Testing Separability between Iranian Import and Domestic Agricultural Commodities (Application to Iran Grains Demand in a Dynamic Model)

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Abstract: In this study the demand relations for two main grains, wheat and rice in Iran are estimated and interpreted. Two main aims of this study are the separability between import and domestic grains and performance of static versus dynamic models of consumer behavior. A dynamic system of demand functions beside a static LA/AIDS model used to test the separability restrictions in Iran grains consumption data. The results indicate that a dynamic specification of the AIDS model is better than the static model. The separability test showed imported wheat and rice are separable from the domestic wheat and rice so Iran import grains demand must analysis separable from Iran domestic grain demand.

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1. Introduction

The concept of separability, originally introduced by Leontief (1945) and Sono (1961), can be extremely useful for economic modeling because of its wide ranging implications for the existence of consistent aggregates and the decentralization of optimization decisions (Moschini et al. 1994). This concept has been used effectively to analyze the structure of consumer preferences and its implications have been widely used in the empirical study of demand analysis for agricultural commodities in order to limit the number of estimated parameter (Boonsaeng and Wohlgenant, 2006). Separability conditions require the marginal rates of substitution between certain pairs of commodities to be functionally independent of the quantities of certain other commodities. Such conditions reduce the number of parameters that enter the family of demand functions and make estimation of the parameter space more feasible. In practice, however, it is next to impossible to look upon marginal utilities to determine the nature of separability. If separability restrictions are inconsistent with the true preference ordering of the representative consumer, empirical estimates of structural demand parameters are invalid. Thus, it is worthy to consider tests of separability (Nayga and Capps, 1994).

Why is it theoretically consistent to express demand as a function of aggregate commodities instead of the individual commodities that households actually purchase? And why can demand for a category of commodities such as food be expressed as a function of the expenditure on food, instead of total household expenditure? The conditions that make both of these specifications theoretically consistent are two stage budgeting, or weak separability.

For years, weak separability has been used as justification for aggregation demand data, though it has been assumed more often than tested. If separability conditions were not satisfied, it was considered inappropriate to aggregate. If separebility was violated, empirical research had to rely upon disaggregated demand systems which lead to many difficulties in estimation including multicollinearity, degrees of freedom constrains and computational limitations (Schulz et al. 2011).

In this paper, we employ a dynamic almost ideal demand system (AIDS). The dynamic specification proposed in this study is similar to the specification proposed by Assarsson (1991).

To our best knowledge, there is no study has explored the relationship between the Iranian demand for domestic and imported foods. Our study will fill the void.

Data

The data used to estimate the static and dynamic models are yearly time series data from 1975 to 2007. The grains considered are wheat, and rice. The quantity data are kilogram per capita consumption.

Iran per capita consumption of domestic commodities was obtained by dividing Iran domestic total disappearance to the Iran population. Iran domestic total disappearance in every period was calculated by adding Iran production to beginning stocks and subtracting exports, and ending stocks. Total Iran production, stocks variation, imports, and exports data are from FAO website . Also wholesale price indices and exchange rates were obtained from central bank of Iran.

Consumption per capita of imported commodities can be obtained by dividing total commodity imports by the Iran population. The import prices for individual items are not publicly available so unit values are used as proxy for prices. Unit import values (import prices) were obtained by dividing import values by import quantities.

2. Methods

The Static AIDS Model

Since Deaton and Muellbauer (1980) published their famous "Almost Ideal Demand System", AIDS had quickly become one of the most widely used demand models because of its theoretical consistency and functional flexibility. It satisfies the axioms of choice and allows aggregation over consumers (Liao and Chern, 2007). The basic AIDS model is written as:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \ln(p_j) + \beta_i \ln(E/P^*) \quad i = 1, 2, \ldots, n. \qquad (1)$$

Where α_i is a constant, w_i is the budgetary share allocated to the i^{th} item, p_j is the price of item j, E is the total expenditures on all items and P^* is aggregate price deflator defined by:

$$\ln P^* = \alpha_0 + \sum_{i=1}^{n} a_i \ln p_i + \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} \gamma_{ij} \ln p_i \ln p_j$$

Deaton and Muellbauer also proposed to convert the nonlinear AIDS model into simplified linear AIDS (LA/AIDS) model by using so called "Stone index" ($\ln P^* = \sum_{i=1}^{n} w_i \ln p_i$) to replace the nonlinear price index. Because of its simplicity and less computation burden, LA/AIDS model was very popular for empirical demand analysis (Green and Alston, 1990).

To be consistent with economic theory, the system of share equations in (4) must satisfy several restrictions. First, the shares w_i have to sum up to unity. Second, adding up implies the following restrictions in the parameters: ($\sum_{i=1}^{n} \alpha_i = 1, \sum_{i=1}^{n} \gamma_{ij} = 0$, and $\sum_{i=1}^{n} \beta_i = 0$); homogeneity implies ($\sum_{j=1}^{n} \gamma_{ij} = 0$); and symmetry implies ($\gamma_{ij} = \gamma_{ji}$).

The Dynamics AIDS Model

There are several ways to specify a dynamic AIDS model. Some economists include lagged budget share or lagged consumption into the AIDS model to account for the habit effects. Various dynamic almost ideal demand systems (Anderson and Blundell 1983 and 1984, Ray 1984, Blanciforti et al. 1986, Shukur 2002, and Eakins and Gallagher 2003) have been applied to demand analysis after Deaton and Muellbauer published their AIDS model and have found improvement in elasticity estimation and functional form specification.

In this study based on the Assarsson (1991), we defined dynamic effects as below:

$$\alpha_i = \alpha_{i0} + \sum \theta_{ij} W_{j(t-1)}$$

Where $W_{j(t-1)}$ is the lagged budgetary share allocated to the j^{th} item .

Elasticities

Based on the Green and Alston (1991), Price elasticities were calculated by using these equations:

Unconditional price elasticities:

$$\varepsilon_{ij} = \delta_{ij} + \frac{\gamma_{ij}}{w_i} - \beta_i \frac{w_j}{w_i}$$

Conditional price elasticities:

$$\varepsilon^*_{ij} = \delta_{ij} + \frac{\gamma_{ij}}{w_i} + w_j$$

Expenditure elasticities:

$$\eta_i = 1 + \frac{\beta_i}{w_i}$$

Morishima elasticities:

$$M_{ij} = \varepsilon^*_{ij} - \varepsilon^*_{ii}$$

Where δ is the Kroncker delta Which is equal to -1 when i = j for the own price elasticity and i $\neq j$ for the cross price elasticities. The coefficient β_i determines the characteristic of the goods. For luxury goods it is positive and for necessary goods it is negative.

Morishima elasticities determine substitutability between goods. If these elasticities are positive, the goods are considered to be substitutes and if they are negative, they are considered to be complement.

Diagnostic Tests

Following shukur (2002) and Boonsaeng and Wohlgenent (2006), The Breusch- Godfrey (BG) test is used to test for autocorrelation; The Breusch-Pagan (BP) test is used for heteroscedasticity; and the RESET test is utilized for functional misspecification. Also we used Jarque- Bera (JB) statistic for testing residual normality.

Separability

The separability assumption is often invoked by researchers doing empirical demand analysis. This assumption allows specifying conditional (second stage) demand systems of equations, thus the system of equations is only conformed by the group of goods that is the focus of the research. However, there are undesirable features associated with the empirical use of conditional demand systems. For example, the resulting estimated elasticities are of limited value because group expenditures in conditional demand systems are endogenous. For these reasons, unconditional demands are more appropriate to obtain elasticities for policy and welfare analysis. The systems in the first stage are also suitable for testing separability (Boonsaeng and Wohlgenant, 2006).

In this paper to test for separability we consider separable structure that proposed by Blackorby, Primont, and Russell (1978). Let **q** = (q_1, …, q_n) denote the vector of consumer goods, **p** = (p_1, …, p_n) denote the corresponding nominal price vector, and y denote total expenditures on the n goods (income, for short).

The set of indices of the n goods is **I** = {1, …, n}, and these goods can be ordered in S separable groups defined by the mutually exclusive and exhaustive partition $\hat{I}$ = { I_1, …, I_S} of the set **I** . To allow for asymmetric separability, some of the groups include only one good. Assume that 1, 2, …, r are the groups in I that include only one good. Thus, the utility function can be written as:

$$U(q)=[q_1, \ldots, q_r, U^{r+1}(q^{r+1}), \ldots, U^s(q^s)] \qquad (6)$$

where, q_1, …, q_r are the one commodity groups of goods, U^{r+1} (.) is subutility function that contains a subset q^{r+1} of goods, and U^s (.) is a subutility functions that contain a subset q^s of goods. These utility functions satisfy strong monotonicity, strict quasi-concavity, and differentiability (Boonsaeng and Wohlgenant, 2006).

Consider the elements I_d and I_m from the partition I. Based on the results of Blackorby, Davidson, and Schworm (1991), the separable utility in (6) implies that, for all i $\in I_d$ and k $\in I_m$ and for all d ≠ m: s defined by Moschini et al. (1994, p. 63) If we take any two goods (i, j) $\in I_g$, and any two goods (m, k) $\in I_s$, (i =j or m = k is possible), for any two groups g f s, it follows that the substitution terms between goods belonging to different groups are proportional to the respective income terms a set of restrictions that can be maintained in any of the commonly used demand systems, or subjected to a statistical test can be written as:

$$\frac{\sigma_{ik}}{\sigma_{jm}} = \frac{\epsilon_i \epsilon_k}{\epsilon_j \epsilon_m}$$

In the LA/AIDS model, the restrictions are:

$$\frac{\gamma_{ik} + w_i w_k}{\gamma_{jm} + w_j w_m} = \frac{(w_i + \beta_i)(w_k + \beta_k)}{(w_j + \beta_j)(w_m + \beta_m)}$$

The number of non redundant weak separability restrictions for any utility tree can be determined by

$$\left(\frac{1}{2}\right)[N^2 + N - S^2 + S - \textstyle\sum_s n_s(n_s + 1)]$$

Where N is the number of products in the utility tree, S is the number of separable groups in the utility tree and n_s is the number of products in group s (Moschini et al. 1994). All of the separability restrictions are applied to both static and dynamic AIDS.

To test restrictions in demand systems, it is common to use either the Wald test or the likelihood ratio test. The likelihood ratio test requires the estimation of both the unrestricted and restricted models, whereas the Wald test requires the estimation only of the unrestricted model. Estimation of the restricted model, although not a problem with linear restrictions, can be difficult and cumbersome when dealing with nonlinear restrictions, especially when combined with linear restrictions (homogeneity and symmetry) in a demand systems context (Nayga and Capps, 1994).

Table 1: Misspecification tests for the static and dynamic models

Test	Domestic Wheat	Domestic Rice	Imported Wheat	Imported Rice
	Results for the static demand model			
BG	0.012	0.052	0.14	0.04
BP	0.002	0.011	0.006	0.025
JB	0.52	0.34	0.67	0.029
RESET	0.35	0.42	0.31	0.37
	Results for the dynamic demand model			
BG	0.48	0.37	0.59	0.61
BP	0.76	0.65	0.12	0.45
JB	0.82	0.74	0.23	0.58
RESET	0.54	0.75	0.84	0.69

Note: Numbers represent P-values

3. Results

Misspecification Test Results

Table 1 shows results of misspecification tests for static and dynamic LA/AIDS models. This table divides into two sections. Results of misspecification tests for static LA/AIDS are given in the upper section and results of misspecification tests for dynamic LA/AIDS model are given in the lower section of this table. Based on the results for static LA/AIDS model, BG tests indicate the presence of autocorrelation. Because BG tests reject the null hypothesis that there is no autocorrelation in the individual demand equations except in imported Wheat equation. But for dynamic LA/AIDS model BG autocorrelation tests fail to reject the null hypothesis that there is no autocorrelation in the demand equations. With regard to the BP tests for homoscedasticity, all of the tests in static model provide evidence of the presence of homoscedasticity. But in the dynamic model these tests reject the null hypothesis of the presence of homoscedasticity. JB test identify normality of residuals in all equations in both models except imported rice in static model. The RESET tests indicate that there is no functional form misspecification in all equations in both models.

Results from the Static Demand Model

The results from the restricted static LA/AIDS demand model are presented in Table2. The highest R^2 belong to domestic rice equation and the lowest R^2 belong to imported rice equation. The estimated parameters are mostly significant. It is expected that if the Iran currency appreciates, then wheat or rice import from foreign countries will increase, therefore the parameter estimates corresponding to the exchange rate variable in the demand equations for domestic rice, imported wheat and, and imported rice have the correct sign. The exchange rate parameter in the domestic wheat has the incorrect sign but it is insignificant. The variable D_1 is used to include the effects of war between Iran and Iraq on demand. All the coefficients of this variable are significant.

Table 2: Parameter estimates for the restricted Static LA/AIDS demand model

Variables	Domestic Wheat	Domestic Rice	Imported Wheat	Imported Rice
Constant	0.1226*	0.0435*	-0.001	0.0032*
	(0.0662)	(0.0207)	(0.002)	(0.0016)
ln(D. Wheat Price)	-0.00083*	0.00034*	0.00014*	-0.00043
	(0.00036)	(0.00017)	(0.00005)	(0.00107)
ln(D. Rice Price)	0.00034*	-0.00056*	0.00034*	-0.00094
	(0.00017)	(0.00023)	(0.00014)	(0.00153)
ln(Im. Wheat Price)	0.00014*	0.00034*	-0.00073*	0.00088
	(0.00005)	(0.00014)	(0.00031)	(0.00795)
ln(Im. Rice Price)	-0.00043	-0.00094	0.00088	-0.0017*
	(0.00107)	(0.00153)	(0.00795)	(0.0005)
ln(Non Grains Price)	-0.0079*	-0.0063*	-0.0005	-0.0012**
	(0.0035)	(0.0034)	(0.0006)	(0.0003)
Exchange Rate	-0.0029	0.0005	-0.0004*	-0.0081*
	(0.0048)	(0.0048)	(0.0002)	(0.0038)
Real Income	-0.0003*	0.002**	0.0007*	-0.0001
	(0.0001)	(0.0001)	(0.0003)	(0.0015)
Time Trend	0.00002*	-0.0003	0.0008*	0.0004*
	(0.00001)	(0.0004)	(0.0004)	(0.0003)
D_1	-0.0045*	-0.0052**	0.0009*	0.0005*
	(0.0023)	(0.0012)	(0.0004)	(0.0002)
R^2	0.7343	0.8923	0.6522	0.5815
Adjusted R^2	0.7321	0.8851	0.6501	0.5372

*Note: * and ** are 10 and 5 significance levels, Standard errors in parenthesis*

Table 3: Elasticities for static LA/AIDS demand model

	D. Wheat	D. Rice	Im. Wheat	Im. Rice
Income Elasticity	0.993	1.4	1.05	-0.2
Marshallian Elasticity Matrix				
D. Wheat	-1.017	0.0073	0.0031	-0.009
D. Rice	0.062	-1.099	0.061	-0.174
Im. Wheat	0.008	0.027	-1.061	0.0726
Im. Rice	-0.327	-0.722	0.677	0.7
Hicksian Elasticity Matrix				
D. Wheat	-0.971	0.012	0.015	-0.008
D. Rice	0.106	-1.094	0.072	-0.166
Im. Wheat	0.057	0.033	-1.048	0.074
Im. Rice	-0.284	-0.717	0.689	0.701
Morishima Elasticity Matrix				
D. Wheat	-	1.077	1.028	0.687
D. Rice	1.106	-	1.127	0.377
Im. Wheat	1.063	1.12	-	1.737
Im. Rice	-0.709	-0.867	-0.627	-

The price, income and Morishima elasticities for this model are presented in Table3. Some of the elasticities have incorrect signs. For example, own price uncompensated elasticities should be negative but the imported rice shows a positive own price elasticity. The Morishima elasticities are also shown some problems. For example according to imported rice equation, imported rice and domestic rice are complements; however, according to the domestic rice equation, they are substitutes. This problem exists between imported rice and domestic wheat or between imported rice and imported wheat too.

Results of the Dynamic Demand Model

Unit root tests show that all time series contain unit root (non stationary), but first difference of all series of the variables turn out to be stationary[1]. Therefore all the variables are I (1) and usable in regression analysis. The results of the ADF tests for the residuals of the static and dynamic LA/AIDS models show these residuals are stationary.

The results from restricted dynamic LA/AIDS demand model are presented in Table4. All equations in dynamic demand model have higher R^2 than the static demand model. In this model the highest R^2 belong to domestic rice equation and the lowest R^2 belong to imported rice equation too. The parameter estimates corresponding to the exchange rate variable in the demand equations for all equations have the correct sign. Results of coefficients θ_{ij} are not shown in this table and they are available upon request. The variable D_1 has both positive and negative signs but all the coefficients of this variable are significant. Time trend parameter has correct sign and all of the time trend coefficients are significant. Domestic and imported wheat and rice demand are increase during the time.

[1] - Results are not shown, but available upon request

Table 4: Parameter estimates for the restricted dynamic LA/AIDS demand model

Variables	Domestic Wheat	Domestic Rice	Imported Wheat	Imported Rice
Constant	0.0132*	0.0733*	0.0072	0.0625*
	(0.0055)	(0.0367)	(0.0087)	(0.0315)
ln(D. Wheat Price)	0.00045*	0.00114*	-0.00028*	-0.00063*
	(0.00017)	(0.00056)	(0.00012)	(0.00025)
ln(D. Rice Price)	0.00114*	-0.00203**	-0.00078*	0.00094
	(0.00056)	(0.00046)	(0.00032)	(0.00082)
ln(Im. Wheat Price)	-0.00028*	-0.00078*	-0.00026*	-0.00073*
	(0.00012)	(0.00032)	(0.00013)	(0.00028)
ln(Im. Rice Price)	-0.00063*	0.00094	-0.00073*	-0.00023*
	(0.00025)	(0.00082)	(0.00028)	(0.0001)
ln(Non Grains Price)	-0.0071*	-0.0039*	-0.0028	-0.0076
	(0.0035)	(0.0016)	(0.0032)	(0.0092)
Exchange Rate	0.0007	0.0045*	-0.0006**	-0.0003*
	(0.0008)	(0.0026)	(0.0002)	(0.0002)
Real Income	-0.0046	0.004*	0.0038	-0.0016
	(0.0053)	(0.0021)	(0.0093)	(0.0103)
Time Trend	0.0002	0.0005*	0.0003	0.0007
	(0.0007)	(0.0002)	(0.0008)	(0.0008)
D_1	0.0067**	-0.0034**	-0.0046**	0.0039*
	(0.0007)	(0.0005)	(0.0009)	(0.002)
R^2	0.6873	0.9214	0.6652	0.5971
Adjusted R^2	0.6552	0.8916	0.6224	0.5372

*Note: * and ** are 10 and 5 significance levels, Standard errors in parenthesis*

The price, income, and Morishima elasticities for this model are presented in Table5. The income elasticities for all commodities are positive except the income elasticity for imported rice. The income elasticity for imported rice is negative and less than one in absolute value. This negative sign could be explained by the fact that most of the rice imported to Iran has low quality and the imported rice is an inferior commodity. The income elasticities for domestic rice and imported wheat are greater than one, which indicate that these commodities are luxury goods. But the income elasticity for domestic wheat is between one and zero which indicates that domestic wheat is a necessary good. The Morishima elasticities indicate domestic rice is substitute for imported rice and domestic wheat is substitute for imported wheat. With regard to all the results the dynamic model is preferred to static model, but for testing separability both models are used.

Table 5: Elasticities for the dynamic LA/AIDS model

	D. Wheat	D. Rice	Im. Wheat	Im. Rice
Income Elasticity	0.9004	1.8	1.314	-0.6
Marshallian Elasticity Matrix				
D. Wheat	-0.985	0.025	-0.0048	-0.0135
D. Rice	0.207	-1.362	-0.138	0.167
Im. Wheat	-0.037	-0.006	-1.025	-0.06
Im. Rice	-0.463	0.725	-0.555	-1.229
Hicksian Elasticity Matrix				
D. Wheat	-0.944	0.0806	0.006	-0.012
D. Rice	0.249	-1.356	-0.127	0.169
Im. Wheat	0.023	-0.058	-1.009	-0.059
Im. Rice	-0.438	0.728	-0.549	-1.229
Morishima Elasticity Matrix				
D. Wheat	-	1.193	0.967	0.506
D. Rice	1.436	-	1.298	2.08
Im. Wheat	1.015	0.882	-	0.46
Im. Rice	1.217	1.396	1.169	-

Separability Tests

Based on Boonsaeng and Wohlgenant (2006), In this study separability tests were carried out with the homogeneity and separability restrictions imposed and without these restrictions imposed in both the static and dynamic models. Likelihood ratio tests were used to test the restrictions and two considered. In the first case in the unrestricted model none of the restrictions (homogeneity and separability) were imposed whereas than in the restricted model these two restrictions were imposed.

In the second case, unrestricted model was similar to the first case; however the restricted model only imposed the separability restrictions.

Separability test results are presented in Table6. In static model and in the first case the separability restriction is rejected but in the second case in this model and in both cases in dynamic model the separability restrictions are not rejected. These results imply that imported rice and wheat are separable from these domestic goods.

Table 6: P-value of the separability tests

	L.R. statistic	P-value
The static LA/AIDS model		
Separability test in case 1	16.66	0.003
Separability test in case 2	7.43	0.12
The dynamic LA/AIDS model		
Separability test in case 1	6.34	0.18
Separability test in case 2	5.83	0.25

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References

1. Anderson, G., and Blundell, R. (1983) Testing restrictions in a flexible dynamic demand system: an application to consumers. Expenditure in Canada, Review of Economic Studies 50 (3): 397.410.
2. Anderson, G., and Blundell, R. (1984) Consumer non-durables in the UK: a dynamic demand system.. Economic Journal 94(376a): 35.44.
3. Assarsson, B. (1991) Alcohol pricing policy and the demand for alcohol in Sweden 1978-1988, Working Paper, Department of Economics, Uppsala University, Sweden.
4. Blackorby, C., Primont, D. and Russell, R. R. (1977) Separability VS Functional Structure:
5. Characterization of their Differences, Journal of Economic Theory 15(1): 135-144.

6. Blanciforti, L.A., Green, R.D., and King, G.A. (1986) U.S. Consumer Behavior Over the Postwar Period: An Almost Ideal Demand System Analysis, Giannini foundation Monograph Number 40 (August).
7. Boonsaeng, T. and Wohlgenant, M.K. (2006) Testing Separability between Import and Domestic Commodities: Application to U.S. Meat Demand in a Dynamic Model, Selected Paper prepared for presentation at the Southern Agricultural Economics Association Annual Meeting, Orlando, Florida, 5-8 February.
8. Deaton, A., and Muellbauer, J. (1980) An Almost Ideal Demand System, American Economic Review (70): 312-326.
9. Eakins, J.M., and Gallagher, L.A. (2003) Dynamic almost ideal demand systems: an empirical analysis of alcohol expenditure in Ireland, Applied Economics, 35: 1025-1036.
10. Green, R., and Alston, J.M. (1990) .Elasticities in AIDS Models, American Journal of Agricultural Economics Vol. 72, No. 2 (May): 442-445.
11. Kesavan, T., Hassan, Z.A., Jensen, H.H., and Johnson, S.R. (1993) Dynamics and Long-run
12. Structure in U.S. Meat Demand, Canadian Journal of Agricultural Economics 41: 139-153.
13. Liao, H. and Chern, W.S. (2007) A Dynamic Analysis of Food Demand Pattern in Urban China, Selected Paper prepared for presentation at the American Agricultural Economics Association Annual Meeting, Portland, OR, July 29- August 1.
14. Moschini, G., Moro, D. and Green, R.D. (1994) Maintaining and Testing Separability in Demand
15. Systems, American Journal of Agricultural Economics, 76: 61-73.
16. Nayga, R.M. and Capps, O. (1994) Tests of Weak Separability in Disaggregated Meat-Products,
17. American Journal of Agricultural Economics, 76(4): 800-804.
18. Ray, R. (1984) A Dynamic Generalisation of the Almost Ideal Demand System, Economics Letters, 14: 235-239.
19. Shukur, G. (2002) Dynamic specification and misspecification in systems of demand equations: a testing strategy for model selection, Applied Economics, 34: 709-725.
20. Schulz, L.L. Schroeder, T.C. and Xia, T. (2011) Using Weak Separability and Generalized Composite Commodity Theorem in Modeling Ground Beef Demand, Selected Paper prepared for presentation at the Agricultural and Applied Economics Association's 2011 AAEA & NAREA Joint Annual Meeting, Pittsburgh, Pennsylvania, 24-26 July.

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