARRA of 2009, α is zero and D ranges from $0 to $12,000. The ARRA states that "*Up to* $4,000 to develop a long-term business adjustment plan. If USDA approves the plan, *up to* $8,000 to implement the long-term plan," However, the ARRA does not specify how exactly the amount of decoupled payment is calculated.

Profit of the farmers with the TAA program ($\tilde{\pi}$) is production-related revenue ($\tilde{p}_{TAA} \times q$) plus decoupled payment from the TAA program (D), less total production cost. Therefore,

$$\tilde{\pi} = \tilde{p}_{TAA} \times q + D - TC(q)$$

$$= \{\tilde{p} + \alpha(\beta\bar{p} - \tilde{p})\} \times q + D - TC(q)$$

$$= \{(1-\alpha)\tilde{p} + \alpha\beta\bar{p}\} \times q + D - c_0 - cq.$$

Case 2: If $\tilde{p} \geq \beta\bar{p}$, then the farmer is not eligible for the TAA payment. Hence,

$$\tilde{m} = 0$$

$$D = 0$$

$$\tilde{p}_{TAA} = \tilde{p}.$$

Profit of the farmers is therefore,

$$\tilde{\pi} = \tilde{p}_{TAA} \times q + D - TC(q)$$

$$= \tilde{p}q - c_0 - cq.$$

3. Definition of the Decision Problem

Define the expected utility of the farmer as below:

$$EU = \int_0^{\beta\bar{p}} U(\tilde{\pi}) dF(\tilde{p}) + \int_{\beta\bar{p}}^{\infty} U(\tilde{\pi}) dF(\tilde{p}),$$

where for $\tilde{p} < \beta\bar{p}$, $\tilde{\pi} = \{(1-\alpha)\tilde{p} + \alpha\beta\bar{p}\}q + D - TC(q)$, and for $\tilde{p} \geq \beta\bar{p}$, $\tilde{\pi} = \tilde{p}q - TC(q)$.

Hence, the farmer's decision problem is to maximize the expected utility defined as below.

$$max \int_0^{\beta\bar{p}} U(\tilde{\pi}) dF(\tilde{p}) + \int_{\beta\bar{p}}^{\infty} U(\tilde{\pi}) dF(\tilde{p})$$

$$= max \int_0^{\beta\bar{p}} U\big(\{(1-\alpha)\tilde{p} + \alpha\beta\bar{p}\}q + D - TC(q)\big)dF(\tilde{p}) + \int_{\beta\bar{p}}^{\infty} U\big(\tilde{p}q - TC(q)\big)dF(\tilde{p})$$

V. Analysis of the Generalized Model

Based on the assumptions so far, we will examine the impact of the TAA program on the mean price, on the spread of prices, on the optimal output, and on the welfare of farmers via parameters α, β, $\bar{p}$, and D. The cumulative distribution function of $\tilde{p}$ is $F(\tilde{p})$, with a probability density function $f(\tilde{p})$, where $\tilde{p} \in [0, \infty)$.

1. Impact on the Mean Price

As discussed in the previous section, $\tilde{p}_{TAA} = (1-\alpha)\tilde{p} + \alpha\beta\bar{p}$ when $\tilde{p} < \beta\bar{p}$, and $\tilde{p}_{TAA} = \tilde{p}$ otherwise. Hence, $\mathrm{E}(\tilde{p}_{TAA})$, the expected value of $\tilde{p}_{TAA}$, can be written as follows.

$$\mathrm{E}(\tilde{p}_{TAA}) = \int_0^{\beta\bar{p}} \{(1-\alpha)\tilde{p} + \alpha\beta\bar{p}\} dF(\tilde{p}) + \int_{\beta\bar{p}}^{\infty} \tilde{p}\, dF(\tilde{p})$$

1.1 Impact of α on the mean price

$$\frac{\partial \mathrm{E}(\tilde{p}_{TAA})}{\partial \alpha} = \int_0^{\beta\bar{p}} (\beta\bar{p} - \tilde{p}) dF(\tilde{p})$$

Hence, the impact of α on the mean price is positive when $\beta\bar{p} > \tilde{p}$. Since the range of price under consideration is $\beta\bar{p} > \tilde{p}$, the impact of α on the mean price is always positive. Another way to see this effect is the following. We can alternatively express the expected value of $\tilde{p}_{TAA}$ in terms of conditional expectation as follows.

$$\mathrm{E}(\tilde{p}_{TAA}) = \mathrm{E}[\tilde{p}_{TAA} \mid \tilde{p} < \beta\bar{p}] F(\beta\bar{p}) + \mathrm{E}[\tilde{p}_{TAA} \mid \tilde{p} > \beta\bar{p}]\{1 - F(\beta\bar{p})\}$$

$$= \mathrm{E}[(1-\alpha)\tilde{p} + \alpha\beta\bar{p} \mid \tilde{p} < \beta\bar{p}] F(\beta\bar{p}) + \mathrm{E}[\tilde{p} \mid \tilde{p} > \beta\bar{p}]\{1 - F(\beta\bar{p})\}$$

From above, we can again see that α is relevant only when $\beta\bar{p} > \tilde{p}$. In this case, larger α means putting a higher weight on $\beta\bar{p}$ which is larger than $\tilde{p}$ when calculating $\mathrm{E}(\tilde{p}_{TAA})$. Therefore, bigger α increases the expected value of the producer price $\tilde{p}_{TAA}$.

1.2 Impact of β on the mean price

$$\frac{\partial \mathrm{E}(\tilde{p}_{TAA})}{\partial \beta} = \int_0^{\beta\bar{p}} \alpha\bar{p}dF(\tilde{p}) = \alpha\bar{p}F(\beta\bar{p})$$

This is positive if $\alpha\bar{p} > 0$, which is always the case given the assumption that $\alpha \in (0,1]$ and $\bar{p} > 0$. The expected producer price increases as β increases, since (i) higher β increases the possibility that the farmer becoming eligible for the TAA benefits, and (ii) once eligible, other things being equal, the producer price with TAA-- the weighted-average price of $\beta\bar{p}$ and $\tilde{p}$ -- increases as β increases. Hence, increase in β increases the mean price.

1.3 Impact of $\bar{p}$ on the mean price

$$\frac{\partial \mathrm{E}(\tilde{p}_{TAA})}{\partial \bar{p}} = \int_0^{\beta\bar{p}} \alpha\beta dF(\tilde{p}) = \alpha\beta F(\beta\bar{p})$$

This is positive if $\alpha\beta > 0$, which is always the case given the assumption that $\alpha \in (0,1]$ and $\beta \in (0,1]$. Hence, increase in $\bar{p}$ increases the mean price. This is intuitive, since (i) higher $\bar{p}$ increases the possibility that the farmer becoming eligible for the TAA benefits, and (ii) once eligible, other things being equal, the producer price with TAA -- the weighted-average price of $\beta\bar{p}$ and $\tilde{p}$ -- increases as $\bar{p}$ increases. This means that the TAA program may create a serial correlation of prices. For example, under the Reform Act of 2002, higher prices for last five marketing years ($\bar{p}$) will cause an increase in the mean price of *this* year.

1.4 Impact of D on the mean price

$$\frac{\partial \mathrm{E}(\tilde{p}_{TAA})}{\partial D} = 0$$

Since $\tilde{p}_{TAA}$ is the weighted-average of p and $\beta\bar{p}$ with α as a weight, the decoupled payment D is irrelevant in determining the $\tilde{p}_{TAA}$.

2. Impact on the Spread of Prices

Recall that,

$$\mathrm{E}(\tilde{p}_{TAA}) = \int_0^{\beta\bar{p}} \{(1-\alpha)\tilde{p} + \alpha\beta\bar{p}\} dF(\tilde{p}) + \int_{\beta\bar{p}}^{\infty} \tilde{p} dF(\tilde{p})$$

Therefore, the spread of $\tilde{p}_{TAA}$ can be expressed as follows.

$$\mathrm{Var}(\tilde{p}_{TAA}) = \int_0^{\beta\bar{p}} \{(1-\alpha)\tilde{p} + \alpha\beta\bar{p} - \mathrm{E}(\tilde{p}_{TAA})\}^2 dF(\tilde{p}) + \int_{\beta\bar{p}}^{\infty} \{\tilde{p} - \mathrm{E}(\tilde{p}_{TAA})\}^2 dF(\tilde{p}) \text{,,}$$

where

$$\mathrm{E}(\tilde{p}_{TAA}) = \mathrm{E}[\tilde{p}] + \alpha F(\beta\bar{p})\{\beta\bar{p} - \mathrm{E}(\tilde{p} | \tilde{p} < \beta\bar{p})\}, \text{ and}$$

$$\mathrm{E}(\tilde{p} | \tilde{p} < \beta\bar{p}) = \frac{\int_0^{\beta\bar{p}} \tilde{p} dF(\tilde{p})}{F(\beta\bar{p})}.$$

2.1 Impact of α on the spread of prices

$$\begin{aligned}\frac{\partial Var(\tilde{p}_{TAA})}{\partial \alpha} = \int_0^{\beta\bar{p}} & \{(1-\alpha)\tilde{p} + \alpha\beta\bar{p} \\ & - \mathrm{E}(\tilde{p}_{TAA})\} \frac{\partial\{\tilde{p} + \alpha(\beta\bar{p} - \tilde{p}) - \mathrm{E}(\tilde{p}_{TAA})\}}{\partial \alpha} dF(\tilde{p}) \\ & + \int_{\beta\bar{p}}^{\infty} \{\tilde{p} - \mathrm{E}(\tilde{p}_{TAA})\} \frac{\partial\{\tilde{p} - \mathrm{E}(\tilde{p}_{TAA})\}}{\partial \alpha} dF(\tilde{p})\end{aligned}$$

$$= \int_0^{\beta\bar{p}} \{(1-\alpha)\tilde{p} + \alpha\beta\bar{p} - \mathrm{E}(\tilde{p}_{TAA})\}\left\{\beta\bar{p} - \tilde{p} - \frac{\partial \mathrm{E}(\tilde{p}_{TAA})}{\partial\alpha}\right\} dF(\tilde{p})$$
$$- \int_{\beta\bar{p}}^{\infty} \{\tilde{p} - \mathrm{E}(\tilde{p}_{TAA})\}\left\{\frac{\partial \mathrm{E}(\tilde{p}_{TAA})}{\partial\alpha}\right\} dF(\tilde{p})$$

$\mathrm{E}(\tilde{p}_{TAA})$ is defined above. Note that first term is negative since it is a product of negative and positive terms [25]. Note also that the second term is positive since it is a product of two positive terms[26]. Therefore, the overall impact is negative. The larger the α, the smaller the spread of prices. Once the commodity is eligible, the producer price is a weighted average of $\tilde{p}$ and $\beta\bar{p}$. Higher α reduces the variance of producer prices by posing a higher weight on $\beta\bar{p}$ which is already a fixed number from the last five years and a lower weight on the random price $\tilde{p}$.

2.2 Impact of β on the spread of prices

$$\frac{\partial Var(\tilde{p}_{TAA})}{\partial\beta} = \int_0^{\beta\bar{p}} \{(1-\alpha)\tilde{p} + \alpha\beta\bar{p}$$
$$- \mathrm{E}(\tilde{p}_{TAA})\}\frac{\partial\{\tilde{p} + \alpha(\beta\bar{p} - \tilde{p}) - \mathrm{E}(\tilde{p}_{TAA})\}}{\partial\beta} dF(\tilde{p})$$
$$+ \int_{\beta\bar{p}}^{\infty} \{\tilde{p} - \mathrm{E}(\tilde{p}_{TAA})\}\frac{\partial\{\tilde{p} - \mathrm{E}(\tilde{p}_{TAA})\}}{\partial\beta} dF(\tilde{p})$$

$$= \int_0^{\beta\bar{p}} \{(1-\alpha)\tilde{p} + \alpha\beta\bar{p} - \mathrm{E}(\tilde{p}_{TAA})\}\left\{\alpha\bar{p} - \frac{\partial \mathrm{E}(\tilde{p}_{TAA})}{\partial\beta}\right\} dF(\tilde{p})$$
$$- \int_{\beta\bar{p}}^{\infty} \{\tilde{p} - \mathrm{E}(\tilde{p}_{TAA})\}\left\{\frac{\partial \mathrm{E}(\tilde{p}_{TAA})}{\partial\beta}\right\} dF(\tilde{p})$$

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[25] $\{(1-\alpha)\tilde{p} + \alpha\beta\bar{p} - \mathrm{E}(\tilde{p}_{TAA})\}$ is negative, since $(1-\alpha)\tilde{p} + \alpha\beta\bar{p}$ is smaller than $\mathrm{E}(\tilde{p}_{TAA})$ in this price range ($\tilde{p} < \beta\bar{p}$).
$\left\{\beta\bar{p} - \tilde{p} - \frac{\partial \mathrm{E}(\tilde{p}_{TAA})}{\partial\alpha}\right\}$ is positive due to the following equality:

$$\bar{p} - \tilde{p} - \frac{\partial \mathrm{E}(\tilde{p}_{TAA})}{\partial\alpha} = \beta\bar{p} - \tilde{p} - \int_0^{\beta\bar{p}} (\beta\bar{p} - \tilde{p}) dF(\tilde{p}) = \int_0^{\beta\bar{p}} \tilde{p} dF(\tilde{p}) - \hat{p}$$

[26] $\{\tilde{p} - \mathrm{E}(\tilde{p}_{TAA})\}$ is positive, since $\tilde{p}$ is larger than $\mathrm{E}(\tilde{p}_{TAA})$ in this price range ($\tilde{p} > \beta\bar{p}$).
We know that $\frac{\partial \mathrm{E}(\tilde{p}_{TAA})}{\partial\alpha}$ is positive from the analysis of the impact of .α on the mean price.

$$= \int_0^{\beta\bar{p}} \{(1-\alpha)\tilde{p} + \alpha\beta\bar{p} - \mathrm{E}(\tilde{p}_{TAA})\}\alpha\bar{p}\{1 - F(\beta\bar{p})\}dF(\tilde{p}) - \int_{\beta\bar{p}}^{\infty} \{\tilde{p} - \mathrm{E}(\tilde{p}_{TAA})\}\{\alpha\bar{p}F(\beta\bar{p})\}dF(\tilde{p})$$

Note that the first term is negative and the second term is positive. Therefore, the overall impact is negative. This makes sense intuitively, since higher β and the resulting higher threshold price increases the chances that the commodity will become eligible for TAA benefits. Once eligible, the random commodity price $\tilde{p}$ is averaged-out with non-random $\beta\bar{p}$, which decreases the spread of prices. Therefore, the price risk is reduced with higher β.

2.3 Impact of $\bar{p}$ on the spread of prices

$$\frac{\partial Var(\tilde{p}_{TAA})}{\partial \bar{p}} = \int_0^{\beta\bar{p}} \{(1-\alpha)\tilde{p} + \alpha\beta\bar{p} - \mathrm{E}(\tilde{p}_{TAA})\}\frac{\partial\{\tilde{p} + \alpha(\beta\bar{p} - \tilde{p}) - \mathrm{E}(\tilde{p}_{TAA})\}}{\partial\bar{p}}dF(\tilde{p})dF(\tilde{p}) - \int_{\beta\bar{p}}^{\infty} \{\tilde{p} - \mathrm{E}(\tilde{p}_{TAA})\}\frac{\partial\{\tilde{p} - \mathrm{E}(\tilde{p}_{TAA})\}}{\partial\bar{p}}dF(\tilde{p})$$

$$= \int_0^{\beta\bar{p}} \{(1-\alpha)\tilde{p} + \alpha\beta\bar{p} - \mathrm{E}(\tilde{p}_{TAA})\}\alpha\beta\{1 - F(\beta\bar{p})\}dF(\tilde{p}) - \int_{\beta\bar{p}}^{\infty} \{\tilde{p} - \mathrm{E}(\tilde{p}_{TAA})\}\alpha\beta F(\beta\bar{p})dF(\tilde{p})$$

Note that the first term is negative and the second term is positive. Therefore, $\frac{\partial Var(\tilde{p}_{TAA})}{\partial\bar{p}}$ is negative. Note also that a higher $\bar{p}$ increases the threshold price just like a higher β does. The intuition is the same as in the case of the impact of β.

2.4 Impact of D on the spread of prices

$$\frac{\partial Var(\tilde{p}_{TAA})}{\partial D} = 0$$

D affects the profit of farmers once farmers are eligible for TAA benefits. However, it affects neither the mean producer price nor the spread of prices.

3. Impact on the Optimal Output

We use the implicit function theorem to study the impact of the TAA parameters on farmers' optimal production. In the previous section, we assumed that the representative farmer producing only one output has a von Neumann-Morgenstern utility function *U*: $\mathbb{R}_+ \to \mathbb{R}_+$ which is strictly increasing in profits $\tilde{\pi}(\tilde{p}_{TAA})$, strictly concave (the farmer is risk-averse), and twice continuously differentiable. Let $A(\tilde{\pi}) = -U''(\tilde{\pi})/U'(\tilde{\pi})$ and $R(\tilde{\pi}) = -U''(\tilde{\pi})\tilde{\pi}/U'(\tilde{\pi})$ denote the absolute and relative rate of risk aversion, respectively.

In the previous section, we defined the farmer's decision problem as following:

$$\max_q \int_0^{\beta\bar{p}} U\big(\{(1-\alpha)\tilde{p} + \alpha\beta\bar{p}\}q + D - TC(q)\big)dF(\tilde{p}) + \int_{\beta\bar{p}}^{\infty} U\big(\tilde{p}q - TC(q)\big)dF(\tilde{p})$$

The first-order condition with respect to q is

$$\frac{\partial EU}{\partial q} \equiv \mathrm{EU_q} = \int_0^{\beta\bar{p}} \{(1-\alpha)\tilde{p} + \alpha\beta\bar{p} - TC'(q)\}U'(\tilde{\pi})dF(\tilde{p}) + \int_{\beta\bar{p}}^{\infty} \{\tilde{p} - TC'(q)\}U'(\tilde{\pi})dF(\tilde{p}) = 0$$

Then we use the implicit function theorem to do comparative statics. First, we differentiate $\mathrm{EU_q}$ with respect to output q to get the second-order condition,

$$\frac{\partial \mathrm{EU_q}}{\partial q} \equiv \mathrm{EU_{qq}} = \int_0^{\beta\bar{p}} \{(1-\alpha)\tilde{p} + \alpha\beta\bar{p} - TC'(q)\}^2 U''(\tilde{\pi}) dF(\tilde{p}) + \int_{\beta\bar{p}}^{\infty} \{\tilde{p} - TC'(q)\}^2 U''(\tilde{\pi}) dF(\tilde{p}) < 0$$

which directly follows from the assumption above that the second derivative of utility function is always negative, i.e., the farmer is risk-averse.

3.1 Impact of α on optimal output

Proposition 3:

If the farmer is risk-averse and $R(\tilde{\pi})$ is less than one, then the optimal output q^* rises with α.

Proof:

Differentiating $\mathrm{EU_q}$ with respect to α,

$$\frac{\partial \mathrm{EU_q}}{\partial \alpha} \equiv \mathrm{EU_{q\alpha}} = \int_0^{\beta\bar{p}} (\beta\bar{p} - \tilde{p}) U'(\tilde{\pi}) \left\{1 - \left(\frac{\tilde{\pi} - D}{\tilde{\pi}}\right) R\right\} dF(\tilde{p}).$$[27]

where $(\beta\bar{p} - \tilde{p}),\ and\ U'(\tilde{\pi})$ are all positive, and $\left(\frac{\tilde{\pi}-D}{\tilde{\pi}}\right)$ is less than one. Hence R≤1 is a sufficient condition for $\mathrm{EU_{q\alpha}}$>0. When $\mathrm{EU_{q\alpha}}$>0, the optimal output q* rises with α by the implicit function theorem.

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[27] *Derivation of Proposition 3:*

$$\frac{\partial \mathrm{EU_q}}{\partial \alpha} \equiv \mathrm{EU_{q\alpha}}$$

$$= \int_0^{\beta\bar{p}} (\beta\bar{p} - \tilde{p}) U'(\tilde{\pi}) dF(\tilde{p}) + \int_0^{\beta\bar{p}} (\beta\bar{p} - \tilde{p})[\{(1-\alpha)\tilde{p} + \alpha\beta\bar{p} - TC'(q)\}q] U''(\tilde{\pi}) dF(\tilde{p})$$

(Assuming $TC(q) = TC'(q)q$)

$$= \int_0^{\beta\bar{p}} (\beta\bar{p} - \tilde{p}) U'(\tilde{\pi}) dF(\tilde{p}) + \int_0^{\beta\bar{p}} (\beta\bar{p} - \tilde{p})(\tilde{\pi} - D) U''(\tilde{\pi}) dF(\tilde{p})$$

$$= \int_0^{\beta\bar{p}} (\beta\bar{p} - \tilde{p}) U'(\tilde{\pi}) dF(\tilde{p}) - \int_0^{\beta\bar{p}} (\beta\bar{p} - \tilde{p})(\tilde{\pi} - D) \frac{U'(\tilde{\pi}) R}{\tilde{\pi}} dF(\tilde{p})$$

$$= \int_0^{\beta\bar{p}} (\beta\bar{p} - \tilde{p}) \left\{1 - \left(\frac{\tilde{\pi} - D}{\tilde{\pi}}\right) R\right\} U'(\tilde{\pi}) dF(\tilde{p})$$

$$\frac{\partial q^*}{\partial \alpha} = -\frac{EU_{q\alpha}}{EU_{qq}} > 0$$

(Q.E.D.)

Choi and Menezes (1992) give an overview of different estimates for the $R(\tilde{\pi})$, the relative risk aversion, in a number of previous research and find that the empirical estimates of $R(\tilde{\pi})$ range from 0.05 to more than 1,000. They also show that $R(\tilde{\pi})$ being less than unity means that the decision maker is almost risk neutral. Given our assumption that the farmer actually participates in the TAA program, the impact of an increase of α on production is explicit – recalling the cash payment formula,[28] it is clear that the bigger the α, the bigger the extent of coupling. When the extent of coupling is bigger, it is more profitable to produce more. Also, we have shown that a higher α reduces the price risk the farmer faces. Hence the optimal production will increase with the magnitude of α if $R(\tilde{\pi})$ is less than one.

3.2 Impact of β on optimal output

Proposition 4:

If the farmer is risk-averse and $R(\tilde{\pi})$ is less than one, then the optimal output q^* rises with β.

Proof:

Differentiating the first-order condition EU_q with respect to β,

$$\frac{\partial EU_q}{\partial \beta} \equiv EU_{q\beta} = \int_0^{\beta\bar{p}} \alpha\bar{p}U'(\tilde{\pi})\left\{1 - \left(\frac{\tilde{\pi}-D}{\tilde{\pi}}\right)R\right\} dF(\tilde{p}),$$[29]

[28] According to the formula discussed before, the amount of cash payment is $\tilde{m} = \alpha(\beta\bar{p} - \tilde{p})q$

[29] *Derivation of Proposition 4:*

$$\frac{\partial EU_q}{\partial \beta} \equiv EU_{q\beta}$$

$$= \int_0^{\beta\bar{p}} \alpha\bar{p}U'(\tilde{\pi})dF(\tilde{p}) + \int_0^{\beta\bar{p}} \alpha\bar{p}[\{(1-\alpha)\tilde{p} + \alpha\beta\bar{p} - TC'(q)\}q]U''(\tilde{\pi})dF(\tilde{p})$$

(Assuming $TC(q) = TC'(q)q$)

where $\alpha, \bar{p},$ and $U'(\tilde{\pi})$ are all greater than 0. Hence R≤1 is a sufficient condition for $EU_{q\beta}$ >0. When $EU_{q\beta}$>0, the optimal output q* rises with β by the implicit function theorem.

$$\frac{\partial q*}{\partial \beta} = -\frac{EU_{q\beta}}{EU_{qq}} > 0$$

(*Q.E.D.*)

We learned earlier in this chapter that the expected producer price increases as β increases, since (i) a higher β increases the possibility of a farmer being eligible for the TAA benefits, and (ii) once eligible, other things being equal, the amount of the coupled cash payment – the weighted-average price of $\beta\bar{p}$ and $\tilde{p}$, multiplied by the production level – increases as β increases. As given earlier, profit of the farmer can be written as follows.

$$\tilde{\pi} = \tilde{p}_{TAA} q + D - TC(q)$$

Taking the expectation on both sides, we get:

$$E(\tilde{\pi}) = E(\tilde{p}_{TAA})q + D - TC(q).$$

Therefore, a rise in β increases $E(\tilde{p}_{TAA})$ and in turn $E(\tilde{\pi})$, the expected profit from production. Also, we have seen that higher β reduces the price risk by reducing the spread of prices. With higher expected profit and less price risk, a risk-averse farmer will decide to produce more. Therefore, higher β will increase the optimal output.

$$= \int_0^{\beta\bar{p}} \alpha\bar{p}U'(\tilde{\pi})dF(\tilde{p}) + \int_0^{\beta\bar{p}} \alpha\bar{p}(\tilde{\pi} - D)U''(\tilde{\pi})dF(\tilde{p})$$

$$= \int_0^{\beta\bar{p}} \alpha\bar{p}U'(\tilde{\pi})dF(\tilde{p}) - \int_0^{\beta\bar{p}} \alpha\bar{p}(\tilde{\pi} - D)\frac{U'(\tilde{\pi})R}{\tilde{\pi}}dF(\tilde{p})$$

$$= \int_0^{\beta\bar{p}} \alpha\bar{p}U'(\tilde{\pi})\left\{1 - \left(\frac{\tilde{\pi} - D}{\tilde{\pi}}\right)R\right\}dF(\tilde{p})$$

3.3 Impact of $\bar{p}$ on optimal output

Proposition 5:

If the farmer is risk-averse and $R(\tilde{\pi})$ is less than one, then the optimal output q^* rises with $\bar{p}$.

Proof:

Differentiating EU_q with respect to $\bar{p}$,

$$\frac{\partial EU_q}{\partial \bar{p}} \equiv EU_{q\bar{p}} = \int_0^{\beta\bar{p}} \alpha\beta U'(\tilde{\pi}) \left\{1 - \left(\frac{\tilde{\pi}-D}{\tilde{\pi}}\right) R\right\} dF(\tilde{p}),$$[30]

where $\alpha\beta \ \ and \ U'(\tilde{\pi})$ are both greater than 0, and $\left(\frac{\tilde{\pi}-D}{\tilde{\pi}}\right)$ is less than one. Hence R≤1 is a sufficient condition for $EU_{q\bar{p}}>0$. When $EU_{q\bar{p}}>0$, the optimal output q* rises with $\bar{p}$ by the implicit function theorem.

$$\frac{\partial q^*}{\partial \bar{p}} = -\frac{EU_{q\bar{p}}}{EU_{qq}} > 0$$

(*Q.E.D.*)

The intuition behind this result is very much similar to the comparative statics of β. With the TAA program, the expected profit of the farmer increases as $\bar{p}$ increases, since (i) higher $\bar{p}$ increases the possibility that the farmer becoming eligible for the TAA benefits, and (ii) once eligible, other things being equal, the amount of the coupled cash payment – the weighted-average price of $\beta\bar{p}$ and $\tilde{p}$, multiplied by the production level – increases as $\bar{p}$

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[30] *Derivation of Proposition 5:*

$$\frac{\partial EU_q}{\partial \bar{p}} \equiv EU_{q\bar{p}}$$

$$= \int_0^{\beta\bar{p}} \alpha\beta U'(\tilde{\pi}) dF(\tilde{p}) + \int_0^{\beta\bar{p}} \alpha\beta q\{(1-\alpha)\tilde{p} + \alpha\beta\bar{p} - TC'(q)\} U''(\tilde{\pi}) dF(\tilde{p})$$

(Assuming $TC(q) = TC'(q)q$),

$$= \int_0^{\beta\bar{p}} \alpha\beta U'(\tilde{\pi}) dF(\tilde{p}) + \int_0^{\beta\bar{p}} \alpha\beta(\tilde{\pi} - D) U''(\tilde{\pi}) dF(\tilde{p})$$

$$= \int_0^{\beta\bar{p}} \alpha\beta U'(\tilde{\pi}) dF(\tilde{p}) - \int_0^{\beta\bar{p}} \alpha\beta(\tilde{\pi} - D) \frac{U'(\tilde{\pi})R}{\tilde{\pi}} dF(\tilde{p}) = \int_0^{\beta\bar{p}} \alpha\beta \left\{1 - \left(\frac{\tilde{\pi}-D}{\tilde{\pi}}\right) R\right\} U'(\tilde{\pi}) dF(\tilde{p}).$$

increases. At the same time, higher $\bar{p}$ reduces the price risk of a risk-averse farmer. A higher expected profit and lower risk from production will increase the expected utility from production, acting as an incentive to produce more. Therefore, increase in $\bar{p}$ will increase the optimal output. This indicates that the TAA program effectively causes a serial correlation of output levels, although the production decisions are independent from year to year.

3.4 Impact of D on optimal output

Proposition 6:

The optimal output q^* rises with D if either (i) the threshold price ($\beta\bar{p}$) is lower than the marginal cost, or (ii) DARA and $R(\tilde{\pi})$ is less than unity.

Proof:

$$\frac{\partial EU_q}{\partial D} \equiv EU_{qD}$$

$$= \int_0^{\beta\bar{p}} \{(1-\alpha)\tilde{p} + \alpha\beta\bar{p} - TC'(q)\} U''(\tilde{\pi}) dF(\tilde{p}) \quad \text{-- (1)}$$

$$= \int_0^{\beta\bar{p}} \{(1-\alpha)\tilde{p} + \alpha\beta\bar{p} - TC'(q)\}\{A(\bar{\pi}) - A(\tilde{\pi})\} U'(\tilde{\pi}) dF(\tilde{p}) - \int_0^{\beta\bar{p}} \{(1-\alpha)\tilde{p} + \alpha\beta\bar{p} - TC'(q)\} A(\bar{\pi}) U'(\tilde{\pi}) dF(\tilde{p})$$

-- (2)

From above, we know that $EU_{qq} < 0$, so

$$\frac{\partial q^*}{\partial D} = -\frac{EU_{qD}}{EU_{qq}} > 0$$

only if $EU_{qD} > 0$.

(*Q.E.D.*)

According to the proof above, $EU_{qD} > 0$ and hence $\frac{\partial q^*}{\partial D} = -\frac{EU_{qD}}{EU_{qq}} > 0$, if either (i) $\beta\bar{p} < TC'(q)$ or (ii) DARA and $R \leq 1$:

(i) $\beta\bar{p} < TC'(q)$

From the expression (1) above, $\mathrm{EU}_{qD} > 0$ *if and only if* $(1-\alpha)\tilde{p} + \alpha\beta\bar{p} < TC'(q)$, since we assumed that $U''(\tilde{\pi}) < 0$. $\tilde{p} < \beta\bar{p}$ is the range of price being considered here, and $(1-\alpha)\tilde{p} + \alpha\beta\bar{p}$ is a weighted average of $\tilde{p}$ and $\beta\bar{p}$, which should be less than $\beta\bar{p}$. Hence, $\beta\bar{p} < TC'(q)$ is a sufficient condition for $(1-\alpha)\tilde{p} + \alpha\beta\bar{p} < TC'(q)$ and hence $\mathrm{EU}_{qD} > 0$. Since $\tilde{p} < \beta\bar{p} < TC'(q)$ in this range of prices considered, the marginal revenue from production, which is the price $\tilde{p}$, is less than the marginal cost $TC'(q)$. To maximize profit from production, the farmer must produce up to the point where the marginal cost equals the marginal revenue. In this case where the marginal cost is greater than the marginal revenue, the farmer should produce less since he loses profits as he produces more. However, a decoupled TAA payment will act as a buffer for the losses and make it profitable to produce more in this situation. Therefore, an increase in decoupled TAA payment will increase optimal output by manipulating the point where the marginal cost equals marginal revenue. Hennessy (1998) also pointed out that decoupled payments can reduce uncertainty on profit stemming from a downward price risk. By stabilizing out profit, decoupled payments reduce risk of farmers, and finally affect optimal production decisions. He suggested this risk-reducing effect of decoupled payments as a primary source of production distortion.

(ii) DARA and $R \leq 1$

From the expression (2) above, in the first term

$(\int_0^{\beta\bar{p}}\{(1-\alpha)\tilde{p} + \alpha\beta\bar{p} - TC'(q)\}\{A(\bar{\pi}) - A(\tilde{\pi})\}U'(\tilde{\pi})dF(\tilde{p}))$, $\bar{\pi}$ is the profit evaluated at the point where $\tilde{p} = (c - \alpha\beta\bar{p})/(1-\alpha)$, i.e., when $(1-\alpha)\tilde{p} + \alpha\beta\bar{p} = TC'(q)$. Since $\tilde{\pi} = \tilde{p}_{TAA}q + D - TC(q)$, $\bar{\pi} = D$, and at any other point,

$\tilde{\pi} = \{(1-\alpha)\tilde{p} + \alpha\beta\bar{p} - TC'(q)\}q + D$. Hence, $\bar{\pi} \leq \tilde{\pi}$, and assuming DARA, $\{A(\bar{\pi}) - A(\tilde{\pi})\} \geq 0$. Therefore the first term is positive. Since $A(\bar{\pi}) < 0$ under the assumption that $U''(\bar{\pi}) < 0$, the second term is negative. Therefore, the whole expression (2) is positive. With DARA, when a farmer receives a decoupled TAA payment, it will increase the farmer's profit and thus decrease the farmer's risk aversion. With a decreased absolute risk aversion, the farmer would like to produce more. This risk-reducing effect of the decoupled payment decreases uncertainty faced by farmers and increases production. It is called "the wealth effect" in Hennessy (1998).

4. Impact on the Welfare of Producers

In the previous section, we defined the expected utility of a producer as below.

$$EU = \int_0^{\beta\bar{p}} U(\tilde{\pi})dF(\tilde{p}) + \int_{\beta\bar{p}}^{\infty} U(\tilde{\pi})dF(\tilde{p})$$

$$= \int_0^{\beta\bar{p}} U\big(\{(1-\alpha)\tilde{p} + \alpha\beta\bar{p}\}q + D - TC(q)\big)dF(\tilde{p}) + \int_{\beta\bar{p}}^{\infty} U\big(\tilde{p}q - TC(q)\big)dF(\tilde{p})$$

Using this expression, we will study the impacts of TAA parameters on producers' welfare measured by expected utility.

4.1 Impact of α on the welfare of producers

$$\frac{\partial EU}{\partial \alpha} = \frac{\partial EU}{\partial \tilde{\pi}} \times \frac{\partial \tilde{\pi}}{\partial \alpha} + \frac{\partial EU}{\partial q} \times \frac{\partial q}{\partial \alpha} = \int_0^{\beta\bar{p}} \{\beta\bar{p}q - \tilde{p}q\}U'(\tilde{\pi})dF(\tilde{p})$$

This follows since $\frac{\partial EU}{\partial q} = 0$ at the optimum. The expression above is greater than zero if $\beta\bar{p} > \tilde{p}$, which is always the case in the range of prices considered. This makes sense,

because in this price range, farmers are eligible and will qualify for TAA cash benefits. Once qualified, greater α increases the amount of the cash benefits and hence the profits the farmer will receive and the price risk will decrease, which yields a higher expected utility.

4.2 Impact of β on the welfare of producers

$$\frac{\partial EU}{\partial \beta} = \frac{\partial EU}{\partial \tilde{\pi}} \times \frac{\partial \tilde{\pi}}{\partial \beta} + \frac{\partial EU}{\partial q} \times \frac{\partial q}{\partial \beta} = \int_0^{\beta \bar{p}} \alpha \bar{p} q U'(\tilde{\pi}) dF(\tilde{p})$$

The above is greater than zero if $\alpha \bar{p} > 0$, which is always the case since we assume that $\alpha \in (0, 1]$ and $\bar{p} > 0$. We learned earlier that a higher β increases the expected producer price, which in turn increases expected profits of producers. At the same time, it decreases the price risk. Hence the expected utility of producers also increases with β.

4.3 Impact of $\bar{p}$ on the welfare of producers

$$\frac{\partial EU}{\partial \bar{p}} = \frac{\partial EU}{\partial \tilde{\pi}} \times \frac{\partial \tilde{\pi}}{\partial \bar{p}} + \frac{\partial EU}{\partial q} \times \frac{\partial q}{\partial \bar{p}} = \int_0^{\beta \bar{p}} \alpha \beta q U'(\tilde{\pi}) dF(\tilde{p})$$

The above is greater than zero if $\alpha \beta > 0$, which is always the case since we assume that $\alpha \in (0, 1]$ and $\beta \in (0, 1]$. A higher $\bar{p}$ works exactly the same way a higher β works. It increases expected producer price and expected profits and decreases the price risk. Hence the expected utility of risk-averse producers will increase.

4.4 Impact of D on the welfare of producers

$$\frac{\partial EU}{\partial D} = \frac{\partial EU}{\partial \tilde{\pi}} \times \frac{\partial \tilde{\pi}}{\partial D} + \frac{\partial EU}{\partial q} \times \frac{\partial q}{\partial D} = \int_0^{\beta \bar{p}} U'(\tilde{\pi}) dF(\tilde{p})$$

The expression above is always greater than zero. In this price range considered, a producer expects to receive a positive amount of decoupled payment, which increases the expected profit and hence expected utility of the producer.

VI. Discussion

In this chapter, we first introduced the TAA program under the TAA Reform Act of 2002 and the ARRA of 2009 and through the discussion on the first and second order stochastic dominance, showed that any producer with non-decreasing utility function would prefer having a price distribution with TAA to that without TAA. Then we extended the model into a general one to analyze the impact of the TAA parameters on the expected value of producer prices, spread of prices, optimal output, and welfare of farmers. The table below is a summary of the comparative statics. The parameters α and β come from the coupled TAA cash payment formula for the TAA Reform Act of 2002. D is the amount of decoupled cash payment for under ARRA of 2009. $\bar{p}$, the past average prices and β determine the eligibility. Thus, parameters α, β, and $\bar{p}$, and the parameters β, $\bar{p}$ and D are relevant in the discussion of the TAA Reform Act of 2002 and the ARRA of 2009, respectively.

<Table 3.1> Comparative statics of the generalized model

TAA Parameters	Impact on			
	Mean price	Spread of prices	Optimal output	Welfare of producers
α	Positive	Negative	Positive if R≤1	Positive
β	Positive	Negative	Positive if R≤1	Positive
$\bar{p}$	Positive	Negative	Positive if R≤1	Positive
D	None	None	Positive if (i) $\beta\bar{p} < TC'(q)$ or if (ii) DARA and $R \leq 1$	Positive

When the coupled cash payment formula is used as in the case of the original TAA Reform Act of 2002, the impact of α, β, and $\bar{p}$ on the mean price is positive and the impact on the spread of prices is negative. Therefore, producers may expect that having larger α and β

in the cash payment formula, which will result in a larger TAA cash payment, would raise the mean producer prices and at the same time lower the variance of prices. That way, high parameters can effectively lower the downside price risk of farmers. When the decoupled cash payment is used as in the case of ARRA of 2009, such impact on the mean and variance producer prices is nonexistent. In both regimes, higher $\bar{p}$ increases the chances of eligibility and creates a positive serial correlation of producer prices.

The impact of the coupled and decoupled TAA parameters on optimal output depends on the magnitude of the relative risk aversion both in the cases of TAA Reform Act of 2002 and the ARRA of 2009. Producers would decide to produce more with larger TAA parameters when the relative risk aversion is less than one. This means that, when $R \leq 1$, the TAA program has an output-distorting effect. When $R \geq 1$, we cannot guarantee such effect. Note that, when $R \leq 1$, the positive impact of $\bar{p}$ on optimal production implies that the TAA program may create a serial correlation of output levels.

The impact of TAA parameters on welfare of producers is always positive under either regime of the TAA program. This is because the program pays out cash benefit to eligible farmers, which will always increase expected profit and expected utility of producers.

<Table 3.2> Magnitude of the TAA parameters

Parameters	TAA Reform Act of 2002	ARRA of 2009
α	0.5	0
β	0.8	0.85
$\bar{p}$	Average price for last five marketing years	Average price for last three marketing years
D	0	Greater than or equal to 0

The major difference between the TAA Reform Act of 2002 and the ARRA of 2009 is that the former provides a TAA cash benefit following a coupled cash payment formula whereas the latter provides a decoupled cash payment. Another important difference is that the eligibility criteria of the ARRA of 2009 are easier to be satisfied. In terms of the TAA parameters, the differences can be summarized as shown in the following table.

The implication on the new TAA program under the ARRA of 2009 is the following: First, TAA cash benefit being decoupled, α is zero, so the price and production distorting impact from coupling seems to be mitigated. However, we have a higher β—a more lenient eligibility criteria – from the new TAA regime that increases the mean price and the optimal output when the relative risk aversion is less than one. Therefore, the magnitude of price and production distortion, if any, would depend on which impact is bigger—decrease in α or increase in β. Second, since larger decoupled payment D increases expected profit of producers, it increases optimal output and thus could affect optimal input decisions if (i) the 85% of the average of national average prices over last three years is less than the marginal cost of production, or (ii) the producers have a relative risk aversion less than one and has a decreasing absolute risk aversion. Especially, the first point implies that the decoupled TAA payment may distort the production decision by making it possible to produce at the price under the marginal cost, which would be unprofitable without the TAA program. Therefore, the TAA regime under the ARRA of 2009, which offers seemingly "decoupled" cash payments could still raise the mean prices and optimal output. In that sense, USDA's very recent policy change, the move of its focus from financial assistance towards technical training programs seems to be an appropriate measure. Lastly, the TAA program, under either regime, would always increase the welfare of farmers.

APPENDICES

Appendix I. Certified/Re-certified Petitions (30 before ARRA, 10 after ARRA)

Year	Commodity	State	Certified/ Re-certified	Petition Date (MM/DD/YY)	Decision Date (MM/DD/YY)
2003 (7)	Wild Blueberries	Maine	Certified	09/15/03	11/06/03
	Salmon	Alaska	Certified	09/15/03	11/06/03
	Salmon	Washington	Certified	09/15/03	11/06/03
	Shrimp	South Carolina	Certified	09/30/03	11/19/03
	Shrimp	Georgia	Certified	10/21/03	11/19/03
	Shrimp	Texas	Certified	10/21/03	11/19/03
	Catfish	Multistate (Alabama, Arkansas, Florida, Georgia, Idaho, Illinois, Kansas, Kentucky, Louisiana, Mississippi, Missouri, Nevada, North Carolina, Ohio, Oklahoma, South Carolina, Texas, Utah)	Certified	10/08/03	11/25/03
2004 (11)	Shrimp	Alabama	Certified	12/04/03	01/12/04
	Lychees	Florida	Certified	02/23/04	04/04/04
	Shrimp	North Carolina	Certified	02/23/04	04/04/04
	Shrimp	Florida	Certified	02/23/04	04/05/04
	Shrimp	Arizona	Certified	02/13/04	04/05/04
	Salmon	Washington	Re-certified	09/15/03	11/01/04
	Salmon	Alaska	Re-certified	09/15/03	11/10/04
	Shrimp	South Carolina	Re-certified	09/30/03	11/18/04
	Shrimp	Georgia	Re-certified	10/21/03	11/24/04
	Shrimp	North Carolina	Re-certified	02/23/04	11/30/04
	Shrimp	Texas	Re-certified	10/21/03	11/30/04
2005 (9)	Shrimp	Alabama	Re-certified	12/04/03	01/10/05
	Shrimp	Louisiana	Certified	11/18/04	01/10/05
	Olives	California	Certified	01/21/05	03/14/05
	Shrimp	Mississippi	Certified	02/01/05	03/14/05
	Fresh Potatoes	Idaho	Certified	02/11/05	03/28/05
	Concord Grape Juice	Pennsylvania, New York, Ohio	Certified	02/25/05	03/28/05
	Shrimp	Arizona	Re-certified	02/13/04	04/04/05
	Lychees	Florida	Re-certified	02/23/04	04/04/05
	Avocados	Florida	Certified	11/16/05	12/29/05
2006 (3)	Snapdragons	Indiana	Certified	12/28/05	02/10/06
	Concord Grape Juice	Michigan	Certified	02/21/06	03/15/06
	Concord Grape Juice	Washington	Certified	02/21/06	03/15/06
2010 (10)	Asparagus	California, Michigan, Washington	Certified	04/27/10	06/25/10
	Catfish	Nationwide	Certified	04/27/10	06/25/10
	Shrimp	Alabama, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Texas	Certified	04/28/10	06/25/10
	Shrimp	Alabama, Alaska, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, and Texas	Certified	07/14/10	09/24/10
	Lobster	Connecticut	Certified	07/14/10	09/24/10
	Lobster	Maine	Certified	07/14/10	09/24/10
	Lobster	Massachusetts	Certified	07/14/10	09/24/10
	Lobster	New Hampshire	Certified	07/14/10	09/24/10
	Lobster	Rhode Island	Certified	08/03/10	09/24/10
	Blueberries	Maine	Certified	08/03/10	10/05/10

Appendix II. Denied/Terminated Petitions (42 before ARRA, 15 after ARRA)

Year	Commodity	State	Denied/ Terminated	Petition Date (MM/DD/YY)	Decision Date (MM/DD/YY)
2003 (2)	Salmon	Oregon	Denied	09/15/03	10/28/03
	Fresh Garlic	California	Denied	10/28/03	12/08/03
2004 (13)	Olives	California	Denied	12/03/03	01/08/04
	Shrimp	Florida	Denied	11/18/03	01/12/04
	Rice	National	Denied	12/04/03	01/13/04
	Crawfish	Louisiana	Denied	12/04/03	01/15/04
	Shrimp	Mississippi	Denied	12/04/03	01/15/04
	Navel Oranges	California	Denied	02/02/04	03/15/04
	Catfish	Michigan	Denied	02/13/04	03/19/04
	Fresh Longan	Florida	Denied	02/23/04	04/04/04
	Alfafa seed	Multistate (California, Colorado, Idaho, Montana, Nevada, Oregon, Washington, Wyoming)	Denied	02/23/04	04/05/04
	York apples	Virginia	Denied	02/23/04	04/05/04
	Shrimps	Kentucky	Denied	02/23/04	04/20/04
	Wild Blueberries	Maine	Terminated	09/15/03	10/08/04
	Catfish	Multistate (Alabama, Arkansas, Florida, Georgia, Idaho, Illinois, Kansas, Kentucky, Louisiana, Mississippi, Missouri, Nevada, North Carolina, Ohio, Oklahoma, South Carolina, Texas, Utah)	Terminated	10/08/03	11/24/04
2005 (14)	Seed Potatoes	Washington	Denied	01/13/05	03/04/05
	Cabbages	New York	Denied	02/11/05	03/21/05
	Shrimp	Florida	Terminated	02/23/04	04/18/05
	Avocados	Florida	Denied	03/08/05	04/28/05
	Salmon	Alaska	Terminated	09/15/03	10/18/05
	Salmon	Washington	Terminated	09/15/03	10/18/05
	Shrimp	Mississippi	Terminated	02/01/05	11/05/05
	Shrimp	South Carolina	Terminated	09/30/03	11/08/05
	Shrimp	Georgia	Terminated	10/21/03	11/08/05
	Shrimp	Texas	Terminated	10/21/03	11/08/05
	Shrimp	Alabama	Terminated	12/04/03	11/08/05
	Shrimp	Arizona	Terminated	02/13/04	11/08/05
	Shrimp	North Carolina	Terminated	02/23/04	11/08/05
	Shrimp	Louisiana	Terminated	11/18/04	11/08/05
2006 (7)	Fresh Potatoes	Idaho	Terminated	02/11/05	03/23/06
	Concord Grape Juice	Pennsylvania, New York, Ohio	Terminated	02/25/05	03/23/06
	Olives	California	Terminated	01/21/05	03/24/06
	Fresh Potatoes	Washington	Denied	03/06/06	03/29/06
	Lychees	Florida	Terminated	02/23/04	04/12/06
	Avocados	Florida	Terminated	11/16/05	12/12/06
2007 (7)	Snapdragons	Indiana	Terminated	12/28/05	02/01/07
	Concord Grape Juice	Washington	Terminated	02/21/06	02/01/07
	Concord Grape Juice	Michigan	Terminated	02/21/06	02/01/07
	Concord Grape Juice	Pennsylvania, New York, Ohio	Denied	02/16/07	03/22/07
	Burley Tobacco	Kentucky. Tennessee, Virginia, North Carolina, West Virginia, Indiana, Ohio, Missouri	Denied	02/16/07	03/22/07
	Honey	Michigan	Denied	02/16/07	03/22/07
	Avocados	California	Denied	02/15/07	04/06/07

Appendix II. Denied/Terminated Petitions (continued)

2010 (15)	Spiny Lobster	Florida	Denied	04/27/10	-
	Cranberries	New Jersey	Denied	04/27/10	-
	Crawfish	Louisiana	Denied	04/27/10	-
	Blue Crab	Georgia	Denied	04/27/10	-
	Apples	Michigan	Denied	04/28/10	-
	Prunes and Dried Plums	California	Denied	04/28/10	09/20/10
	Coffee	Puerto Rico	Denied	07/14/10	09/20/10
	Wool	Idaho, Utah, and Wyoming	Denied	07/14/10	09/20/10
	Wool	Montana	Denied	07/14/10	-
	Lamb	Ohio	Denied	07/23/10	09/20/10
	Lamb	Idaho, Utah, and Wyoming	Denied	07/23/10	09/20/10
	Apples	Maine	Denied	07/30/10	09/20/10
	Multi-species Fish	Connecticut, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island	Denied	08/03/10	10/06/10
	Tilapia	Arkansas	Denied	08/03/10	10/05/10
	Blueberries	New Hampshire	Denied	08/13/10	10/05/10

Appendix III. Variable Description

Category	Variable name	Description
Petition variables	petition	Whether or not a petition is filed (0 or 1)
	approval	Whether or not a filed petition for TAA is approved (0 or 1)
	previously_approved	Whether the commodity had been petitioned and approved ever before (0 or 1)
	petition_new	Whether the petition is a new petition or is filed for a re-evaluation (0 or 1)
	re_petition	Whether a petition has been ever filed before for the same commodity (Excluded the cases for automatic re-assessment by ERS) (0 or 1)
	multistate	Whether the petition was filed by a group of states (0 or 1)
	cv	Coefficient of variation of commodity prices (based on 5 preceding year's price data)
Eligibility criteria	eligible_price5	Eligibility in 5 year price criterion (0 or 1)
	eligible_price3	Eligibility in 3 year price criterion (0 or 1)
	eligible_import	If import quantity in the petition year has increased compared to the previous year (0 or 1)
	eligible_import5	If import quantity in the petition year has increased compared to the previous 5-year-average (0 or 1)
	chg_impqty5	Change of import quantity in the petition year from the five year average (%)
	chg_imptval5	Change of import value in the petition year from the five year average (%)
	eligible_income	If net farm income has decreased compared to the previous year (0 or 1)
	eligible_priceimport	Interaction term of price and import eligibility. (0 or 1)
	eligible_all	Interaction term of price, income and import eligibility. (0 or 1)
State farm characteristics	farmsize	Average farm size of the state in the petition year (acres) (2002 and 2007 data)
	avg_age	Average operator age (years) (2002 and 2007 data)
	primary	Farms with farming as principal farm operators' primary occupation (%) (2002 and 2007 data)
	full_owner	Percentage of full ownership farmers (%) (2002 and 2007 data)
	indiv	Percentage of individual/family, sole proprietorship farms (%)(2002 and 2007 data)
	corp	Percentage of non-family corporation farms (%)(2002 and 2007 data)
	top5	Whether the commodity is of top 5 agricultural commodity of the state (in value of receipt in 2008) (0 or 1)
	hrs_worked	Average hours worked per week in the state in petition year (hours)
	tfp	Total factor productivity of the state (2002, 2003, 2004 data)
	somecollege	Percentage of rural population with age 25 or older with college degree or some college or upper education (2000 data) (%)
	chg_govpmt	Change in the direct government payment from previous year to the petition year (%) (yearly data)
	chgsign_govpmt	If direct government payment has increased in the petition year (0 or 1) (yearly data)
	extension_ratio	Number of extension staff per 1,000 farmers in 1997
	farm_advisor_ratio	Number of farm and home management advisors per 1,000 farmers in the state, as of one year before petition date (2002 and 2007 data)
Farm productivity measures	tfp	Total factor productivity of the state (2002, 2003, 2004 data)
	agri_pr_farm	Value of agricultural production/number of farms (million dollars/farm) (2002-2007)
	crop_pr_farm	Value of crop production/number of farms (million dollars/farm) (2002-2007)
	agri_pr_acre	Value of agricultural production/farmland (thousand dollars/acre) (2002-2007)
	crop_pr_acre	Value of crop production/farmland (thousand dolloars/acre) (2002-2007)
State and year dummy	stAL ~ stWY	State dummy for 50 states in the US
	yr04~yr07	Year dummy from 2004 to 2007

REFERENCES

Adams, G., P. Westhoff, B. Willott, and R. E. Young II (2001). Do "decoupled" payments affect U.S. crop area? Preliminary evidence from 1997-2000. *American Journal of Agricultural Economics* 83 (5), pp. 1190-1195.

Ahearn, M. C., H. El-Osta, and J. Dewbre (2006). The impact of coupled and decoupled government subsidies on off-farm labor participation of U.S. farm operators. *American Journal of Agricultural Economics* 88 (2), pp. 393-408.

Alston et al. (2011). An Analysis of the North Carolina Cooperative Extension Service's Role in Bridging the Digital Divide. *Journal of Extension*, December 2011, 49 (6). Available at: http://www.joe.org/joe/2011december/rb1.php.

Antón, J. and C. L. Mouël (2004). Do counter-cyclical payments in the 2002 US Farm Act create incentives to produce? *Agricultural Economics* 31, pp. 277-284.

Arrow, K. J. (1965). "The theory of risk aversion," in *Aspects of the Theory of Risk Bearing*, by Yrjo Jahnssonin Saatio, Helsinki. Reprinted in: *Essays in the Theory of Risk Bearing*, Markham Publ. Co., Chicago, 1971, 90–109.

Bacho, Allan P. and H.L. Goodwin Jr. (2008). Outcome of trade adjustment assistance for farmers program in the United States: Trade Reform Act of 2002. *Selected Paper prepared for presentation at the Southern Agricultural Economics Association Annual Meeting.* Dallas, Texas, February 2-5, 2008.

Binswanger, Hans P. (1980). Attitude Toward Risk: Experimental Measurement in Rural India, *American Journal of Agricultural Economics*, 62 (3), pp. 395.

Binswanger, Hans P. (1981). Attitudes Toward Risk: Theoretical Implications of an Experiment in Rural India, *Economic Journal*, Royal Economic Society 91(364), pages 867-90, December.

Breakell, D. (2011). Farmland Preservation and Conservation in Litchfield County, Connecticut, Brown University Center for Environmental Studies, May 2011.

Brock, T., Lisa Matus-Grossman, and Gayle Hamilton (2002**).** Welfare Reform and Community Colleges: A Policy and Research Context, *MDRC Working Paper*, May 2002.

Burfisher, M.E., S. Robinson, and K. Thierfelder (2000). North American Farm Programs and the WTO, *American Journal of Agricultural Economics* 82(3), pp.768-774.

Chau, N. H., and de Gorter (2005). Disentangling the consequences of direct payment schemes in agriculture on fixed costs, exit decisions, and output, *American Journal of Agricultural Economics* 87 (5), pp. 1174-1181.

Chavas, J., and M. T. Holt (1990). Acreage decisions under risk: The case of corn and soybeans. *American Journal of Agricultural Economics* 72 (2), pp. 529-538.

Choi, E. Kwan. and Carmen F. Menezes (1985). On the magnitude of relative risk aversion, *Economic Letters* 18 (2-3), pp. 125-128.

Choi, E. Kwan. and Carmen F. Menezes (1992). Is relative risk aversion greater than one? *International Review of Economics and Finance* 1 (1), pp. 43-54.

Conniffe, D. and D. O'Neill (2012). An Alternative Explanation for the Variation in Reported Estimates of Risk Aversion, *IZA Discussion Paper* No. 6877, September 2012, Institute for the Study of Labor (IZA).

Davidson, Russell (2013). "Stochastic Dominance", "The New Palgrave Dictionary of Economics", Eds. Steven N. Durlauf and Lawrence E. Blume, Palgrave Macmillan, 2008, *The New Palgrave Dictionary of Economics Online*, Palgrave Macmillan. 17 July 2013, DOI:10.1057/9780230226203.1622

Dillon, John L. and Pasquale L. Scandizzo (1978). Risk Attitudes of Subsistence Farmers in Northeast Brazil: A Sampling Approach, *American Journal of Agricultural Economics*, 60 (3), pp. 425-435, Aug. 1978.

Evans, Edward A. (2005). Understanding the Trade Adjustment Assistance (TAA) for Farmers Program, *EDIS document FE498*, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL.

Foster and Rosenzweig (1995). Learning by Doing and Learning From Others: Capital and Technical Change in Agriculture, *Journal of Political Economy*, Vol 103, No. 6.

Feder, G., and R. Slade (1984). The Acquisition of Information and the Adoption of New Technology, *American Journal of Agricultural Economics*, 66 (3), pp. 312-320.

Gebremedhin, B. and Swinton, S. M. (2003). Investment in soil conservation in northern Ethiopia: the role of land tenure security and public programs, *Agricultural Economics*, 29(1), pp. 69–84.

Goodwin, B.K., and A.K. Mishra (2005). Another Look at Decoupling: Additional Evidence on the Production Effects of Direct Payments, *American Journal of Agricultural Economics* 87 (5), pp.1200-1210.

Graham, A. W. and Darroch, M. A. G. (2001) Relationship between the mode of land redistribution, tenure security and agricultural credit use in KwaZulu-Natal, *Development Southern Africa*, 18(3), pp. 295–308.

Hadar, J., and Russell, W. (1969). Rules for Ordering Uncertain Prospects, *American Economic Review* Vol. 59, pp. 25-34.

Hadar, J. and Seo, T. K. (1990). The effect of shifts in a return on optimal portfolios, *International Economic Review*, Vol. 31, pp. 721-736.

Hahn, F. (1970). Savings and uncertainty, *Review of Economic Studies* 37, pp. 21-24.

Hennessy, D. A. (1998). The production effects of agricultural income support policies under uncertainty, *American Journal of Agricultural Economics,* Vol. 88, Issue 1, pp. 46-57.

Hiebert, L. D. (1981). Production Uncertainty and Factor Demands for the Competitive Firm: An Extension, *Southern Economic Journal*, Vol. 48, No. 1, pp. 211-215.

Jenkins A. et al, (2011). Factors influencing the selection of precision farming information sources by cotton producers, *Agricultural and Resource Economics Review*, 40/2 (August 2011), pp. 307-320.

Jurenas, R. (2010). Trade Adjustment Assistance for Farmers, *CRS Report for Congress*, Congressional Research Service, March 12, 2010.

Key, Nigel & Roberts, Robert J. (2008). Do Decoupled Payments Stimulate Production? Estimating the Effect on Program Crop Acreage Using Matching, 2008 Annual Meeting, July 27-29, 2008, Orlando, Florida 6072, American Agricultural Economics Association (New Name 2008: Agricultural and Applied Economics Association)

Kibet et al. (2011), The Role of Extraneous Incentives and Drivers in Farm Enterprise Diversification: A Study of Passion-Fruit (Passiflora edulis) Uptake in Uasin-Gishu County, Kenya, *Asian Journal of Agricultural Science* 3(5): 358-365, 2011.

King, Gary and Langche Zeng (2001a). Explaining Rare Events in International Relations**,** *International Organization*, 55 (3), pp. 693-715, Summer 2001.

King, Gary and Langche Zeng (2001b). Logistic Regression in Rare Events Data, *Political Analysis*, 9 (2), pp. 137-163, Spring 2001.

King, Gary and Langche Zeng (2002). Estimating Risk and Rate Levels, Ratios, and Differences in Case-Control Studies**,** *Statistics in Medicine*, Vol. 21, pp. 1409-1427.

Lambert et al. (2006). Conservation-Compatible Practices and Programs: Who Participates?, *USDA ERS Report*, February 2006.

Mas-Colell, A., M.D. Whinston, and J.R. Green (1995). *Microeconomic Theory*, Oxford University Press, U.S.A., pp.194-195.

McKernan, Signe-Mary and Caroline Ratcliffe (with contributions from Emily Rosenberg), and Robert Gibbs (2003). Employment Factors Influencing Food Stamp Program Participation, E-FAN-03-012, USDA Economic Research Institute (ERS).

Mishra, Ashok K. and Timothy A. Park (2005). An Empirical Analysis of Internet Use by U.S. Farmers, *Agricultural and Resource Economics Review* 34 (2), pp.253-264, Oct 2005.

Mittal and Mehar (2012). An Assessment of Farmer's Information Networks in India-Role of Modern ICT, *A paper for presentation at the 8th Asian Conference for Information Technology in Agriculture and World Conference on Computer in Agriculture*, Taipei City, Taiwan, September 3-6, 2012.

Moscardi, Edgardo and Alain de Janvry (1977). Attitudes Toward Risk Among Peasants: An Econometric Approach, *American Journal of Agricultural Economics* 59 (4), pp. 710, Nov 1977.

Moschini, G., and D.A. Hennessy, (2001). "Chapter 2: Uncertainty, Risk Aversion, and Risk Management for Agricultural Producers," *Handbook of Agricultural Economics* Volume 1, Part 1, p.88-153.

Neumann, John von, and Morgenstern, Oskar (1944-53). *Theory of Games and Economic Behavior*, Princeton, NJ, Princeton University Press, 1944, second ed. 1947, third ed. 1953.

O'Brien, Robert M. (2007), A Caution Regarding Rules of Thumb for Variance Inflation Factors, *Quality & Quantity*, October 2007, 41 (5), pp 673-690.

O'Donoghue, Erik J. & Whitaker, James (2006). How distorting are direct payments?, 2006 Annual meeting, July 23-26, Long Beach, CA 21247, American Agricultural Economics Association (New Name 2008: Agricultural and Applied Economics Association).

Place, F. and Otsuka, K. (2002). Land tenure systems and their impacts on agricultural investments and productivity in Uganda, *Journal of Development Studies*, 38 (6), pp. 105–128.

Pratt, J. W. (1964). Risk aversion in the small and in the large, *Econometrica* 32, January–April 1964, 122–136.

Rothschild, Michael and Stiglitz, Joseph E. (1970). Increasing risk I: A Definition, *Journal of Economic Theory* 2 (3), pp. 225–243.

Rothchild, Michael and Stiglitz, Joseph E. (1971). Increasing risk II: Its Economic Consequences, *Journal of Economic Theory* 3 (1), pp. 66-84.

Ruan, J., Steven Buccola, and Daniel Pick (2007). USDA's Trade Adjustment Assistance for Farmers: The Raspberry Industry, *Agribusiness*, 23 (1) pp. 101–115.

Schiller, Z., Amanda Woodrum, David Rothstein, and Sapna Mehta (2009). Trade Adjustment Assistance: New Opportunities for Ohio Workers: A Report from Policy Matters Ohio, May 2009.

Shade, L. R. (2002). The digital divide: From definitional stances to policy initiatives, Available at: http://www.edtechpolicy.org/AAASGW/Session11/shade_digitaldivide.pdf .

Smith, R. E. (2004). Land tenure, fixed investment, and farm productivity: evidence from Zambia's Southern Province, *World Development*, 32(10), pp. 1641–1661.

Tesfatsion, Leigh (1976). Stochastic Dominance and the Maximization of Expected Utility, *The Review of Economic Studies* 43 (2), pp. 301-315.

Tomz, M., Gary King, and Langche Zeng (1999). RELOGIT: Rare Events Logistic Regression, Version 1.1 Cambridge, MA: Harvard University, October 1, 1999 (http://gking.harvard.edu/).

United States Government Accountability Office (GAO) (2006). Trade Adjustment Assistance: New Program for Farmers Provides Some Assistance, but has had Limited Participation and Low Program Expenditures, *GAO Report to the Committee on Finance, U.S. Senate* (GAO-07-201), Dec 2006.

United States Government Accountability Office (GAO) (2012). Trade Adjustment Assistance: USDA Has Enhanced Technical Assistance to Farmers and Fishermen, but Steps are Needed to Better Evaluate Program Effectiveness, *GAO Report to Congressional Committees* (GAO-12-731), July 2012.

Whitacre, B. E. (2008). Extension's role in bridging the broadband digital divide: Focus on supply or demand? *Journal of Extension* [On-line], 46(3) Article 3RIB2. Available at: http://www.joe.org/joe/2008june/rb2.php)

World Trade Organization (WTO) (2007). Legal Affairs Division, WTO Analytical Index: Guide to WTO Law and Practice, Cambridge University Press, ISBN 0521880297.

Young, C. E., and P. C. Westcott (2000). How decoupled is U.S. agricultural support for major crops? *American Journal of Agricultural Economics* 82 (3), pp. 762-767.