Journal of Agricultural and Resource Economics 24(2):506–524

Option Values for Provisions in Export Credit Guarantees

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All major exporting countries of agricultural commodities have some form of credit guarantee program. As the importance of credit programs escalates, it is incumbent on policy makers to examine the value of their program relative to those of competitors. In this study, a model based on option pricing theory was developed to estimate the value of credit guarantees extended to importers and applied to U.S. and competing countries' programs. The Canadian guarantee has the lowest implicit value, followed by the U.S., Australian, and French guarantees. French guarantees had the highest implicit value due to higher coverage for interest and freight and insurance.

Key words: export credit guarantees, GSM-102, implicit subsidy, option value, Supplier Credit Guarantee Program

Introduction

Credit guarantee programs have become an increasingly important element of export strategy for agricultural products and are used by all major exporters. However, several structural changes affect the future use and design of these mechanisms. As a result of changes in the composition of importers (primarily privatization), inter-country competition, and the GATT (exporting countries must limit export programs that provide visible subsidies), use of export credit guarantee programs has escalated.[1]

Competition among exporting countries' programs makes it more important to evaluate the critical features that enhance the value of credit guarantees. In the primary U.S. export credit program (GSM-102), credit terms are standardized across importing countries, thus implying limited flexibility when granting loans and restricting the ability to differentiate guarantee premiums by loan risk. Amstutz and others have appealed to the need for greater flexibility in U.S. credit guarantee programs. Industry responses to the establishment of the Supplier Credit Guarantee Program (SCGP) also argued for alternative levels of program coverage, inclusion of freight in the amount covered by guarantees, alternate levels for fee structures, etc. [U.S. Department of Agriculture/Commodity Credit Corporation (USDA/CCC)]. In contrast, the French COFACE program provides greater flexibility in credit terms across

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This research was supported under NRI Grant No. 93-37400-9464, "Export Credit in International Wheat Trade." Helpful comments were received from D. Demcey Johnson, Vidya Satyanarayana, Laurence Crane, and Charlene Lucken. All errors and omissions remain the responsibility of the authors.

[1] For a more in-depth discussion of export credit programs, their provisions, utilization, and policy issues, see Dahl et al.

importing countries, and Canadian programs vary export credit insurance premiums based on risk.

Understanding the factors that contribute to the value of credit mechanisms is important for policy makers and program administrators for a number of reasons. First, the programs are designed to add value to recipients. Second, an exporting country's programs are subjected to competition from similar programs from other countries. Third, the use and interpretation of credit programs is an important issue in World Trade Organization negotiations. It is important that the U.S. Commodity Credit Corporation is regarded as having similar features as a state trading enterprise (STE) due primarily to the mechanisms of the CCC in credit programs (Fegley).[2]

Previous research on export credit guarantee valuation has focused largely on the interest subsidy component of the mechanism. Skully, and Hyberg et al. examined the subsidy value of GSM guarantees by estimating the inherent interest subsidy contained in GSM guarantees. The value of the guarantee was represented by the interest rate differential facing the importer when borrowing with the guarantee versus higher alternative borrowing costs. Hyberg et al. estimated that the implied interest subsidy incorporated in GSM guarantees averaged 4% of the value of GSM allocations for wheat exports from 1979–92. These results illustrate the potential magnitude of implicit interest subsidies, but do not account for the guarantee value of the instrument. In addition, in the U.S. credit guarantee programs, interest rates on guaranteed loans are set administratively by the USDA and do not vary across importing countries. Thus, interest rate differentials for guaranteed sales would not reflect the true risk premium associated with guaranteed over nonguaranteed sales. Finally, other program features affect program value—namely insurance, freight, and exchange rate risk.

Credit guarantees have an option value due to the guarantee feature which can be evaluated using contingent claims analysis as suggested in the recent literature on real options (see Amram and Kulatilaka for a summary of applications of option methodology to nontradable real options). In this study, we derive the implied value of provisions embedded in export credit guarantee programs. The model was applied to various export credit guarantee terms/provisions to examine the value of providing increased flexibility for both the GSM-102 program and the recent Supplier Credit Guarantee Program. Comparisons are made to competing countries' programs.

U.S. and Competitor Program Provisions

Most major exporting countries of agricultural commodities extend some form of export credit guarantee/insurance. The United States, Canada, Australia, France, and other countries in the European Union (EU) have export credit insurance/guarantee programs. The United States has several export credit programs operated by the CCC; however, most guarantees are extended under the GSM-102 and GSM-103 programs.

[2] In a recent paper, Sumner and Josling describe the extent and use of CCC programs. They indicate that with the implementation of the Uruguay Round constraints and changes in domestic farm programs, use of the Export Enhancement Program (EEP) dropped in 1997 to less than 10% of the value of EEP exports that occurred at their peak in 1993, while credit programs in 1997 remained at over 50% of the value of exports under credit that occurred at their peak in 1992.

Traditionally, these programs guarantee export sales to importers that are financed through U.S. banks. If importers default, the CCC reimburses the U.S. bank and takes ownership of the loan. These programs cover up to 98% of the principal and a portion of the interest for terms up to three years (GSM-102) and 3–10 years (GSM-103). The USDA announces credit allocations under these programs each year by country and commodity. Premiums are charged to the importer based on the term of the loan; however, imports from all countries are charged the same rate regardless of the risk involved. No exchange rate guarantee is provided, and freight and insurance can be included only as a response to competing offers.

Most countries offer terms of one to three years, with some offering shorter and/or longer terms.[3] For example, France and the United States can extend guarantees for up to 10 years, while some exporters like Malaysia and Ireland will only extend up to 180 days. Coverage limits also vary. Most countries offer coverage on 85% to 100% of the principal and from all to only a portion of the interest paid. In 1993–94, U.S. GSM-102 guarantees covered interest at the rate of 2.8%, except for the Former Soviet Union (FSU) where all interest was covered.[4] Generally, most credit guarantee programs have not required a down payment; however, Canada requires a down payment of 10% to 25%.

Premium rates charged vary both across countries and within programs. The United States traditionally charges a flat fee to all importing countries. Other exporters—notably Canada, Australia, Belgium, Ireland, the Netherlands, and Portugal—may vary their premiums based on the creditworthiness of the importing country. Some countries offer guarantees that include freight terms, such as cost and freight (c&f), and cost, insurance, and freight (c.i.f.), to match competing offers. France includes these terms when the goods are shipped on French vessels. Although Canada may guarantee c&f sales, inclusion of c&f terms reduces the amount of grain that can be purchased under credit limits.

Interest subsides and exchange rate guarantees are not available from most exporters. Canada has the ability to use interest subsidies, but in practice has not used them for many years. France offers interest subsidies through Banque Francaise du Commerce Exterieur (BFCE) and exchange rate guarantees. The United States does not extend interest subsidies or exchange rate guarantees for agricultural products through GSM-102, GSM-103, or the Eximbank.

Credit programs continue to be responsive to market and competitive conditions. In 1995, Canada, which had previously focused on sovereign sales, changed provisions of its program allowing loans to nonsovereign buyers to a maximum of $CAN 1.0 billion. The United States announced an adjustable interest rate for GSM-102 and GSM-103 programs in 1995. Rates for GSM-102 and GSM-103 are not to exceed 55% and 80%, respectively, of the most recent 52-week Treasury bill auction prior to the date rates are adjusted. In July 1995, the United States proposed rules for a new program, the Supplier Credit Guarantee Program (SCGP). The SCGP provides short-term credit directly to importers for terms up to 180 days. No foreign letter of credit is required, but instead, a form of promissory note or contract between the importer and exporter.

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[3] See Dahl et al. for a summary of competitor programs.

[4] Guarantees to the FSU were changed in 1991 to cover 100% of the principal and interest at the prevailing rate for 52-week Treasury bills.

Coverage limits are projected to cover 50% of the port value and provide no interest coverage. Guarantee fees are set at $0.95 per $100 of coverage.

Analytical Model to Value Export Credit Programs

Previous Studies

Valuation of guarantees has received more attention in the past few years due in part to advances in option valuation models. Contingent claims analysis using option pricing theory provides a useful analytical model to value guarantees. Previous research using option pricing to value guarantees has focused on several specific areas. Most of the work done initially was applied to Federal Deposit Insurance Corporation (FDIC) insurance guarantees (Merton) and federal guarantees (Jones; Sosin) for large corporate loans (e.g., Chrysler, Massey Ferguson, the steel industry). Recent work has focused on valuing changes in federal deposit insurance programs (Flood; Pennacchi; Ronn and Verma) and FmHA and state guarantees of farm loans (Sherrick).

Valuation of options on foreign exchange has been examined extensively (Garman and Kohlhagen; Grabbe; Ritchken; Shastri and Tandon). However, option valuation models for foreign currency depend on whether the options are on spot or futures exchange rates. Garman and Kohlhagen, and Grabbe argued that using the Black-Scholes model to value options on foreign currency exchange was incorrect. Models on foreign currency exchange must include expectations about interest rates in both countries. Since expectations about interest rates in both countries are incorporated into the price of the futures contract, formulation of an option valuation model based on futures results in a model similar to the Black-Scholes model.

Valuing Export Credit Guarantees

A model was developed in this study to estimate the value of export credit guarantees extended to importers, to value the effects of flexibility, and to make comparisons across exporting countries' programs. Valuation of guarantees within an option framework allows for inclusion of individual components of guarantee programs and is consistent with the structure of actual payoffs incurred by the CCC under export credit guarantee programs. Credit programs offered by exporters entail several forms of guarantees to buyers' and exporters' banks. As such, these can be viewed as having implicit option values. Thus, the analytical goal is to derive implicit values associated with these guarantees.

Valuation of government guarantees for bank deposits or corporate liabilities is equivalent to the limited liability of a common stock put option (Merton). Traditionally, credit guarantees exhibit a similar form of limited liability. At maturity, if the value of the credit instrument guaranteed is low, the guarantee has a positive value to the holder of the guarantee. As the value of the credit instrument being guaranteed increases, the value of the guarantee to the holder diminishes. Losses incurred from the purchase of the guarantee by the holder are limited to the premium paid for the

guarantee. Similarly, as the value of the credit instrument guaranteed increases, the value of the guarantee to the writer (e.g., CCC) increases. When the value of the credit instrument that is guaranteed exceeds its face value, the writer's value of the guarantee is limited to the value of any premium paid by the holder.

The Black-Scholes option model was used for estimating the value of export credit guarantees. This model provides an estimate of an actuarially fair premium that an insured (importer/U.S. bank) would pay for this insurance/guarantee. Credit guarantees are valued as

$$G(T) = Be^{-rT}\Phi(x_2) - V\Phi(x_1), \tag{1}$$

where

G is the fair market value of the loan guarantee,
T is the term of the loan guarantee,
B is the strike or guarantee price,
e is the transcendental number 2.71828 ...,
r is the market rate of interest,
V is the current value of the asset,
$\Phi(\cdot)$ is the cumulative normal density function,
$x_1 = \{\ln(B/V) - (r + \sigma^2/2)T\}/\sigma\sqrt{T}$,
$x_2 = x_1 + \sigma\sqrt{T}$, and
σ^2 is the instantaneous volatility of the market value of the asset (V).

Greater flexibility in the terms of the credit guarantee involves changing coverage levels, adding coverage for freight and insurance, and adding an exchange rate guarantee. Flood noted that different coverage levels can be viewed as compound or multiple options written on the bank's assets where deposits are held. In the case of credit guarantees extended by the CCC, the principal covered could be represented implicitly by an option written by the CCC and held by the U.S. bank. The uncovered portion does not affect the value of the CCC guarantee. It represents an option written by stockholders and depositors of the exporting bank on the value of the bank's assets (including the letter of credit from the importer) and held by the exporting bank's stockholders.

In this study, we are concerned primarily with the valuation of guarantees extended by the CCC and competitor countries. Consequently, valuing the variability in the percentage of principal covered can be modeled by simply increasing or decreasing the total value of the loan that is guaranteed per metric ton exported (the strike price of the option). Valuing coverage for freight and insurance may be treated analogously from the perspective of the CCC and can be incorporated by adding these costs to the per unit value of the amount guaranteed. The guarantee also can be examined from other perspectives including those of the participating bank and the importer. These different perspectives would necessitate different value formulations comprising multiple options.

An exchange rate guarantee adds the equivalent of a second guarantee onto the basic export credit guarantee. A second option representing an option on the foreign currency exchange for the loan value was developed for estimating the fair market value of this feature. A general model for valuation of put options on foreign currency exchange based on spot rates (Ritchken) is specified as

$$P(X) = Xe^{-rT}\Phi(-d_2) - S_o e^{-rT}\Phi(-d_1), \tag{2}$$

where

$P(X)$ is the value of the exchange rate guarantee,
X is the strike price,
S_o is the spot rate,
σ^2 is the instantaneous volatility of the spot rate,
r is the risk-free rate for currency 1,
r^* is the risk-free rate for currency 2,
$d_1 = \{\ln(S_o/X) + (r - r^* + \sigma^2/2)T\}/\sigma\sqrt{T}$, and
$d_2 = d_1 - \sigma\sqrt{T}$.

The total value of a credit guarantee with coverage for exchange rate risk is equal to the sum of the two separate option values where applicable [i.e., $TG = G(T) + P(X)$, where TG is the value of the total guarantee]. This does not consider variable interactions affecting each of the option valuations. Tregeorgis reports that for real options, values are more likely additive if options are of opposite types, exercise times are close together for both options, and the options are further out of the money. Since exercise times should be equivalent, assuming additive option values should provide outer bounds for the changes examined. Further, interactions of variables that affect both the guarantee and exchange rate portions of the total value of the credit guarantee would tend to reinforce each other.

Valuation models for three periods were developed to represent the annual installments (n) required under GSM guarantees (Harris; Dahl et al.). Therefore, the total value of the guarantee is

$$TG = \sum_{t=1}^{n} TG_t. \tag{3}$$

Option values derived from the three periods were summed to arrive at the total value of the credit guarantee. Similar simulations were made for competing country programs to represent installments for each.

Representative Importing Country Parameters

Model parameters for the base case were taken to be representative of a typical importing country using credit. Simulations of critical model parameters were conducted to evaluate the sensitivity of the option values to changes in assumptions. Those parameters in the base case are representative of Pakistan which has been an important recipient of credit for wheat.[5] Factors affecting the option value of the guarantees would

[5] Indeed, Pakistan has been the largest importer of wheat under credit in a number of years during the 1990s, and was the source of recent issue in credit administration. Specifically, during the fall of 1998, Pakistan was suspended from the GSM-102 credit program after falling behind in payments, but was reinstated as a credit recipient in early 1999.

Table 1. Initial Parameters for Option Valuation of GSM Guarantees

Item	Units	Value
FOB value of exports	$/metric ton	156.78
Freight and insurance	$/metric ton	26.00
GSM interest rate (LIBOR + 25)	%	6.875
Risk-free interest rate, importer	%	13.05
Percent of principal covered	%	98.00
Percent of interest covered	% basis points	2.8
Down payment	%	0.0
Current value of letter of credit	$/1,000	903.125
Volatility of letter of credit	standard deviation	0.30
Current value of exchange rate	local currency/dollar	24.58
Volatility of exchange rate	standard deviation	0.042
Term	years	3

be unique to every country and would depend on a multitude of factors. To fully understand and explore the effects of credit guarantee specifications, the effects of program provisions including down payment and coverage levels, interest rates, value, and volatility of the value of the underlying security (letter of credit) were simulated.

Data required for estimation of the value of export credit guarantees were gathered from several sources. FOB and freight and insurance values were taken from Landes and Ash. Exchange and interest rates [London Interbank offer rates (LIBOR) and local lending rates] were derived from the International Monetary Fund. Forfaiting rates[6] were obtained from various issues of *International Trade Finance.*

Data used for the initial parameter values are shown in table 1. Principal and interest coverage, down payments, and the term of the guarantee represent provisions for GSM programs (Dahl et al.). Interest rates for the GSM program were at 25 basis points over the London Interbank offer rates (LIBOR) (Skully; Hyberg et al.). The market value of letters of credit by country was estimated by applying the discount indicated by current forfaiting rates to a base ($1,000) letter of credit. Due to the unavailability of historical data on the value of importers' letters of credit, an initial value of 0.3 was used for the volatility (typical of recent values based on observations and discussions with industry participants), and sensitivities of model results were examined for a range of volatilities to determine their effect on option values. The annualized exchange rate volatility for the base country was estimated from monthly observations of exchange rates over the three-year period 1991–93. These provide a reasonable set of initial parameters for valuing credit guarantee programs and making comparisons across competing exporters' mechanisms. In addition, and where relevant, sensitivities were conducted from these base values.

[6] Forfaiting is an export trade financing mechanism that trades properly executed and documented debt obligations obtained directly from exporters (can be letters of credit). Forfaiting rates are the discount applied to the future flow of funds and reflect the forfaiter's cost of funds and a premium. An explanation and current examples of rates are available online from Benning Bassett.

Table 2. Value of Credit Guarantees, by Type of Coverage

Guarantee	Option Value ($/mt)	Change from Base	
		Value ($/mt)	Percent (%)
Base Case	23.15	—	—
Base Case + Freight	27.27	4.12	17.8
Base Case + Exchange	23.69	0.53	2.3
Base Case + Freight + Exchange	27.90	4.74	20.5

Results

Base Model

Values of credit guarantees were estimated using provisions in place for GSM-102 in fiscal year 1994. Premiums ranged from .16% to .67% of the value of exports depending on the term of the guarantee. Coverages for freight, insurance, and exchange rates were not included in the initial valuation.

Results from the base case and alternative packages of features are shown in table 2. The value of GSM credit guarantees extended to the base country was $23.15 per metric ton (mt), or 14.8% of the export value. Adding freight and insurance coverage increases the value of GSM credit guarantees by $4.12 per mt. Adding an exchange rate guarantee to either the base case or the case with freight and insurance increases the value of credit guarantees to $23.69 per mt and $27.90 per mt, respectively. These results suggest that adding freight coverage would have the greatest impact on the value of credit guarantees. An exchange guarantee adds minimal additional value to the GSM guarantee.

Sensitivity Analysis

Initial parameters were varied to examine the sensitivity of the value of GSM guarantees to changes in conditions and program provisions. Changes included the value of the letter of credit guaranteed, volatility of the value of the letter of credit, FOB export value, down payment level, percentage of principal and interest covered, length of term of the guarantee, adding coverage for freight and insurance, and adding an exchange rate guarantee. Results are summarized in table 3.

Changes in Default Risk

An important parameter affecting the value of a credit guarantee is the default risk of the importer. This is reflected in both the price level of the underlying asset (value of the letter of credit) and volatility. Importers with greater default risk would have larger volatilities in the value of the letter of credit and/or lower price levels.

Table 3. Option Value Sensitivity for Export Credit Guarantee to Percentage Changes in Base Parameters ($/mt)

Change in Base Value	Value of Letter of Credit	Volatility of Letter of Credit	Value of GSM Interest	Value of Foreign Interest	Value of Freight & Shipping
Base Case:					
-30%	48.03	16.32	26.70	23.15	23.15
-20%	38.18	18.60	25.47	23.15	23.15
-10%	29.90	20.88	24.29	23.15	23.15
0%	23.15	23.15	23.15	23.15	23.15
10%	16.19	25.41	22.06	23.15	23.15
20%	12.26	27.67	21.01	23.15	23.15
30%	9.28	29.91	20.00	23.15	23.15
Base + Freight and Shipping:					
-30%	56.41	19.29	31.44	27.27	26.04
-20%	44.89	21.96	30.00	27.27	26.45
-10%	35.18	24.62	28.61	27.27	26.86
0%	27.27	27.27	27.27	27.27	27.27
10%	21.00	29.92	25.99	27.27	27.69
20%	16.11	32.54	24.75	27.27	28.10
30%	12.36	35.16	23.57	27.27	28.51
Base + Exchange Rate Guarantee:					
-30%	48.57	16.85	26.87	25.86	23.69
-20%	38.71	19.13	25.73	24.94	23.69
-10%	30.43	21.41	24.66	24.17	23.69
0%	23.69	23.69	23.69	23.69	23.69
10%	18.34	25.95	22.81	23.42	23.69
20%	14.19	28.20	22.06	23.28	23.69
30%	11.00	30.44	21.42	23.21	23.69
Base + Freight, Shipping, and Exchange Rate Guarantee:					
-30%	57.03	19.92	31.64	30.44	26.63
-20%	45.51	22.58	30.29	29.35	27.05
-10%	35.81	25.24	29.04	28.46	27.48
0%	27.90	27.90	27.90	27.90	27.90
10%	21.62	30.54	26.87	27.58	28.32
20%	16.73	33.17	25.98	27.42	28.74
30%	12.98	35.78	25.23	27.34	29.16

[a] Since no down payment was required in the base case, values for sensitivity of down payments were evaluated as actual percentage down payment required.

Table 3. Extended

Percent of Principal Covered	Percentage Points of Interest	Percent Down Payment	Term of Credit Guarantee	Volatility of Exchange Rates
5.23	21.89	—	22.09	—
9.56	22.31	—	22.42	—
15.56	22.73	—	22.78	—
23.15	23.15	23.15	23.15	—
—	23.58	15.42	23.39	—
—	24.01	9.35	23.64	—
—	24.45	5.02	23.89	—
8.16	25.79	—	26.04	—
13.13	26.28	—	26.43	—
19.53	26.77	—	26.85	—
27.27	27.27	27.27	27.27	—
—	27.78	19.39	27.55	—
—	28.29	12.90	27.84	—
—	28.80	7.90	28.13	—
5.76	22.42	—	22.78	23.24
10.10	22.84	—	23.06	23.34
16.09	23.26	—	23.37	23.49
23.69	23.69	23.69	23.69	23.69
—	24.11	15.96	23.89	23.93
—	24.55	9.89	24.11	24.23
—	24.98	5.55	24.32	24.56
8.78	26.41	—	26.85	27.38
13.75	26.90	—	27.17	27.49
20.90	27.40	—	27.53	27.66
27.90	27.90	27.90	27.90	27.90
—	28.40	20.01	28.14	28.19
—	28.91	13.52	23.38	28.53
—	29.42	8.52	28.63	28.91

As the price level for the underlying asset decreases, the value of the credit guarantee increases at an increasing rate. As an example, the value of a GSM credit guarantee would be $29.90 for a country whose letter of credit has a current value of $812 (10% less than the base case). For a higher risk country whose letter of credit is only worth $631 (30% less than the base case), due to a higher potential that loans will not be repaid because of political instability, threat of nationalization of industries, occurrence of wars, etc., or because of a higher financial risk of default by the importer, the importer's bank, and/or the importing country, the value of the GSM guarantee would be $48.03.

There is a positive relationship between the volatility of the letter of credit and the value of the GSM guarantee (figure 1). In the base case, the volatility was 0.3. and the value of the guarantee was $23.15/mt. For a country whose risk was greater (volatility was 30% greater), the value of the guarantee increased to $29.91/mt. Thus, countries with higher default risk would have a greater value of the guarantee implied in the GSM program. Changes in either the volatility or price level of the letter of credit, within the range examined, have a dramatic impact on the value of credit guarantees.

Adding coverage for freight and insurance to the base guarantee increases the sensitivity of the value of the guarantee to changes in default risk. As default risk increases, the value of the guarantee including coverage for freight and insurance increases at a faster rate than the base guarantee. However, if an exchange rate guarantee is added to the base guarantee, changes in the default risk for the importers have no effect on the value of the exchange rate guarantee. Therefore, unlike adding coverage for freight and insurance, adding an exchange rate guarantee does not increase or decrease the sensitivity of the total value of the guarantee to changes in default risk.

Down Payment, Principal, and Interest Covered

The model was simulated to evaluate effects of changes in these variables on the value of the GSM guarantee. Increasing the down payment as a percentage of the FOB value required for GSM guarantees reduces the value of guarantees. In the base case, the GSM guarantee has no down payment and has a value of $23.15/mt. Increasing the down payment to 10% or reducing the percentage of the principal covered by a GSM credit guarantee by 10% reduces the value of the guarantee to $15.42/mt and $15.56/mt, respectively. These results illustrate that changes in the principal covered or down payments required for credit guarantees can have significant impacts on the value of credit guarantees.

The U.S. GSM guarantees the payment of interest accrued at a specified rate, or percentage points of interest, unlike other exporters. Changes in the percentage points of interest covered have limited impact on the value of credit guarantees. Increasing the percentage points of interest covered by 30% (from 2.8% to 3.64%) increases the value of guarantees to $24.45 per mt.

Changing the term of the guarantee also has limited impact. Lengthening the term of the loan from the initial three-year guarantee increased the value of credit guarantees (basic, with freight, and with exchange rate guarantees). An increase of 30% in the term of the loan increased the value of the basis loan guarantee by $0.74.

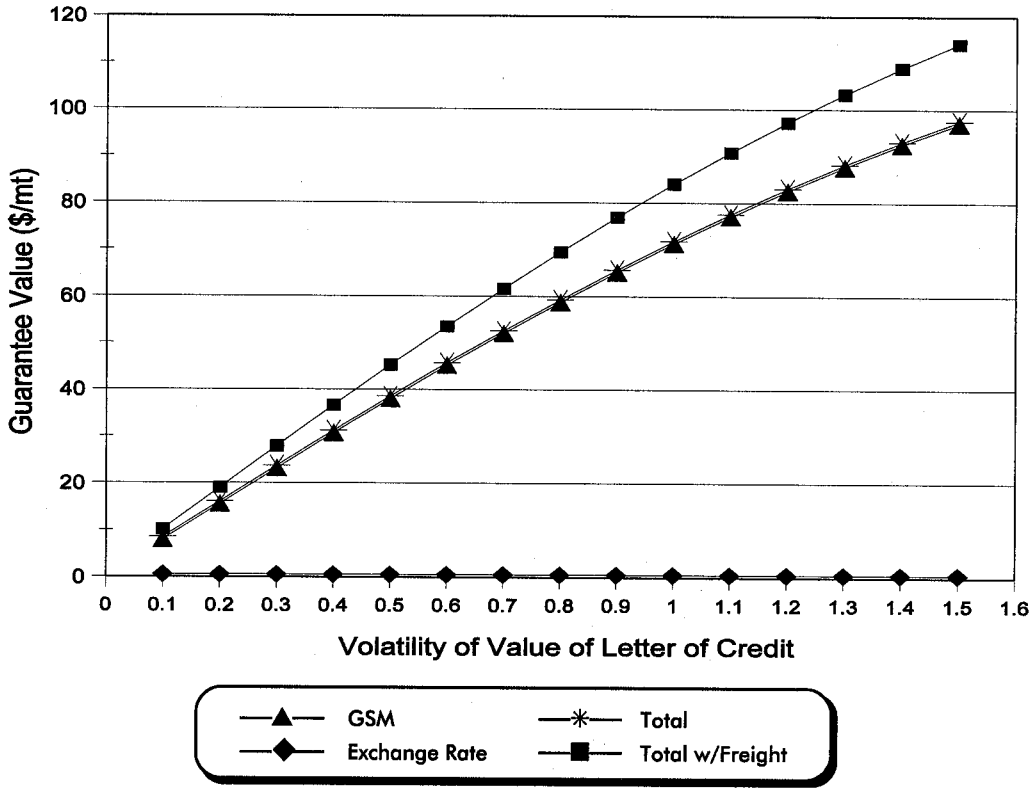

Figure 1. Value of GSM guarantee and components, by volatility of the value of the letter of credit

Effects of Lending Interest Rates on Credit Guarantee Value

The interest rate charged by lenders for loans guaranteed by GSM and the spread between this rate and the alternative cost of money in the importing country have interesting effects on the value of credit guarantees (figures 2 and 3). A change in the interest rate charged for loans guaranteed by GSM affects the value of the basic guarantee. However, changes in the interest rate spread do not. For example, increasing the interest rate charged by banks on guaranteed loans from 6% to 7% decreases the value of the basic guarantee from $24.61/mt to $22.95/mt (figure 2), while increasing the importer's interest rate, which increases the interest rate spread, has no effect on the value of the base guarantee (figure 3).

Changes in the interest rate spread due to either changes in rates charged on guaranteed loans or alternative interest rates did affect the value of a guarantee that includes coverage for exchange rates. For example, in the base case with an exchange rate guarantee, the interest rate charged by banks for the guaranteed loan is 6.875% and the alternative cost of borrowing in the importing country is 13.05%, resulting in an interest rate spread of 6.175%. As the interest rate on the guaranteed loan is increased to 13.05%, the spread between interest rates declines and the value of the

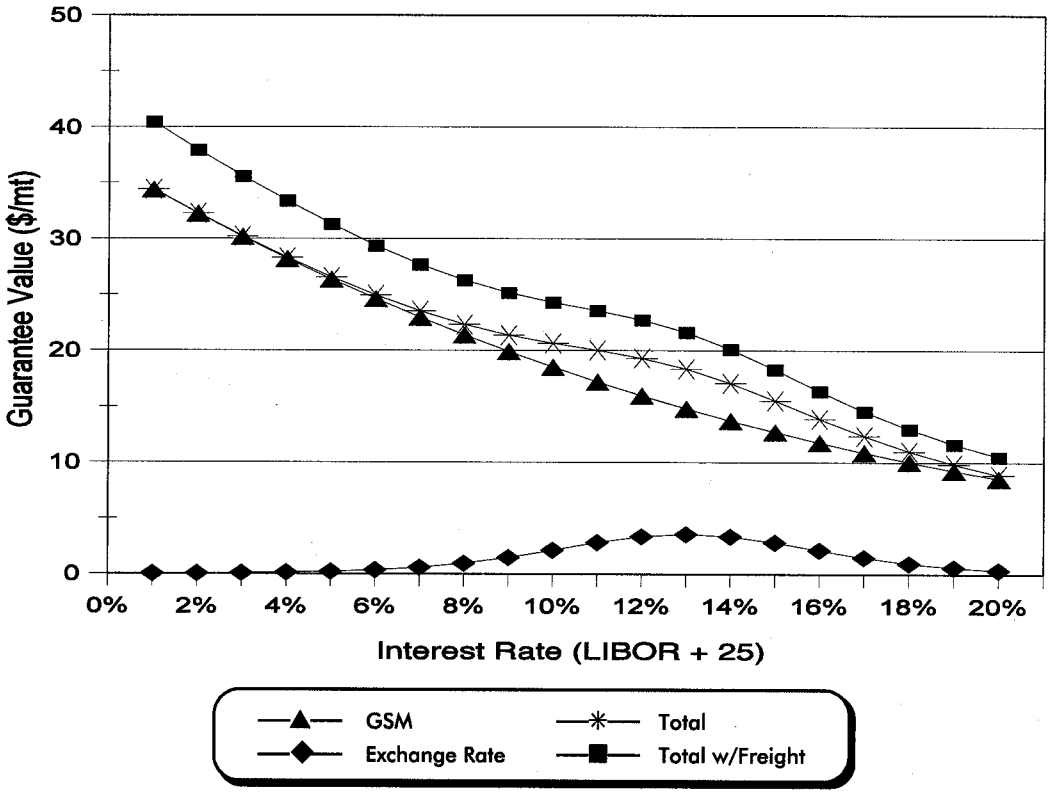

Figure 2. Value of GSM guarantee and components, by GSM interest rate

guarantee increases under an exchange rate guarantee (figure 2). Beyond 13.05%, the interest spread becomes negative and the value of the guarantee with the exchange rate coverage declines. Similarly, as the importer's alternative cost of borrowing declines to 6.875%, the spread in interest rates declines and the value of the exchange rate guarantee increases. Below 6.875%, the spread becomes negative and the value of the exchange rate guarantee declines.

Exchange Rate Guarantee Parameters

Both the level and volatility of the exchange rate have an effect on the value of the credit guarantee. The effect of an exchange rate guarantee on the credit guarantee value was evaluated "at the money." As the current value of the exchange rate decreases from the guaranteed exchange rate, the value of extending a credit guarantee with exchange rate coverage increases dramatically. In this case, a 20% decrease in the current value of the exchange rate would more than double the value of the credit guarantee. Likewise, increasing the exchange rate volatility produces a similar increase in the value of extending an exchange rate guarantee.

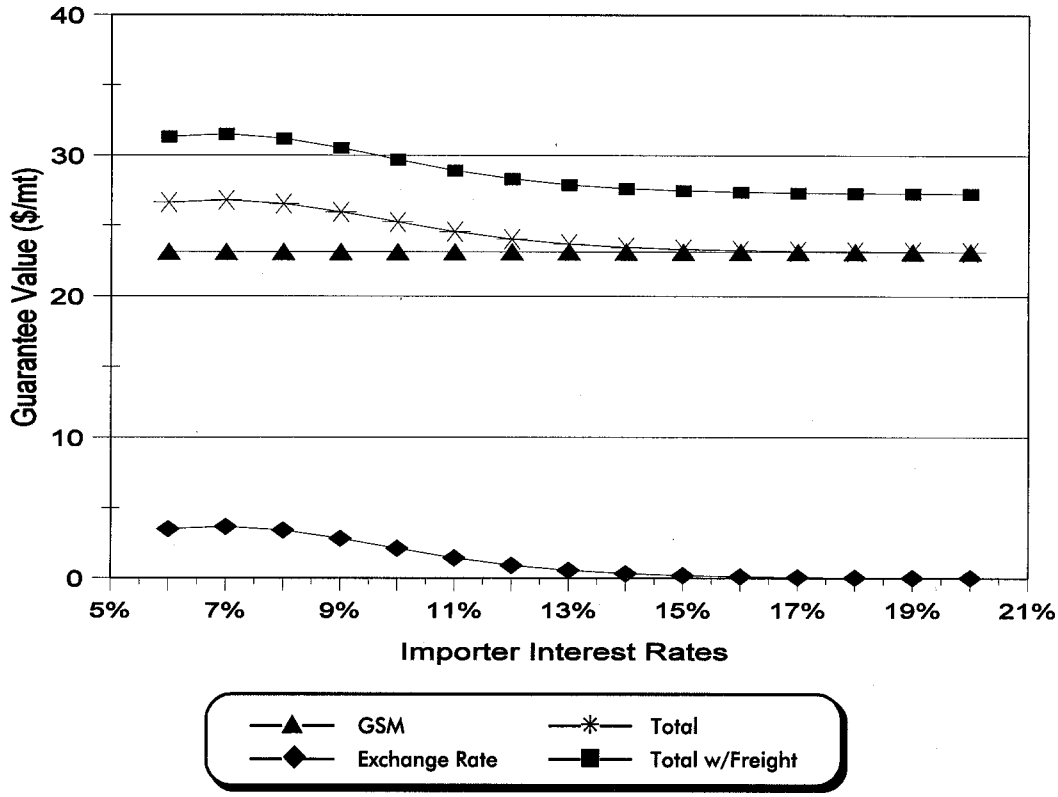

Figure 3. Value of GSM guarantee and components, by importer interest rate

Supplier Credit Guarantee Program

The model was also used to analyze the option value of the SCGP. Differences in model parameters between the base model and the SCGP model were (*a*) a reduction in the value covered from 95% to 50% of the export value, (*b*) a shorter term (0.5 year versus three years), and (*c*) no coverage for interest. The basic SCGP had a value of $0.01 per mt in comparison to the GSM at $23.15. The main reasons for the lower value of SCGP than GSM-102 guarantees are the shorter term and the lower coverage levels which result in options that are far out of the money.

Sensitivities of the value of the basic SCGP program to changes in parameters were examined for the value of the promissory note, volatility of the promissory note, percentage of principal coverage, term, interest rate, and interest coverage (table 4). The value of the basic SCGP program was most sensitive to the value of the promissory note, as in the GSM-102 guarantee. A 10% decrease in the value of the promissory note increases the value of the guarantee by $0.04/mt. However, unlike the GSM-102 program, changes in the volatility of the promissory note have a lesser impact on the value of the SCGP credit than the amount of principal coverage. A 30% increase in the percentage of principal covered (50% to 65%) increased the value of the SCGP guarantee by $0.43/mt ($0.01 versus $0.44). Increasing the volatility of the promissory note by 30%

Table 4. Sensitivity of Option Value for SCGP Program to Percentage Changes in Base Parameters ($/mt)

Change in Base Value	Value of Promissory Note	Volatility of Promissory Note	Principal Coverage	Term of Credit Guarantee	SCGP Interest	Percent Interest Coverage[a]
-30%	0.89	0.000	0.0000	0.001	0.012	—
-20%	0.22	0.001	0.0001	0.003	0.011	—
-10%	0.05	0.003	0.001	0.005	0.010	—
0%	0.01	0.01	0.01	0.010	0.010	0.010
10%	0.001	0.03	0.05	0.015	0.009	0.011
20%	0.003	0.06	0.16	0.023	0.009	0.011
30%	0.000	0.11	0.44	0.033	0.008	0.012

[a] 10% interest coverage reflects 10% of interest cost covered.

only increased the value of the guarantee to $0.11/mt. Changes in other parameters had lesser impacts on the value of the SCGP guarantee.

Comparisons Among Competing Countries' Programs

Credit terms vary across competing exporters and have an important effect on their value. The model was used to determine the value of each program. This comparison provides insight into the relative value to the importer implied in each of the exporting countries' guarantee programs. Programs for the four major wheat exporters were examined (Canada, Australia, France, and the United States). Importing country parameter characteristics equivalent to those in the previous analysis were assumed. Shipping costs were assumed equal for each exporting country to provide a direct comparison.

Individual parameters for each of the major exporting countries' programs are shown in table 5 and denominated in local currency. The most important differences among the programs are reflected in principal and interest coverage and the percentage of down payment required. However, the France-COFACE program also covers freight and insurance.

Comparison results are shown in table 6. The credit guarantee provided by the Canadian Wheat Board had the lowest value ($12.55/mt), followed by the United States ($22.61/mt), Australia ($26.95/mt), and France-COFACE ($38.55/mt). The Canadian guarantee had the lowest value primarily because of the large down payment required on guaranteed sales. The values of the U.S. and Australian guarantees are similar, with differences in values between the two programs being largely due to different coverage levels for principal and interest. The French-COFACE guarantee had the highest value primarily because the COFACE guarantee includes coverage for freight and shipping. Moreover, the COFACE guarantee can also include an exchange rate guarantee, adding further value to the guarantee for the importer. In this case, that value is an additional $4.98/mt.

Table 5. Initial Parameters for Comparisons of Export Credit Programs for Major Exporters

Item	Units	U.S.	Canada	France	Australia
Value of exports for coverage	export currency/mt	156.78	184.56	1,007.17	118.07
Guarantee interest rate	%	6.875	6.625	6.625	6.625
Risk-free interest rate, importer	%	13.05	13.05	13.05	13.05
Percent of principal coverage	%	98	100	95	100
Percent basis points, interest covered	% basis points	2.8	—	—	—
Percent of interest coverage	% basis points	—	100	95	75
Down payment	%	0	25	0	0
Current value, $1,000 letter of credit	export currency	903.125	1,063	4,976	680
Volatility of letter of credit	std. deviation	0.30	0.30	0.30	0.30
Current value of exchange rate	import currency/ export currency	24.58	21.58	4.62	32.02
Exchange rate volatility	std. deviation	0.042	0.054	0.094	0.069
Term	years	3	3	3	3

Table 6. Value of Export Credit Guarantees for Major Wheat Exporters (US$/mt)

Country	Basic Guarantee	Exchange Rate (if offered)	Letter of Credit	
			$1,000	$500
Canada (Canadian Wheat Board)	12.55	—	9.58	38.26
Australia	26.95	—	21.76	63.41
U.S.	22.61	—	18.01	56.44
France-COFACE [a]	38.55	4.98	31.96	80.50

Note: Term periods for U.S., Canada, and France = three annual installments; Australia = six semiannual installments.

[a] Includes coverage for freight and shipping.

The sensitivity of valuations of the export credit programs for the major exporters to changes in related parameters was examined. As the current value of the importer's letter of credit declines (increase in potential default), the values of the export credit programs for each of the major exporters increase. The ranking of values for the export credit guarantee programs (lowest to highest value) remains the same, but the spread among values for individual exporters' programs becomes wider (table 6). These results illustrate that the advantages of the French (COFACE) guarantee increase for riskier importing countries. Similar conclusions can be made as the probability of default increases. Specifically, the credit guarantee provided by France (COFACE) becomes more valuable in comparison to other exporters' programs.

Conclusions and Policy Implications

Use of credit guarantee programs for the export of agricultural commodities has escalated in importance since the early 1980s. In this study, a methodology to value export credit guarantees was developed. This methodology was applied to various export credit guarantee terms and provisions including the new SCGP program to examine the value of providing increased flexibility. Comparisons were also made with competing countries' programs.

The value of the basic GSM credit guarantee was most sensitive to the current price level, volatility of the importer's letter of credit (assets guaranteed), down payment, and percentage of principal covered. Adding an exchange rate guarantee to the GSM program generally increased the value of the guarantee minimally ($0.54 per mt). In addition, the value of credit guarantees with an exchange rate guarantee was highly sensitive to the current value, strike price, and volatility of exchange rates. This indicates that the value of a credit guarantee extended to an importer is heavily influenced by the default probability and the amount covered.

Adding coverage for freight and insurance increased the value of a credit guarantee in our base case by $4.12 per mt. Changes in interest coverage and terms for the GSM program result in equal or smaller changes in the value of extending guarantees. Increasing GSM interest coverage by 30% (to 3.64%) increases the value of the base guarantee by $1.30/mt, while decreases in the interest rate spread between the GSM rate and the importer's alternative rate increased the value of an exchange rate guarantee. Therefore, introducing flexibility by modification of terms, adjusting the percentage of coverage, and inclusion of freight and insurance affect the value of export credit guarantees. These effects are important if the CCC is actively trying to reduce default exposure. However, these values are evaluated from the perspective of the CCC. Valuation of changes in these parameters when viewed by the administering banks and importers may affect the success/failure of the implementation of any of these changes.

The option value implied in the new SCGP credit program was lower than the GSM-102 program primarily due to the low coverage levels and a shorter term. It was also less sensitive to changes in the volatility of the underlying asset (promissory note) than the GSM-102 program.

Comparisons of the value of export credit guarantees implied in programs offered by Canada, Australia, France, and the United States reveal important differences. The Canadian program had the lowest value; the French-COFACE program had the highest. The Canadian program had the lowest value primarily due to the down payment requirement. The French program had the highest value because it covers freight and insurance and it covers more of the interest. This relationship holds for a wide range of values for the price level and volatility of the importer's letter of credit. Further, the spread between valuations of individual exporters' programs widens as the default potential increases, giving a greater value to the French-COFACE program.

With typical premiums for credit guarantees (at .15% to .67% of the FOB value), the value of export credit guarantees exceeds income received from premiums. This should be interpreted as the implicit subsidy embedded in export credit guarantee programs. This is not surprising. In fact, Funatsu, who examined extending insurance guarantees for Eximbank loans, suggests that underpricing or charging very low premiums for insurance coverage may be optimal behavior if the objective is to maximize exports.

Hyberg et al. estimated the implicit interest subsidy in GSM guarantees for wheat to all countries at 4%. To be comparable, our estimate of the fair market value of the guarantee would have to be reduced by the amount of premiums paid and aggregated across countries. Dahl et al. measured implicit interest subsidies for selected countries, and report a range from .89% to 12.43% of the value of imports. Our estimate for the base case is on the high side of this range (14.77% - .67% = 14.1%). These results suggest that by incorporating the option value, the implicit value of the subsidy is substantially greater than previously envisioned.

These results are dependent on the initial parameters specified. One of the major problems associated with option valuation of guarantees is in obtaining the current value of the assets being guaranteed. Since daily observations for the current value of letters of credit are not readily observable, volatilities cannot be empirically derived, and thus must be assumed based on industry discussions and insight. Consequently, this methodology may be more appropriate for use as a ranking tool or as a decision aid when determining where to allocate a given amount of guarantees over a cross-section of countries/banks. Further empirical research is also required to determine distributions for the current value of assets.

[*Received July 1998; final revision received May 1999.*]

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