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Risk Aversion Through Nontraditional Export Promotion Programs in Central America

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Abstract

This paper discusses the growing importance of policies by Central American countries to promote nontraditional agricultural exports. It demonstrates that these programs are rational if countries are risk-averse utility maximizers. It describes the characteristics that crops must have for utility maximizers to benefit from nontraditional export promotion programs. It also shows that the recent nontraditional vegetable and fruit exports of Central America can meet these requirements.

Keywords: Central American exports, nontraditional exports, risk aversion, price covariances, fruit imports, vegetable imports, Costa Rica, Dominican Republic, Guatemala, Honduras, El Salvador, Mexico, avocados, broccoli, cantaloups, cauliflower, cucumbers, limes, peppers, strawberries

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Introduction

Since the world recession in the early 1980's, many Central American governments have provided incentives to producers of nontraditional agricultural goods.[1] For example, Costa Rica has offered tax holidays and export subsidies to producers who export nontraditional agricultural products. These programs are currently being encouraged by international agencies and by the U.S. Government through its Agency for International Development (5).[2] This support has coincided with an increase in exports of crops that Central American countries had not grown until the last decade. Guatemala, for example, has rapidly increased exports of broccoli, celery, melons, and snow peas. None of these products, except melons, was commercially grown in Guatemala 10 years ago.

Nontraditional crop promotion programs began in Chile, Colombia, and Mexico in the early 1970's. In the mid-1970's, Brazil also provided incentives to its newly established citrus and soybean crops. Central American countries began promoting nontraditional agricultural exports in the early 1980's, after a steep recession had reduced prices for their traditional export products. Several of these countries had been provided preferential trading status with the United States as part of the U.S.-Caribbean Basin Initiative, and this status encouraged these countries to seek new export markets in the United States (1).[3]

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[1] We define nontraditional agricultural goods as products that have never previously provided 1 percent or more of a country's agricultural exports.

[2] Underscored numbers in parentheses cite sources listed in the References.

[3] Costa Rica, the Dominican Republic, El Salvador, Guatemala, and Honduras have promoted nontraditional agricultural exports since 1983. We exclude Nicaragua and Panama from this report because Nicaragua faced a trade embargo in the 1980's and Panama is a transhipment zone.

Nontraditional goods are typically defined as products that had not been exported in the past (5). Bananas, cocoa, coffee, sugar, and low-quality beef represent the traditional agricultural exports of Central America. Nontraditional exports are composed primarily of fruits and vegetables that grow well in the cool and well-watered volcanic slopes of Central America. The availability of surplus labor in Central America is well suited to the intense labor requirements of these crops.

Exports of nontraditional products from Central America increased rapidly in the mid-1980's. From 1983 to 1987, the value of nontraditional exports to the United States from Central America increased from $45.7 million to $122.3 million, or more than 250 percent. Exports to Europe of nontraditional products also were considered significant during this time. Table 1 provides a list of exports of selected products for four Latin American countries for the years 1983 and 1987.

Despite the increased growth of nontraditional exports, it is not clear that participating countries will benefit in the long run. Nontraditional product promotion programs compete with traditional products for agricultural inputs. Government promotion of nontraditional crops could eventually crowd out traditional crops by driving up prices of these inputs. For example, Costa Rica is already facing labor shortages for harvesting coffee, while the government is promoting labor-intensive strawberry production. Since countries often have a comparative advantage with traditional goods, why should governments intervene and distort world price signals to promote nontraditional crops?[4]

Several explanations have been used to justify nontraditional product promotion programs. First, it is argued, technology and relative production costs have changed. For example, while Guatemala did not have a comparative advantage in broccoli production in the past, it now does. This implies that the opportunity cost of broccoli production, both within Guatemala and in other countries, has shifted in recent years. However, it seems doubtful that such a dramatic change has occurred since the early 1980's.

Second, it could be argued that countries may have had imperfect information. For example, Guatemalans may have only recently discovered their comparative advantage in broccoli production. Yet, this explanation does not justify nontraditional product promotion programs that encourage crops that have never been tried before. How could countries know beforehand what their relative costs of production would be? Also, why then should government intervention be sought?

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[4] Economists say that, given the proper price signals from international competitive markets, countries will produce the goods for which they have an absolute or comparative advantage.

Table 1--Exports of selected nontraditional products to the United States

Country and commodity	1983		1987	
	Quantity	Value	Quantity	Value
	Metric tons	Million dollars	Metric tons	Million dollars
Costa Rica:				
Pineapples	3,716	1.1	34,210	13.4
Strawberries	NA	0	NA	.2
Cut flowers	1	NA	4.6	NA
Guatemala:				
Broccoli	2,524	1.8	12,630	8.7
Celery	0	0	3,567	.6
Melons	3,598	.7	9,984	3.6
Snow peas	0	0	4,900	4.1
Honduras:				
Melons	2,471	1.5	22,607	6.8
Dominican Republic:				
Citrus	544	.1	2,185	.5
Melons	3,913	.9	9,266	1.7
Tomatoes	78	.2	7,576	1.5

NA = Not available.

A third argument might be that changing tastes and preferences, or changing incomes, of consumers in importing countries have shifted demand away from traditional export crops in recent years. For example, health concerns could have turned consumer tastes from coffee and toward alternatives such as vegetables and fruit juices. Also, rising incomes in developed countries could have led to an increased demand for specialty fruits and vegetables. Yet, why would government intervention be necessary? International price signals can efficiently guide producers toward any crop for which the demand is rising.

Probably the major reason countries want to diversify their product base is because they wish to reduce income variability. A reduction in income variability could appeal to risk-averse countries even if that goal is achieved at the expense of maximizing income. In this paper, we explore that last explanation for nontraditional product promotion programs and determine the conditions required for a risk-averse, utility-maximizing producer to grow a nontraditional crop. We then test to see if nontraditional crops meet those conditions.

Traditional Production Patterns

To illustrate the advantages of nontraditional crop programs to risk-averse countries or producers, we must introduce at least two goods. In the following discussion, one good is considered a traditional export good and the other is a nontraditional export good.

When a fixed input is jointly used to produce more than one good, a constant-cost frontier can be created with a slope equal to the ratio of marginal costs. This frontier has obvious illustrative uses when producer expenditures are constrained. However, even when producer expenditures are not constrained, the constant cost frontier can graphically depict the solution to a profit maximization problem.[5] Profit-maximizing producers will select the point where the slope of the optimal constant cost frontier is tangent to an isorevenue line or where the ratio of marginal costs equals the price ratio.

Suppose profit maximizers produce only one crop. Figure 1 depicts the optimal production point for profit maximizers as lying in the corner of the frontier labeled C_n. At this point, the optimal $Y_1 = \underline{Y}_1$, and the optimal $Y_2 = 0$.

For a country like Guatemala, Y_1 could be a traditional crop such as coffee, and Y_2 could be a nontraditional crop such as broccoli. Suppose there exists a situation similar to that

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[5] The constant-cost frontier can be derived by writing a multioutput cost function as a level curve or:

$$C(Y_1(Y_2),\ Y_2,\ w,\ z) = \underline{C},$$

where $\underline{C}$ represents constant cost, Y_1 and Y_2 are outputs, w is a vector of input prices, and z is a fixed input.

The slope of the frontier can be derived by taking derivatives with respect to an output, or:

$$(\delta C/\delta Y_1)(\delta Y_1/\delta Y_2) + \delta C/\delta Y_2 = 0,$$

$$\text{so that } \delta Y_1/\delta Y_2 = -\delta C/\delta Y_2/\delta C/\delta Y_1.$$

If costs are unconstrained, rises in either price may move producers along the existing frontier or shift the frontier outward. Most likely, costs will rise with production, but some substitution will take place so the frontier will shift and rotate.

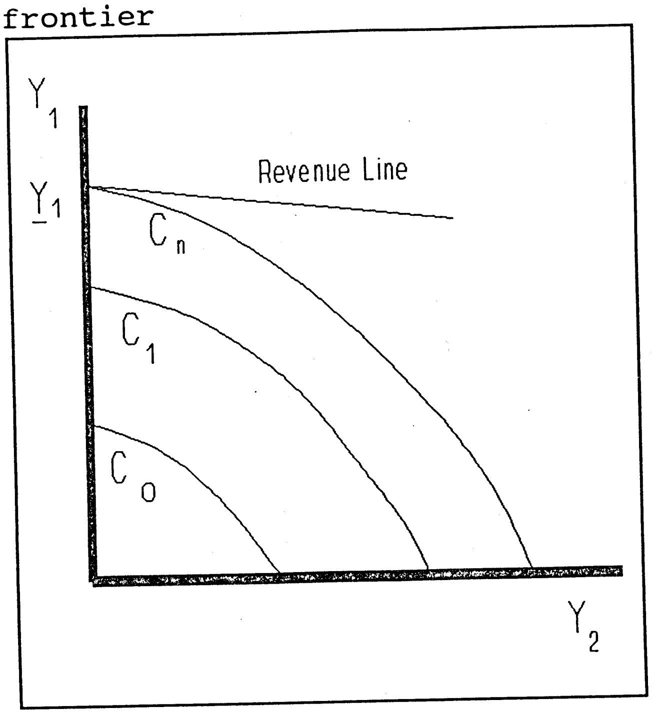
portrayed in figure 1 and relative marginal costs do not change. Any rise in P_2 will rotate the revenue line and lead to an interior solution on the same or higher cost frontier. If this is the case, any rise in the relative price of the nontraditional crop will bring producers out of the corner and lead to nontraditional crop production.

Utility Maximization

Given the situation described above, we will next determine whether nontraditional production will expand from zero when risk-averse utility maximizers replace profit maximizers. We will not consider whether the utility-maximizing decision belongs to a government that earns foreign exchange or to individual producers who earn profits. The following analysis is general enough so that the results can be applied to either case.

The procedure to account for risk aversion allows agents to maximize a linear combination of income and the variance of income. This approach is similar to the expected-value variance (E-V) approach used by Tobin (11) and Levy and Markowitz (7). E-V analysis maintains that the solution to expected utility maximization is equivalent to maximization of a linear combination of the first two moments of the distribution of wealth.

Figure 1
Corner solution on constant cost frontier



Lambert and McCarl (6) list several critiques of the E-V approach and provide an alternative approach to modeling risk aversion, but they note that the controversial basis for "E-V analysis has not limited its widespread application." Just (4) demonstrates that maximization of expected profit itself will account for production risk, but only maximization of a mean variance utility function will account for both production and price risk. Taylor (10) claims that risk aversion may be apparent when producers are actually risk neutral. The major critique by Taylor rests on the notion that stochastic variables can enter the objective function nonlinearly in interaction with decision variables. In this case, the objective function, such as the profits to be maximized, depends on higher moments of stochastic variables.

The widely accepted notion by Pratt (9) that risk aversion is represented in any utility function that is concave in its arguments and when outcomes are stochastic is criticized by Weiss (15). He claims that risk aversion cannot be described by the Arrow-Pratt measure when preferences are not continuous. Futhermore, there is nothing in the utility-based Arrow-Pratt risk measure that accounts for the source of risk. In contrast, the Friedman and Savage approach allows the variance of income to be the source of risk (3). In either case, risk is viewed as subjective, which means that the E-V approach is as useful as any other.

Because of the unsettled nature of this question, the continued use of E-V analysis by economists, and its ease of use, we represent risk-averse utility maximizers as maximizing a linear combination of the first two moments of the distribution of income. Agents that maximize a risk-averse expected utility function are portrayed as:

$$\text{Max} \quad E(\pi) - \phi * \sigma_\pi^2, \tag{1}$$

where π represents income, E is an expectation operator, σ_π^2 represents the variance of income, and ϕ represents a coefficient of risk aversion. We assume prices are stochastic and output is known. When there are two goods and the output prices of both goods are stochastic, the expected income can be written as:

$$E(\pi) = p_1Y_1 + p_2Y_2, \tag{2}$$

where lowercase p's stand for expected prices.

The variance of income is:

$$\sigma_\pi^2 = VAR(P_1)Y_1^2 + VAR(P_2)Y_2^2 + 2COV(P_1,P_2)Y_1Y_2, \tag{3}$$

where $VAR(P_1)$ refers to the price variance of good 1 and $COV(P_1,P_2)$ refers to the covariances between the prices of good 1 and good 2.

Substituting for income in equation 1 can be portrayed as:

$$\max_{Y_1\ Y_2}\ p_1 Y_1 + p_2 Y_2 - C(Y_1, Y_2, w, Z) - \phi^* \sigma_\pi^2, \tag{4}$$

where the terms under the maximization symbol indicate that outputs Y_1 and Y_2 are choice variables, and $C(Y_1, Y_2, w, Z)$ represents a multioutput cost function, w is a vector of input prices, and z is a fixed input.

The first-order conditions for the utility-maximization problem in equation 4 are:

$$P_1 = \delta C(.)/\delta Y_1 + \phi(2VAR(P_1)Y_1 + 2COV(P_1, P_2)Y_2),$$

$$P_2 = \delta C(.)/\delta Y_2 + \phi(2VAR(P_2)Y_2 + 2COV(P_1, P_2)Y_1), \tag{5}$$

where $\delta C(.)/\delta Y_1$ is the marginal cost with respect to Y_1.

The first-order conditions in equation 5 differ from the first-order conditions of profit maximizers by the variance and covariance terms added to marginal costs. If the coefficient of risk aversion (ϕ) were zero, there would be no difference between equation 5 and the typical first-order conditions of a multioutput profit maximizer.

Equation 5 can be written as:

$$(P_1 - \phi W_1)/(P_2 - \phi W_2) = [\delta C(.)/\delta Y_1]/[\delta C(.)/\delta Y_2], \tag{6}$$

where $W_1 = 2(VAR(P_1)Y_1 + COV(P_1, P_2)Y_2)$, and

where $W_2 = 2(VAR(P_2)Y_2 + COV(P_1, P_2)Y_1)$.

We now examine the conditions required for an expansion on the nontraditional crop Y_2 when utility maximization replaces profit maximization. We have assumed that producers lie just in the corner of a constant-cost frontier so that any rise in P_2/P_1 will lead to production of the nontraditional (Y_2) crop. Therefore, if the ratio of the prices with the additional variance terms is greater than the ratio of the price without the variance terms, the nontraditional crop will be produced. That is, if

$$P_2/P_1 < (P_2 - \phi W_2)/(P_1 - \phi W_1), \tag{7}$$

the nontraditional crop will be grown.

In reality, the inequality in condition 7 represents a necessary condition for growing the nontraditional crop when a utility-maximization objective replaces a profit-maximization objective. How much of a price rise will be required depends on the slope of the initial revenue line relative to the cost frontier.[6]

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[6] It is a necessary condition if producers were initially in the corner and relative marginal costs do not change.

Determining whether the inequality in condition 7 holds is complicated because the W terms are a function of the levels of output. Because we want to evaluate whether production expands from the point of profit maximization (where $Y_2 = 0$), the terms in W that include Y_2 drop out. This greatly simplifies determination of the conditions required for production of the nontraditional crop.

Condition 7 can be rewritten as:

$$(P_1 - \phi W_1)/P_1 < (P_2 - \phi W_2)/P_2. \tag{8}$$

Substituting the terms for the W's and then rearranging them, the expression becomes:[7]

$$P_2/P_1 > COV(P_1,P_2)/VAR(P_1) \tag{9}$$

Condition 9 must hold if risk-averse utility maximizers are to grow the nontraditional crop. A negative covariance between the traditional crop price and the nontraditional crop price will ensure that condition 9 will hold. However, condition 9 can hold even when there are positive covariances between output prices of traditional and nontraditional crops. This case is particularly interesting because it makes plain that risk-averse producers can increase utility by choosing crops that are not countercyclical.[8]

A positive covariance between the traditional crop and the nontraditional crop is acceptable if: a) the price of the nontraditional crop is relatively high and b) the ratio of the covariance between the two crop prices to variance of the traditional crop price is relatively low. High nontraditional crop prices may induce profit maximizers to grow nontraditional crops. However, risk-averse utility maximizers may grow a nontraditional crop even with relatively low prices if the covariance between the traditional crop and nontraditional crop is low in relation to the variance of the traditional crop.[9] Very interesting is the insight that an incentive to grow

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[7] When the nontraditional crop production is initially zero, condition 8 equals:

$$(P_1 - \phi 2VAR(P_1)Y_1)/P_1 < (P_2 - \phi 2COV(P_1,P_2)Y_1)/P_2,$$

$$1 - [(\phi 2VAR(P_1)Y_1)/P_1] < 1 - [(\phi 2COV(P_1,P_2)Y_1)/P_2].$$

Dropping the 1's, multiplying through by -1, and rearranging results in condition 9.

[8] Countercyclical crops are crops with prices that are negatively correlated with the traditional crop.

[9] This makes sense because with higher prices for the nontraditional crop, there are higher profits to compensate for the added risk when $COV(P_1,P_2) > VAR(P_1)$.

nontraditional crops with low relative prices may exist even when the prices of the nontraditional crops are not countercyclical.

The above exercise leads to several rules of thumb that risk-averse, utility-maximizing countries or producers can follow:

1. Countries may produce nontraditional products if the covariance between the prices of the traditional and nontraditional crops is small relative to the price variance of the traditional crop. This condition allows for production of crops whose prices have neither a strong negative nor positive relationship with traditional crops. Many crops are likely to fall within this category, expanding the range of possibilities for nontraditional crops.

2. Nontraditional export promotion programs should target crops whose prices have a negative covariance with the prices of traditional crops. This follows from any risk-averse utility maximization scheme.

3. Countries may produce nontraditional products with large and positive price covariances if the price of the nontraditional crop is high relative to the price of the traditional crop. In this case, even producers who only maximize profits would grow nontraditional crops.

Crops that fall under rules 1 and 2 may lead to government intervention if producers are interested only in maximizing profits, while, at the same time, the government wants to maximize a risk-averse utility function. However, this wide divergence in objectives between governments and producers is unlikely. Crops that fall under rule 3 require no intervention, since profit maximizers would have incentives to produce the nontraditional crop.

Generally, risk-averse governments should target nontraditional crops with prices that are negatively related to the traditional crops. Targeted crops may respond differently to weather conditions than do the traditional crops. For example, cold weather, which damages coffee and raises coffee prices, may not damage strawberries and influence strawberry prices. On the other hand, hot weather may damage strawberries and raise strawberry prices but not influence coffee production. Targeted crops may face different income elasticities in developed countries than do the traditional crops. For example, world demand and prices for cut flowers may rise in boom periods and fall in recessions, while demand and prices for low-grade beef (a traditional Central American export) may fall in boom periods and rise in recessions.

A Comparison of Countries and Prices

Comparing the degree of diversification of Latin American agricultural economies represents the first step toward understanding the background for nontraditional crop programs. Table 2 reports indices of concentration of agricultural production and agricultural trade for the Central American countries and nine other Latin American countries. To obtain an index of production concentration, we obtained the United Nations Food and Agriculture Organizaton (FAO) production data and summed the square of each product's share of total acreage devoted to agriculture (13). To obtain an index of export concentration, we used FAO trade data and summed the square of each product's share of total export value (14). These sums were then multiplied by 100. If all production or exports center on one product, the index equals 100. The more diverse the

Table 2--Indices of concentration of crops in Central America and other Latin America

Country	Product concentration	Trade concentration	Ratio of trade to production
	Index	Index	Ratio
Countries with major nontraditional crop programs:			
Brazil	9.0	22	2.4
Colombia	18.0	66	3.7
Costa Rica	10.5	20	1.9
El Salvador	11.0	49	4.4
Dominican Republic	9.5	47	4.9
Ecuador	10.8	16	1.5
Guatemala	12.0	30	2.5
Honduras	12.0	24	2.0
Mexico	12.3	17	1.4
Countries without major nontraditional crop programs:			
Argentina	10.0	13	1.3
Bolivia	7.3	23	3.0
Peru	7.0	45	6.4
Paraguay	14.0	29	2.1
Uruguay	11.6	36	3.1
Venezuela	7.3	29	3.9

Sources: (13,14)

agricultural economy, the closer the indices lie toward zero. Further discussion of the concentration indices are provided in the appendix.

Table 2 illustrates that Latin American countries do not differ widely in the concentration of crops produced. Indices of product concentration ranged from a high of 18 for Colombia to a low of 7 for Peru. Product concentration in trade was much higher and more varied between countries. Indices of trade concentration range from a high of 66 for Colombia, where coffee represents most of the agricultural exports, to a low of 13 for Argentina. All the relative indices are greater than 1, indicating that countries trade a smaller variety of agricultural crops than they export. The difference between the concentration of crops produced and the concentration of crops exported may be a result of import substitution policies followed by many Latin American countries.

It has been shown that agricultural export trade is much more concentrated than agricultural production. The next step is to find nontraditional export crops that satisfy the relative price and variance/covariance inequality shown in condition 9. Because the United States receives the bulk of nontraditional Latin American exports, New York monthly prices from January 1975 to September 1984 were used to obtain the crop price variances and covariances required by condition 9. Nontraditional crops were selected on the basis of the availability of their prices and the growth of their exports from Central America or the Caribbean. Reliable monthly price series for pineapples and cut flowers were unavailable.

Bananas, cattle, coffee, cocoa, and sugar were used as traditional crops. Four of these crops had traditionally formed a large share of agricultural exports. For example, bananas contributed to 16 percent of the value of agricultural exports of four Central American countries (Costa Rica, El Salvador, Guatemala, and Honduras) in 1970 and contributed to 40 percent of Costa Rica's agricultural exports in that same year. Cattle constituted 6.5 percent of exports for these four countries in 1970 and constituted 12 percent of Honduran exports for that year. Coffee constituted 35.5 percent of agricultural exports of the four countries in 1970 and 48 percent of El Salvador's exports in that year. Sugar was 19 percent of the agricultural exports of the four countries in 1970 and 23 percent of Guatemala's agricultural exports in that year. Cocoa has not contributed a large share of exports but is one of the region's longest established crops.

Table 3 lists the ratio of prices of selected nontraditional and traditional crops. For example, row 1 shows that the ratio of 1975-87 average of avocado prices per pound to average 1975-87 coffee prices per pound is 0.42, the ratio of avocado prices to coffee prices is 0.53, but avocado prices are almost four times as high as banana prices. Table 4 gives the covariances between the prices of traditional crops and nontraditional crops. Table 5 lists the ratio of the estimated covariances between

Table 3--Relative prices of nontraditional exports compared with traditional exports[1 2 3]

Nontraditional crop	Bananas	Beef	Cocoa	Coffee	Sugar
			Ratio		
Avocados	3.91	0.61	0.53	0.42	5.96
Broccoli	2.67	.42	.36	.29	4.08
Cantaloups	2.20	.35	.31	.25	3.52
Cauliflower	3.50	.55	.47	.38	5.34
Cucumbers	1.50	.23	.20	.16	2.26
Honeydew	1.70	.26	.23	.19	2.61
Lemons	2.12	.33	.24	.23	3.23
Limes	3.64	.57	.49	.40	5.56
Okra	4.85	.74	.74	.58	7.96
Peppers	2.50	.39	.34	.27	3.78
Pineapples	1.50	.23	.23	.18	2.46
Strawberries	6.48	1.01	.87	.70	9.90

[1] The number in each cell is the ratio of the average price of the nontraditional crop in each row divided by the average price of the traditional crop in each column.
[2] Statistics calculated from July 1975 to December 1987, except cantaloups (1/82-12/87), honeydew (4/80-12/87), okra (1/78-12/87), and pineapples (1/78-12/87).
[3] All prices are New York quotes, except for bananas (all U.S. ports), beef (all U.S. ports), and cocoa (New York and London).

Table 4--Covariances between traditional and nontraditional crop prices[1 2]

Nontraditional crop	Bananas	Beef	Cocoa	Coffee	Sugar
			Ratio		
Avocados	0.0002	0.0060	0.0075	0.0154	0.0054
Broccoli	.0014	.0084	-.0087	-.0034	-.0001
Cantaloups	.0019	.0066	-.0100	-.0006	-.0009
Cauliflower	.0017	.0112	-.0068	-.0038	-.0007
Cucumbers	.0010	.0049	-.0040	.0007	-.0003
Honeydew	.0013	.0045	-.0067	-.0009	-.0005
Lemons	.0018	.0101	-.0238	-.0157	-.0009
Limes	.0018	-.0004	.0145	.0428	-.0015
Okra	-.0009	-.0016	-.0001	.0019	-.0011
Peppers	.0021	.0077	-.0109	-.0034	.0008
Pineapples	.0003	-.0031	-.0075	-.0022	-.0016
Strawberries	.0015	.0198	-.0491	-.0230	-.0056

[1] The number in each cell gives the covariance between monthly prices for the traditional crop in each column and the nontraditional crop in each row.
[2] Statistics are based on same data as table 3.

Table 5--Covariance to variance ratio for traditional and nontraditional crop prices[1 2]

Nontraditional crop	Bananas	Beef	Cocoa	Coffee	Sugar
			Ratio		
Avocados	0.20	0.15	0.05	0.10	1.10
Broccoli	1.40	.21	-.05	-.01	-.02
Cantaloups	1.90	.17	-.06	-.01	-.18
Cauliflower	1.70	.28	-.04	-.02	-.14
Cucumbers	1.00	.13	-.03	.01	-.06
Honeydew	1.30	.11	-.04	-.01	-.10
Lemons	1.80	.25	-.15	-.10	-.18
Limes	1.80	-.01	.09	.04	-.30
Okra	-.90	-.04	-.01	.01	-.22
Peppers	2.10	.19	-.07	-.02	.16
Pineapples	.30	-.08	-.05	-.01	-.32
Strawberries	1.50	.50	-.30	-.15	-1.12

[1] The number in each cell gives the ratio of the covariance between each nontraditional crop price (rows) and each traditional crop price (columns) to the variance of each traditional crop price (columns).
[2] Statistics are based on same data as table 3.

Table 6--Relative covariances/variances to relative prices for traditional and nontraditional crops[1 2]

Nontraditional crop	Bananas	Beef	Cocoa	Coffee	Sugar
			Ratio		
Avocados	0.05	0.25	0.09	0.23	0.18
Broccoli	.52	.48	-.15	-.01	-.01
Cantaloups	.85	.47	-.20	-.02	-.05
Cauliflower	.49	.51	-.09	-.06	-.03
Cucumbers	.68	.54	-.13	.03	-.03
Honeydew	.78	.43	-.18	-.03	-.04
Lemons	.85	.77	-.51	-.44	-.06
Limes	.49	-.02	.19	.11	-.05
Okra	-.19	-.05	-.01	.02	-.03
Peppers	.85	.49	-.21	-.08	.04
Pineapples	.20	-.33	-.21	-.08	-.13
Strawberries	.23	.49	-.35	-.21	-.11

[1] The numbers represent the appropriate covariance to variance ratio to the appropiate relative price ratio. If this number is less than 1, then condition 9 holds.
[2] Statistics are based on same data as table 3.

traditional crop prices and nontraditional crop prices to the variance of the traditional prices. For example, the ratio of the covariance between avocado and coffee prices to the variance of coffee prices is 0.10. With the exception of bananas, the covariances tend to be smaller than the variances of the traditional crop.

Condition 9 holds if the ratio of the relative covariance-variance measure to relative prices is less than one.[10] Table 6 lists this ratio for the selected crops. It is clear that this ratio is less than one for every comparison of a selected nontraditional crop with a traditional crop. If producers or governments want to maximize a risk-averse utility function, nontraditional crop promotion programs appear to fulfill the required conditions.

Several crucial points can be made from viewing the preceding tables. First, the benefits of choosing these nontraditional crops are not obvious. Relative prices are low. The prices of most nontraditional crops are higher than those of bananas and of sugar. As measured by their covariances, only okra and pineapples are countercyclical to most of the traditional crops.[11] If producers of several traditional crops were choosing only crops with countercyclical prices to reduce risk, they would miss many of the nontraditional crops listed in tables 3-6.

Second, it was assumed that the profit-maximization production point is just in the corner of the constant cost frontier and that any rise in the relative price of the nontraditional crop would be enough to ensure its production. In reality, changes in relative prices (with risk terms included) may not be enough to overcome differences in marginal costs. However, if profit maximizers do not grow nontraditional crops, but condition 9 holds, we know that the probability of growing the nontraditional crop must rise.

Table 3 raises the question of which traditional crop should serve as a base for testing condition 9. For individual producers who grow one traditional crop, this is not an issue. For national governments, however, this could be of importance. Aggregating traditional crops into one crop is the most logical way to test condition 9 at the national level. Prices of the five traditional crops listed in table 3 were aggregated into a traditional crop price index for eight Latin American countries. Average export shares (from 1975 to 1984) of the total value of the five traditional crop exports were used as weights for obtaining an aggregate traditional crop price. Since countries

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[10] Condition 9 can be written as:

$$1 > [\ COV(P_1,P_2)/VAR(P_1)\ ]/[P_2/P_1\ ]$$

[11] Many crops are countercyclical to coffee, cocoa, and sugar.

have a different mix of exports, they have a unique aggregate traditional crop price.

Tables 7 and 8 report the relative prices and the ratio of relative prices to the covariance-variance ratio for several of the nontraditional crops and the aggregated traditional crops for six Latin American countries. The covariances and variances were obtained by first calculating an aggregate price index and then by calculating the variances and covariances with these indices. When reading table 8, it is important to note that the variance of the indices reflects a complex interaction of its component prices. The format and the interpretation of the data are the same as for table 6.

From table 8, it is clear that condition 9 holds for all the selected nontraditional crops in each country. Countries that diversify their source of agricultural foreign exchange earnings by choosing countercyclical crops would choose only peppers and strawberries as nontraditional crops. Yet, avocados, broccoli, cauliflower, cantaloups, cucumbers, and limes also satisfy the conditions laid out in condition 9. Table 8 illustrates that targeting these crops, many of which have been chosen for nontraditional export programs, makes sense if countries are maximizing a risk-averse utility function.

Conclusions

Many developing countries are now promoting exports of nontraditional agricultural products. International agencies and U.S. foreign-assistance programs have encouraged this promotion of nontraditional exports. Programs to promote nontraditional exports may be partially responsible for the large growth in nontraditional fruit and vegetable exports that have come from several Central American countries over the past 10 years. This paper has asked whether promotion of production or exports of nontraditional agricultural products serves the best interests of the agricultural sector. Under certain assumptions, we found:

1. A developing country's nontraditional product promotion programs make sense if the country's goal is to maximize a risk-averse utility function.

2. A developing country's nontraditional product promotion programs may usefully target countercyclical crops. The output prices of countercyclical crops are negatively correlated to those of the main crop.

3. A developing country can target nontraditional products with output prices that are positively correlated to the traditional crop if the nontraditional crop meets certain restrictions. Foremost, the covariance between the prices of the nontraditional crop and the traditional crop should be small relative to the variance of prices of the traditional crops.

Table 7--Relative prices using country aggregate of traditional crops[1,2]

Nontraditional crop	Costa Rica	Dominican Republic	Guatemala	Honduras	El Salvador	Mexico
			Ratio			
Avocados	0.65	0.71	0.27	0.71	0.35	0.47
Broccoli	.42	.46	.17	.46	.23	.30
Cantaloups	.36	.39	.15	.39	.20	.26
Cauliflower	.57	.61	.23	.62	.31	.41
Cucumbers	.24	.26	.10	.26	.13	.17
Limes	.60	.65	.25	.66	.33	.43
Peppers	.39	.42	.16	.43	.21	.28
Strawberries	.68	.73	.28	.73	.43	.49

[1] The numbers represent the price of the nontraditional crop in the rows relative to a weighted averge of the five traditional crops. Weights are based on export shares of the countries in the columns.
[2] Data for this table are based on prices from January 1975 to September 1984.

Table 8--Relative covariance/variance to relative prices for traditional and nontraditional crops using country aggregate of traditional crops[1,2]

Nontraditional crop	Costa Rica	Dominican Republic	Guatemala	Honduras	El Salvador	Mexico
			Ratio			
Avocados	0.32	0.49	0.44	0.33	0.25	0.27
Broccoli	.16	.17	.12	.18	.06	.09
Cantaloups	.10	.05	.05	.12	.02	.04
Cauliflower	.15	.16	.12	.16	.06	.09
Cucumbers	.13	.16	.10	.15	.05	.07
Limes	.63	.83	1.06	.65	.61	.57
Peppers	.01	-.03	-.10	.02	-.07	-.05
Strawberries	-.14	-.37	-.10	-.16	-.03	-.07

[1] The numbers represent the covariance-to-variance ratio to the relative price ratio. If this number is less than 1 then condition 9 holds.
[2] Data for this table are based on prices from January 1975 to September 1984.

4. A developing country may target crops with large and positive covariances between the price of the targeted crop and the traditional crop if the price of the nontraditional crop is high relative to the traditional crop. Providing market price information to profit-maximizing producers is a sufficient promotion program for crops with these characteristics.

In sum, nontraditional crops need not have high relative prices or have countercyclical prices to maximize the utility of agricultural producers or government agricultural planners. If the output price of nontraditional crops meets the conditions delineated in this report, risk-averse utility maximizers have incentives to grow nontraditional crops. However, the opportunity cost of production should also be taken into account. Often countries will be on the corner of a constant-cost frontier, and when the price of the nontraditional crop rises, they will remain in the corner. Future research can extend the approach used in this report by estimating the slope of the constant-cost frontier and comparing this slope with relative prices before and after the risk terms are added.

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Appendix

We defined the concentration index as:

$$CC = 100*\sum_{1=i}^{N}(x_i/\Sigma x_i)^2,$$

where each x_i represents one of N different commodities produced or exported. Separate CC terms can be calculated for trade and production. Each term CC must lie between 0 and 100. When a country's agricultural sector produces only one crop, the production CC equals 100. The wider the diversity of crops, the closer CC will be to zero.

FAO publishes production and export data of 100 to 250 agricultural commodities for each Latin American country. Acreage planted to each crop was the best common unit we found for comparing crops. We aggregated the 1975-83 average acreage of land planted to various crops and pastures to obtain the denominator of the production CC. Livestock products not produced on pastures were not included, so our CC calculations overestimate the product concentration of the agricultural sector.

We had the relevant international prices and could compare export values. However, obtaining the trade concentration index was more difficult. Postharvest processing diversifies the amount of goods produced. For example, wheat can be sold as wheat, bread, or wheat flour. The form in which each good is exported is a separate issue. Therefore, we aggregated postharvested goods into their common crop component. For example, we summed the value of wheat, wheat flour, and bread into one good. We summed the value of exports of every crop to obtain the denominator of the trade concentration index. The trade concentration index has the same interpretation as the production concentration index. Because both indices are unit free, they can be compared directly.

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