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CREDIT ALLOCATION DECISIONS BY WHEAT EXPORTING COUNTRIES

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Abstract

This study models credit allocation decisions by major wheat exporting countries, using Cragg's two-step process. Important factors explaining credit decisions are market share and size and existence of credit by competitor countries. U.S. decisions are most sensitive to market share, while Canada's decisions are most sensitive to the other countries' provisions of credit.

INTRODUCTION

Credit guarantees provided by exporting countries in international wheat transactions escalated in importance during the 1980s. These programs have become important tools for maintaining exports and/or increasing sales in markets that have difficulty expanding consumption without some form of credit guarantee. Given the changing composition of importers and competitive environment, use of credit guarantees is likely to continue to be an important component of trade policy.

Despite its emerging importance, research on export credit guarantee programs has been limited.[2] Although a popular allegation about credit is that political pressures influence allocation decisions, we are not aware of any studies that analyze factors and decision structures that determine the allocation of export credit guarantees among importing countries. Understanding credit allocation decisions is critical to explaining strategic behavior of competitor exporting countries and design of effective policy mechanisms.

This study analyses the decision process and factors explaining allocation decisions of credit guarantees for wheat by the United States, Canada and the European Community during 1982-1989. The two-step Cragg model is used with economic variables reflecting market and competitive conditions, demand for credit guarantees, and risks of default.

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[1]An extended version of this paper is available from the authors (Yang and Wilson).

[2]Previous research mainly focused on impacts of credit on welfare (Grigsby and Dixit), on exchange rate risk (Baxter and Smith), and on trade flows (Fleming and Konandreas et al.; Koo and Karemera). Other researchers evaluated the extent that credit programs are export subsidies (Baron; Eaton; Skully).

Model Development

An exporting country determines the optimal level of credit guarantee by maximizing the expected payoff, $E(\pi_i)$, associated with allocating credit to country i:

$$[1] \quad \text{Max } E(\pi_i) = p^*[cx_i + E(ax_i)] - C[cx_i + E(ax_i)] - Prob_i * p * cx_i,$$

where p is the world wheat price, cx_i is the amount of the credit guaranteed, and $E(ax_i)$ is expected additional cash sales due to the credit allocation, i.e, market expansion potential. $C(\cdot)$ is the well-behaved cost function of export, and $Prob_i$ is the probability of default.

From the first-order condition, the optimal level of credit guarantee can be expressed as

$$[2] \quad cx^*_i = f[p, E(ax_i), Prob_i].$$

For purposes here, world price is assumed to be the same across countries. Therefore, the level of credit guarantee is a function of market expansion potential and probability of default. However, these variables are not directly observable, so we used proxies instead to capture these effects.

Two variables are included to capture the direct effect of market expansion potential: previous year's total wheat imports from all exporting countries ($TOTIMP_{t-1}$) and exporting country's market share during the previous year (MS_{t-1}). Lagged variables were used because data at time t are not available when credit decisions are made. Sales expansion potential is assumed greater for larger import markets, thus warranting greater credit allocations. The relation of MS_{t-1} would be positive if an exporting country protects markets in which it has had a strong position.

The impact of competitor country credit programs on credit allocation decisions is captured as a dummy variable, D_{other}. This variable reflects intercountry rivalry among exporting country's credit allocation decisions. D_{other} is equal to one if any other competitor country provides credit to the target market and zero otherwise.

Three variables are included to reflect import country risk: debt-service as a percent of GDP, DSR; non-gold foreign reserve divided by the monthly average of total import in value, RPM; and the Euromoney risk index, SCORE, which measures country risk based on economic factors and political and social conditions. A country evaluated to have no risk is rated 100; being rated 0 is chaotic and risky.

While these variables represent a country's ability to repay, they also represent economic strength of the importing countries. Countries with low debt would be unlikely to respond to credit being allocated to them. Similarly, RPM represents the importing country's ability to make cash purchases. Countries with a higher RPM would respond less to credit guarantees. On the other hand, countries with a high DSR or low RPM would have more demand for credit.

Finally, we included regional dummy variables (D_{AS}, D_{AF}, D_{SA} and D_{EU} for Asia, Africa, South America, and Europe, including eastern Europe, respectively) to capture potential political, location, and other geographical impacts on credit allocation decisions.

Estimation Method

Credit sales would not be made if the potential for market expansion is negligible or if the risk of loss due to default is too large. In these cases, the quantity of sales under credit would be zero, and the dependent variable would be truncated below zero. The number of countries that demand credit guarantees, but are not eligible, is not small. Least squares estimation applied to this limited dependent variable model would lead to biased and inconsistent parameter estimates.

Suppose the decision is simply to select recipient importers with the exporting countries providing whatever amount they require. This is a discrete "give-it-or-not" decision and can be explained by simple probit or logit models. However, exporting countries also determine the quantity of guarantees. Moreover, these two decisions may not be based on the same criteria. If the quantity decision is made conditional on the discrete choice, Cragg's two-step model would be appropriate. The Cragg model allows parameters affecting the quantity decision to differ from those impacting the discrete decision.[3]

Let P^* be the likelihood of giving credit guarantee and cx^* be potential credit sales. The two-step Cragg model can be specified as a two-equation model:

$$[3] \quad P^* = Z\alpha + \mu, \qquad I = 1 \quad \text{if } P^*>0 \quad \text{and}$$

$$= 0 \quad \text{else},$$

$$[4] \quad cx^* = X\beta + \sigma\varepsilon,$$

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[3]In fact, the decision process for the United States suggests a two-step process (TEID).

where X and Z are matrices of explanatory variables, and α and β are corresponding vectors of unknown parameters. μ is assumed to be a standard normal random variable and $\varepsilon \sim N(0,\sigma^2)$. I is a binary indicator, and equation [3] represents a typical probit model. The latent variable cx^* is observed only when I=1 and is truncated normal at zero. Thus, the observed actual amount cx is defined as

$$[5] \quad cx = cx^* \quad \text{if } Z\alpha+\mu > 0,$$

$$= 0 \quad \text{else.}$$

The log-likelihood function for the sample is

$$[6] \quad L_c = \Sigma_i[(1-I_i)\ln(1-\Phi(Z_i\alpha)) + I_i\{-\ln\sigma+\ln\phi((cx_i-X_i\beta)/\sigma)+\ln\Phi(Z_i\alpha)-\ln\Phi(X_i\beta/\sigma)\}].$$

where $\phi(\cdot)$ and $\Phi(\cdot)$ are the density and probability functions of standard normal distribution, respectively. Since first-order derivatives of this function are highly nonlinear, an iterative numerical method was used (Lee and Maddala).

Data Description and Scope of Analysis

Exporting countries for which credit programs have been important include the United States, Canada, and the EC.[4] Empirical models were estimated, using panel data for each exporting country.

U.S. data for credit sales were taken from the USDA Foreign Agricultural Service, and Canadian data were taken from the Canadian Wheat Board Annual Reports. Aggregate wheat sales under credit guarantee programs reported in the International Wheat Council (IWC) were used for the EC.

Data for DSR were derived from Balance of Payment Statistics (IMF), and RPM was taken from the International Financial Statistics (IMF). SCORE was taken from Euromoney. Wheat trade data were derived from the IWC and supplemented with data from USDA Grain Market News and Canadian Wheat Board annual reports.

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[4]Though Australia and Argentina provide credit guarantees, the frequencies of doing so were insufficient for empirical analysis. Thus, these exporting countries were not included in this study.

Countries having no imports for the sample period were deleted, leaving a data set of 89 importing countries. Table 1 presents sample statistics. The variable P indicates the proportion of the countries that received credit from the exporting countries. The United States provided credit guarantees to about 24 percent of the potential countries, while Canada and the EC provided 7% and 6%, respectively. The variable Y indicates that, on average, the U.S. guarantee was for about 114 thousand metric tons. This amount is about four times larger than the amount Canada or the EC gave.

Table 1. Summary Statistics

	United States		Canada		EC	
Variable	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
			Total Sample			
P(%)	24	43	7	26	6	1
Y(000MT)	114	353	22	131	27	131
DSR	38.90	31.92	38.90	31.92	38.90	31.92
SCORE	48.93	38.99	48.93	38.99	48.93	38.99
RPM(Month)	14.03	12.81	14.03	12.81	14.03	12.81
MS(%)	0.48	0.38	0.14	0.22	0.24	0.34
TOTIMP(000MT)	880	1760	880	1760	880	1760
D_{other}	0.12	0.33	0.28	0.45	0.26	0.44
D_{AF}	0.39	0.49	0.39	0.49	0.39	0.49
D_{AS}	0.20	0.40	0.20	0.40	0.20	0.40
D_{EU}	0.20	0.40	0.20	0.40	0.20	0.40
D_{SA}	0.21	0.40	0.21	0.40	0.21	0.40
N	507		507		507	
			Truncated Sample[a]			
P(%)	1	0	1	0	1	0
Y(000MT)	471	590	321	394	450	317
DSR	52.70	27.91	67.85	28.59	65.65	38.26
SCORE	37.70	17.76	34.46	12.09	42.37	16.51
RPM(Month)	11.07	10.47	14.40	10.90	6.03	4.46
MS(%)	0.70	0.28	0.19	0.17	0.31	0.22
TOTIMP(000MT)	1330	1580	1930	2000	2820	2770
D_{other}	0.35	0.48	1	0	0.70	0.47
D_{AF}	0.44	0.50	0.43	0.50	0.77	0.43
D_{AS}	0.15	0.36	0.11	0.32	0.20	0.41
D_{EC}	0.05	0.22	0.03	0.17	0	0
D_{SA}	0.36	0.48	0.43	0.50	0	0
N	123		35		30	

[a]The sample includes the importing countries that received nonzero credit guarantees.

Averages for the truncated sample show few differences among exporting countries. Comparing statistics for the total sample to those for the truncated sample for the explanatory variables provides expected relations to the dependent variable. For example, the average DSR of the total sample is 38.90, while those of the truncated samples are 52.70 for the United States, 67.85 for Canada, and 65.65 for the EC. These statistics indicate that, on average, credit was given to countries with higher DSRs. Similarly, credit was more likely given to countries with lower SCOREs or RPMs, and higher MS_{t-1} or $TOTIMP_{t-1}$.

Statistics for D_{other} show that all three exporting countries tended to provide credit to countries that received credit from competing exporting countries. This is particularly true for Canada, which provided credit to importing countries whenever other competing countries provided credit. Statistics for the regional dummy variables indicate that, in general, a greater proportion of the countries in Africa received credit than countries in Asia and Europe. Also, no countries in Europe or South America received credit from the EC. As a result, the empirical model presented for Canada does not include D_{other} since it is a perfect predictor; and regional dummy variables were not included for the EC model.

Results and Interpretations

Estimated results for each exporting country are shown in Table 2. In the U.S. model, most economic variables are significant at the 10% level, except DSR. SCORE and RPM are significant in both decisions and are negatively related to the probability of receiving credit as Table 1 indicates. However, conditional upon receiving credit, the quantity allocated to individual countries is positively related to SCORE and RPM. This indicates that, once the United States decides to provide credit to a country, a larger amount is given to countries with strong economies.

MS_{t-1} is significant and positive in both the discrete and quantity decisions. This suggests that credit is used to maintain market share. Similarly, $TOTIMP_{t-1}$ and D_{other} have positive impacts on both decisions, suggesting that the United States is likely to provide more credit to large importing countries, especially when they receive credit from other exporting countries.

Results for the Canadian model are quite similar to those for the United Sttes except that DSR is significant instead of RPM. Countries with a higher DSR (i.e., greater demand for credit guarantees) are more likely to receive credit, but the quantity allocated is inversely related to DSR. This reflects efforts to reduce exposure to risk by decreasing the quantity to countries with a higher DSR.

Table 2. Cragg Model Estimates of Credit Allocation[a,b]

	United States		Canada		EC	
	discrete	quantity	discrete	quantity	discrete	quantity
Intercept	-1.356***	-34.000***	-1.776***	-9.705	-2.268***	-2.039
	(-5.73)	(-4.30)	(-6.61)	(-1.54)	(-5.60)	(-0.49)
MS	1.367***	17.322***	1.236***	15.769**	0.904**	5.601
	(6.17)	(5.02)	(2.58)	(2.46)	(2.32)	(1.32)
TOTIMP	0.101***	6.111***	0.141***	3.720***	0.247***	0.985**
	(2.69)	(5.95)	(3.19)	(4.38)	(5.18)	(2.31)
D_{other}	1.21***	5.203*	.	.	1.091***	0.442
	(6.00)	(1.92)	.	.	(4.16)	(0.20)
DSR	0.003	-0.013	0.010***	-0.101*	0.005*	0.010
	(1.40)	(-0.31)	(4.10)	(-1.80)	(1.91)	(0.38)
RPM	-0.020**	0.277*	0.003	-0.053	-0.066***	-0.171
	(-2.56)	(1.72)	(0.37)	(-0.54)	(-2.98)	(-0.78)
SCORE	-0.006*	0.152**	-0.013**	0.137	0.001	0.031
	(-1.94)	(2.17)	(-2.55)	(1.51)	(0.19)	(0.60)
D_{AS}	-0.227	-3.144	-0.233	-4.883	.	.
	(-1.12)	(-0.76)	(-0.78)	(-1.39)	.	.
D_{EU}	-0.492*	2.309	-1.031*	4.160	.	.
	(-1.79)	(0.43)	(-1.81)	(0.99)	.	.
D_{SA}	0.302	-5.921	0.231	3.077	.	.
	(1.45)	(-1.53)	(0.96)	(1.21)	.	.
σ	1	6.17	1	7.44	1	3.32

[a]The values in parentheses are t-statistics.

[b]The dependent variable in the quantity decision model was divided by 100 to avoid scaling problem in estimation. One, two, and three asterisks denote significance at 10%, 5%, and 1%, respectively.

Results for the EC are similar to other exporting countries except that only $TOTIMP_{t-1}$ is significant in explaining the quantity decision. This indicates that once the EC makes a decision on the discrete choice, the market size is the most important factor in deciding the quantity.

To make direct comparisons on the magnitude of the impacts of the independent variables, we calculated marginal effects evaluated at means in Table 3. The previous year's market share has the greatest positive impact on the two decisions in the U.S. and Canadian models and the second largest on the discrete decision in the EC model. Among the three countries, this variable has the greatest impact on the U.S. discrete decision.

Table 3. Marginal effects of the explanatory variables evaluated at means for United States, Canadian, and EC data

	United States		Canada		EC	
	Probit	Truncated	Probit	Truncated	Probit	Truncated
DSR	0.00088	-0.00250	0.00065	-0.09215	0.0001	0.0066
SCORE	-0.00191	0.02986	-0.00087	0.12514	0.0200	0.0203
RPM	-0.00059	0.05463	0.00022	-0.04870	-0.0022	-0.1139
MS_{t-1}	0.40716	3.40900	0.08232	14.41699	0.0304	3.7139
TOTIMPt-1	0.03275	1.20284	0.00941	3.40326	0.0083	0.6533
D_0	0.36069	1.02411			0.0367	0.2932
D_{AS}	-0.06750	-0.61870	-0.01551	-4.46729		
D_{EU}	-0.14649	0.45447	-0.06866	3.80581		
D_{SA}	0.08985	-1.16522	0.01541	-2.81516		

The dummy variable D_{other} also significantly impacts allocation decisions, indicating the importance of credit on rivalry among wheat exporting countries, especially between Canada and the United States. In addition, the importing country's market size is important, especially in determining how much to provide. Large markets are likely to receive more credit from these three exporting countries. The other three variables, DSR, SCORE, and RPM, do not appear to have large impacts on the decisions.

Conclusions

Allocation of credit guarantees was modeled, using variables reflecting market and competitive conditions, credit guarantee demand, and default risk. In general, exporting countries are likely to provide more credit to countries in which they have greater market shares and/or where other exporting countries provide credit guarantees. Impacts of variables are less in magnitude in the Canadian and EC models than the U.S. model, except D_{other} for Canada. U.S. decisions are most sensitive to market share, while Canadian decisions are most sensitive to other country's credit allocations. No single factor seems to dominate the EC's decision.

The empirical results of this study suggest that credit allocation decisions are not purely political. Regional dummy variables are only minimally important, and many of the economic variables are significant. Credit allocation decisions conform to expectations encompassing market expansion potential, demand for credit guarantees, competitive conditions, and risk.

Different results across exporting countries suggest they have divergent views on the expected additional sales revenue and expected cost of default. The significance of the market share in explaining credit decisions suggests a dynamic simultaneous feedback between the wheat exports and credit guarantees. Ignoring this simultaneity may lead to incorrect conclusions about how credit programs affect wheat trade and welfare analysis.

Results of this study provide information on how major exporting countries make decisions on export credit allocations, which can be used to understand a competitor's marketing and trade strategies, and to design more effective policy programs.

References

Baron, D. The Export-Import Bank. New York: Academic Press, 1983.

Baxter, T., and M. Smith. "Exchange Rate Risk, Dollar Appreciation and U.S. Export Credit Progress." AGES 870430, September 1987.

Canadian Wheat Board, Annual Report, from various issues.

Eaton, J. "Credit Policy and International Competition" in Strategic Trade Policy and the New International Economics, P. Krugman (ed.) 1988:115-46.

Fleming, A. "The Role of Export Credit Programs for Rice," USDA Rice Situation (RS-59) 1990:12-16.

Grisby, S., and P. Dixit. "Agricultural Export Strategies and U.S. Agricultural Policies for Grain and Oilseeds, 1950-83," ERS Staff Report No. AGES 8606215, ERS/USDA, Aug. 1986.

International Monetary Fund, Balance of Payment Statistics, from various issues.

International Monetary Fund, International Financial Statistics, from various issues.

International Wheat Council, "Export Credit for Wheat" in PMR 189, Dec 1990.

Konandreas, P., P. Bushnell, and R. Green. "Estimation of Export Demand Functions for U.S. Wheat," Western Journal of Agricultural Economics 3(1978):39-49.

Koo, W. and D. Karemera. "Determinants of World Wheat Trade and Policy Analysis," Canadian Journal of Agricultural Economics (forthcoming).

Krugman, P., editor. Strategic Trade Policy and the New International Economics, The MIT Press, Cambridge, 1988.

Lee, L., and G. Maddala, "The Common Structure of Tests for Selectivity Bias, Serial Correlation, Heteroskedasticity and Non-Normality in the Tobit Model," International Economic Review 26(1985):1-20.

Skully, D. "The Export Credit Guarantee Program as a Risk Business," selected paper, American Agricultural Economic Association, Manhattan, Kansas, 1991.

U.S. Department of Agriculture, Grain Market News, from various issues.

U.S. Department of Agriculture. A TEID Risk Analysis: A Handbook for Staff and Users. Produced by the International Economic and Financial Indicators Branch, Trade and Economic Information Division, Foreign Agricultural Service, October, 1990.

Yang, S. and William W. Wilson. Modeling Export Credit Allocation Decisions for Wheat Exporting Countries. AE Paper 92004, Department of Agricultural Economics, North Dakota State University (1992).

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