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VALUING OPTION PROVISIONS FOR EXPORT CREDIT GUARANTEES

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HIGHLIGHTS

Credit guarantees have become increasingly more important for the export of agricultural commodities. All major exporting countries of agricultural commodities have some form of credit guarantee program. Financing terms vary by country, with some providing more flexibility than U.S. programs. As the importance of these credit programs escalates, it will be incumbent on exporting countries to carefully examine the value of their features relative to competitor's programs. This study developed a model using option pricing theory to estimate the "fair market value" of credit guarantees. The model was applied to U.S. GSM-102 credit guarantees. The model was used to make comparisons of the value of U.S. program features to those of competing countries' programs. The value of adding more flexibility to program provisions was evaluated. Specific provisions examined included adding coverage for freight and insurance, an exchange rate guarantee, changing down payment requirements, principal and interest coverage, and the term of the guarantee.

The value of export credit guarantees extended to a base country were estimated at $21.58 per MT or 13.76 percent of the value of exports. Adding guarantees for freight and insurance and exchange rates increased the value of GSM guarantees by $3.50 and $0.20 per MT, respectively. The value of credit guarantees was most sensitive to the price level and volatility of price changes for the importer's letter of credit. Decreasing premium coverage or increasing down payments reduced the value of credit guarantees on approximately an equal percentage basis.

Including an exchange rate guarantee as a component of GSM credit guarantees resulted in the value of guarantees becoming sensitive to the current value, strike price, and volatility of exchange rates. Further, adding an exchange rate option produced interesting results for changes in interest rates for GSM guarantees and alternative interest rates in the importing country. Changing the GSM interest rates impacted the value of the base guarantee, while changes in the interest rate spread between the GSM rate and the importers alternative cost of borrowing affects the value of an exchange rate guarantee. A one percent decline in the GSM rate decreased the value of the base guarantee by $2.11/MT. Decreasing the interest rate spread between the GSM rate and the importers alternative rate increased the value of an exchange rate guarantee up to the point where the interest spread becomes negative. As the spread becomes increasingly negative, the value of the exchange rate guarantee declines.

Decreasing the guarantees' term for both the current program, a program that covered freight and insurance, and a program with an exchange rate guarantee reduced the value of the guarantee. However, the value of the exchange rate guarantee declined as the term of the guarantee increased.

Percentage changes in principal, interest coverage, term, and down payment for the GSM program resulted in equal or smaller changes in the value of guarantees. However, these values are evaluated from the perspective of the CCC. Valuation of changes in these parameters when viewed by participating banks and importers may affect the success/failure of the implementation of any of these changes.

Finally, the value of credit guarantee programs for Canada, Australia, France, and the U.S. were compared for a base country. The Canadian guarantee had the lowest value ($18.36/MT), followed by the U.S. ($21.58/MT), Australia ($23.23), and French guarantees ($26.32/MT). The main reasons for the French guarantees having the greatest value was the inclusion of coverage for freight and insurance and higher interest coverage.

Valuing Option Provisions for Export Credit Guarantees

Bruce L. Dahl, William W. Wilson, and Cole R. Gustafson*

INTRODUCTION

Credit guarantee programs have become increasingly more important for the export of agricultural products. In 1993, the U.S. exported $3.828 million of agricultural products under GSM-102 and GSM-103, the Commodity Credit Corporation's (CCC's) export credit guarantee programs (USDA-FAS). All major exporters of agricultural products including Canada, EU, and Australia have export credit guarantee programs. Under the recent GATT agreement, exporting countries must limit export programs that provide visible price/commodity subsidies like the Export Enhancement Program (EEP) and the EU restitution. Use of export credit guarantee programs could escalate due to limitations on programs like EEP and increase in popularity as a means of promoting agricultural exports.[1]

Competition among exporting countries' programs will make it more important to evaluate the critical features that enhance their value. Under the U.S. GSM-102 export credit program the U.S. acts like a Stackelberg leader. Traditionally, the CCC announces allocations annually, and terms are standardized across importing countries. This implies limited flexibility when granting loans and limits the ability to differentiate guarantee premiums by loan risk. In contrast, the French COFACE program provides a high degree of flexibility in specifying terms across importing countries, and Canadian programs charge export credit insurance premiums for coverage based on risk characteristics of the loan (Harris).

In this study, we develop a methodology to 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 and comparisons were made with competing countries' programs.

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[1]For a more in-depth discussion of Export Credit Guarantee programs, utilization, and issues see Dahl et al.

REVIEW OF U.S. AND COMPETITOR PROGRAM PROVISIONS

Most major exporting countries of agricultural commodities extend some form of export credit guarantees/insurance. The U.S., Canada, Australia, France and other countries in the EU have export credit insurance/guarantee programs. The U.S. has several export credit programs operated by CCC; however, most guarantees are extended under the GSM-102 and GSM-103 programs. These programs guarantee export sales to importers financed through U.S. banks. If importers default on export loans, the CCC reimburses the U.S. bank and takes ownership of the loan. These programs cover 98 percent of the principal and 2.8 percent interest for terms up to 3 years (GSM-102) and 3 to 10 years (GSM-103).[2] Credit allocations under these programs are announced each year by country and commodity. Premiums are charged based on the term of the loan; however, all countries are charged the same rate regardless of the risk involved. No exchange rate guarantee is provided, and freight and insurance can only be included as a response to a competing offer. This means that the U.S. announces how many dollars in GSM guarantees it will extend to individual importers for particular commodities. Traditionally, terms of the credit agreement have been standardized across importers.

Provisions for credit insurance/guarantee programs of competing exporting countries vary (Table 1). Most countries offer terms of 1 to 3 years with some offering shorter and/or longer terms. For example, France and the U.S. can extend guarantees for up to 10 years, while some exporters of agricultural commodities like Malaysia and Ireland will only extend up to 180 days. Coverage limits also vary. Most countries offer coverage on 85 to 100 percent of the principal and from all to only a portion of the interest paid. In 1993-94, U.S. GSM-102 guarantees covered 2.8 percent interest except for the Former Soviet Union where all interest was covered. Most credit guarantee programs have not required a down payment; however, Canada requires a down payment of 10 to 25 percent.

Premium rates charged vary both across countries and within programs. The U.S. charges a flat fee to all importing countries. Other exporters, notably Canada, Australia, Belgium, Ireland, Netherlands, and Portugal, vary their premiums based on the credit worthiness of the importing country.

Guarantees that include freight terms (c & f, c.i.f) are offered by a number of countries to match other offers. France includes these terms when shipped on French vessels. Canada may offer c & f sales; however, inclusion of c & f terms reduces the amount of grain that can be purchased under credit limits.

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

Table 1. Terms and Conditions of Export Credit Programs of Major Exporters.

Country	Entity Extending Credit	Maximum Credit Terms	Coverage	Down payment	Premium	Freight Guarantee	Interest Subsidies	Exchange Risk Guarantee
United States	GSM-102	3 years	98% + 2.8% interest	none	0.15 - 0.67%	cif/c&f on matching basis	none	none
	GSM-103	10 years	98% + 80% interest	none	1.5 - 2.67%	cif/c&f on matching basis	none	none
	Eximbank	ag commodities 360 days up to max of 10 years on limited basis	98 - 100% + daily prime - .5%	15%	0.03 - 4.90%		none	
France	COFACE	10 years	up to 100%	none	0.67 - 2.67%	cif/c&f french flag	available via BFCE	available
Australia	Australian Wheat Board/EFIC	3 years +	100% political up to 100% commercial	none	0.2 - 2.67%	none	none	none
Malaysia	MECI	6 months	85%	none	0.72 - 1.2%	can be c.i.f.		none
	ECR	6 months	100% post-shipment 80% pre-shipment	none	none	can be c.i.f.	2.5% - 4.0%	none
Denmark	ECC	up to 8 years	85 - 90%	none	0.15 - 3.77%	none	none	none
Canada	Canadian Wheat Board	3 years	up to 100%	10 - 25%	none	c&f	none	none
	Export Development Corporation	3 years	100% political 95% commercial	CA $1,000	0.5 - 1.5%	none	none	none
Belgium	SND	360 days	95%	none	up to 2%	none	none	none
	COBAC	5 years	85%	none	0.4 to 2.0% annually	none	none	none
Netherlands	NCM	2 years	95%	none	1.5%-5% 180-day higher for 2 yr.	c.i.f.	none	none
Italy	SACE	2 years	90%	15% + $73	1.6% - 5.4%	none	direct credit and refinancing	available
	Medicredito	over 18 months	85%	variable	variable	none	available	none
Portugal	COSEC	short to medium	n.a.	none	0.45% - 0.65%	none	none	none
Ireland	ICI	180 - days	90%	variable	variable	none	none	none
U.K.	ECGD	3 years	up to 95 %	none short 15% 2-3 years	0.5-1.5% short 1-3% 2-3 years.	none	none	none
Austria	OKB	360 days	100% political 90% to 100% commercial	none	0.5%	none	none	none

Source: Harris

Interest subsides and exchange rate guarantees are not available from most exporters. Canada has the ability to use interest subsidies, but has not used them for many years. France offers interest subsidies through Banque Francaise du Commerce Exterieur (BFCE) and exchange rate guarantees. The U.S. does not extend either interest subsidies or exchange rate guarantees through GSM-102, GSM-103, or Eximbank.[3]

PREVIOUS STUDIES ON VALUATION OF GUARANTEES

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 on guarantee valuation was applied to FDIC insurance guarantees (Merton) and federal guarantees (Jones and Sosin) for large corporate loans (Chrysler, Massey Ferguson, the steel industry). Another related area has focused on valuation of FmHA and state guarantees of farm loans (Sherrick).

The following sections review literature on alternative valuations of GSM guarantees and exchange rate guarantee programs. Then, pertinent literature on option pricing and guarantees is reviewed. Literature related to valuing exchange rate options is also examined.

Export Credit Guarantee Valuation

Previous research on the valuation of export credit guarantees has focused on two areas. First, 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 costs for borrowing. Hyberg et al. estimated the implied interest subsidy incorporated in GSM guarantees averaged 4.39 percent of the value of GSM allocations for wheat exports from 1979-1992. This indicates the potential magnitude of implicit interest subsidies extended to countries for given commodities.

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[3]Credit programs of individual countries are continuing to be modified. Canada, which previously focused on sovereign sales, in 1995 changed provisions and set aside $1 billion for loans to non-sovereign buyers. Further, the U.S. announced an adjustable interest rate for the 1995 GSM-102 and GSM-103 programs. Both fix interest rates for a period of one year based on the 52 week rate for Treasury bills and is adjusted annually. Rates for GSM-102 and GSM-103 are not to exceed 55 percent and 80 percent respectively, of the most recent 52-week Treasury bill auction prior to the date rates are adjusted.

The second area has focused on the addition of an exchange rate guarantee to GSM programs to determine if it was cost effective (Baxter and Smith). They used cost benefit analysis and indicated that the program could be cost effective if it produced additional credit exports without displacing other U.S. exports that are greater in value than the cost of operating the program. They indicated that the level of additional exports required to cover cost of program operation is unlikely to be obtained. In addition, countries with the potential for additional credit exports show the greatest potential for displacing other U.S. commercial exports. Thus, they argued that an exchange rate program may not be cost effective.

Valuation of FDIC Insurance Guarantees and Related Studies

Several studies have examined the valuation of credit guarantees for non-export loans using option pricing models. Seminal work in this area focused on deposit insurance and includes work by Merton on deposit insurance and loan guarantees. Merton presented the basic premise of valuing loan guarantees as a put option written by the government on the value of bank assets. The limited liability inherent in a federal deposit guarantee is equivalent to the limited liability inherent in a common stock put option. Merton then demonstrated that valuing federal deposit guarantees was equivalent to valuing common stock put options using the options pricing model developed by Black, and Black and Sholes. He argued that the value of deposit insurance guarantees can be calculated as a traditional put option model developed by Black and Sholes.

Jones and Sosin extended Merton's analysis to examine valuing federal guarantees for deposit insurance and loans by large corporations. Their analysis incorporated valuations that considered guaranteed and unguaranteed junior and senior debt. Jones also examined effects of partial versus full guarantees.

Flood reviewed studies on valuing federal deposit insurance guarantees using option pricing methods. He presented a methodology to value different levels of federal deposit insurance coverage and deductibles using compound or multiple options. Maximum coverage levels were valued using two options: one written by the FDIC on the assets of the bank and the other written by the depositor and held by the FDIC. This is similar to valuation of senior and junior debt, but includes different owners of the options.

Other recent studies examined federal deposit insurance guarantees focusing on costs associated with introducing flexibility into the program terms (Ronn and Verma, Pennacchi). Pennacchi examined changes from a flat insurance premium to one based on risk. Ronn and Verma used an option model to value federal deposit insurance and applied it to a cross section of banks. They indicated their model was more appropriate for ranking banks than for estimating a value for individual banks. Alternatively, it could be used as a decision aid for allocating a given premium over the market.

Flood also discussed problems associated with insurance guarantee valuations with option models. An important problem is how to estimate the volatility of a bank's assets. Since values for a bank's assets are not readily observable, estimates of volatility can be difficult to acquire. An alternative formulation for valuing guarantees that is more general was developed by Sherrick in his examination of FmHA and Indiana Farmer loan guarantee programs. Sherrick presented a model that introduced a more general 3 parameter Burr-12 (Singh-Maddala) distribution. This distribution contains the traditional log-normal assumed by Black-Sholes as a special case. Sherrick indicated this distribution family is used extensively in the insurance industry to model loss distributions under liability policies and has been used to fit business failure data. Sherrick advanced the following theoretical valuation for loan guarantees based on the Burr-12 distribution:

$$\text{Guarantee} = e^{-r(T)} \int \{p(V_T)\} \ \alpha\lambda^{\alpha}\gamma V_T^{\gamma-1}(V_T^{\gamma} + \lambda)^{-(\alpha+1)} \, dV_T$$

where

Guarantee is the "fair market value" of the guarantee,
V is asset value,
$\{p(V_T)\}$ is the loan guarantee payoff as a function of asset value,
$\alpha\lambda^{\alpha}\gamma V_T^{\gamma-1}(V_T^{\gamma} + \lambda)^{-(\alpha+1)}$ is the PDF for the Burr-12 distribution,
r is the risk adjusted discount rate
T is the time to maturity,
α is the scale parameter for the Burr-12 distribution, and
λ and γ are shape parameters for the Burr-12 distribution.

However, data are required to estimate the Burr-12 distribution parameters to establish the probability of future default.

Exchange Rate Guarantee Valuation

Exchange rates have significant impacts on the levels of agricultural trade. Pick indicated that the effects of exchange rate variability were significant for a few developing countries, but not for the developed countries. He suggested that this may occur because developed countries have access to more developed financial and commodity markets with which they can defray or hedge costs of exchange rate variability.

Options on foreign currency exchange can be used to guarantee an exchange rate level. The value of a foreign exchange rate guarantee is equivalent to the value of a put option on foreign currency exchange. Organized exchanges exist around the world for trading options on many of the currencies for developed countries. In addition, valuation of options on foreign exchange has been examined extensively (Garman and Kohlhagen, Orlin, Grabbe, and Shastri and Tandon).

Prior research on formulation of option valuation models for foreign currency exchange identified differences based on whether options are on spot or futures exchange rates. Garman and Kohlhagen and Grabbe argued that using the Black-Sholes 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-Sholes model. However, they argued that valuation of options for foreign exchange based on spot prices did not incorporate expectations on interest rates, thus, their valuation required information on both interest rates. A general model for valuation of call options on foreign currency exchange based on spot exchange rates is as follows (Ritchken):

$$C(X) = S_o e(-rT)N(d_1) - Xe(-rT)N(d_2)$$

where

C(X) is the value of the exchange rate option,
X is the strike price,
S_0 is the spot rate,
σ is the instantaneous volatility of the spot rate,
r is the risk free interest rate for currency 1,
r* is the risk free interest rate for currency 2,
N (.) is the cumulative normal density function,
$d_1 = \{\ln(S_o/X) + (r - r^* + \sigma^2/2)T\} / \sigma\sqrt{T}$, and
$d_2 = d_1 - \sigma\sqrt{T}$.

This formula assumes a lognormal distribution of foreign exchange rates. Ritchken indicated that empirical studies have indicated large deviations from this distribution are possible.

ANALYTICAL MODEL TO VALUE EXPORT CREDIT PROGRAMS

A model was developed to estimate the value of GSM export credit guarantees extended to importers, to value the effects of flexibility and to make comparisons across exporting countries' programs. Following Merton, valuation of government guarantees for bank deposits or corporate liabilities is equivalent to the limited liability of a common stock put option. Traditionally, credit guarantees have the same limited liability.

These can be illustrated in Figure 1. At maturity, if the value of the credit being guaranteed is low, the guarantee has a positive value to the holder of the guarantee. As the value of the credit being guaranteed increases, the value of the guarantee to the holder decreases. 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 being guaranteed increases, the value of the guarantee to the writer (e.g. CCC) increases. When the value of the credit being guaranteed exceeds the amount guaranteed, the value to the writer of the guarantee is limited to the value of any premium paid by the holder.

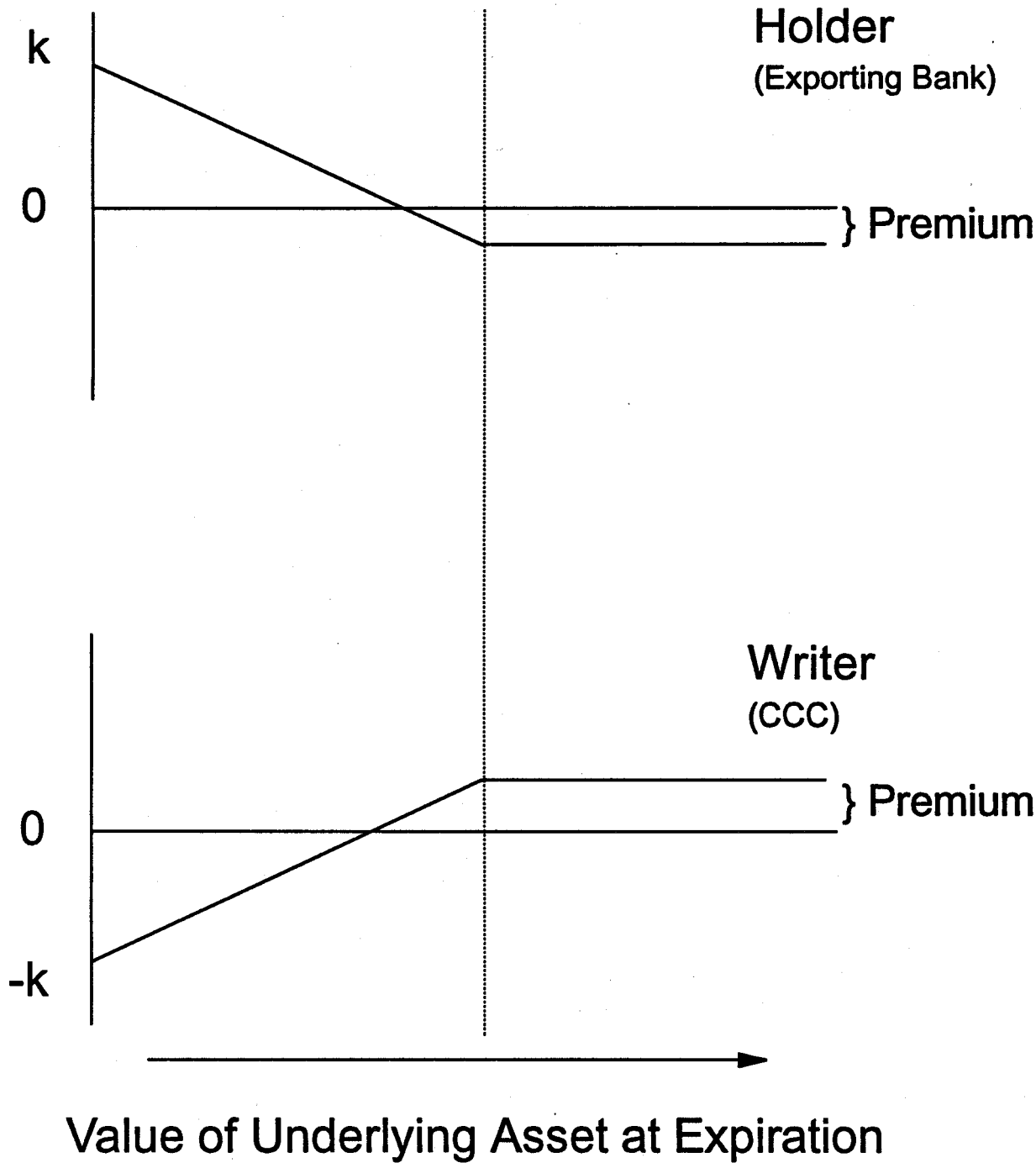

Figure 1. Value of Put Option to Writer (CCC) and Holder (Exporting Bank), at Expiration of Option

The Black-Sholes option model was assumed for estimating the value of a credit guarantee obtained with the GSM-102 program. This model provides an estimate of a "fair market value" of the guarantee if it were traded on an organized exchange and is comparable to the "actuarially fair" premium an insured (importer/U.S. bank) would pay for this insurance/guarantee. Credit guarantees are valued as:

$$G(T) = Be^{-rT}\phi(x_2) - V\phi(x_1)$$

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,
V is the current value of the asset,
ϕ (.) is the cumulative normal density function,
$x_1 = \{\log(B/V)-(r+ \sigma^2/2)T\} / \sigma\sqrt{T}$, and
$x_2 = x_1 + \sigma\sqrt{T}$,

Greater flexibility in the terms of the credit guarantee involves changing coverage levels, adding additional coverage for freight and insurance, and adding an exchange rate guarantee. Flood examined the valuation of different coverage levels for federal deposit insurance. He indicated 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 CCC, the principal covered could be implicitly represented 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 the stockholders and depositors of the exporting bank on the value of the assets of the bank (including the letter of credit from the importer) and held by the exporting banks' stockholders.

In this analysis, we are only concerned with the valuation of the guarantee extended by the CCC; and consequently, valuing flexibility for the percent of principal covered can be modeled by simply increasing or decreasing the value of the asset being guaranteed. Additional coverage for freight and insurance has the same impact from the perspective of the CCC and can be incorporated by adding these costs to the amount guaranteed. However, the true value of the guarantee can also be examined from other perspectives including those of the participating bank and the importer. These different perspectives would necessitate different value formulations comprised of multiple options.

An exchange rate guarantee adds further complexity to the valuation of export credit guarantees. This adds the equivalent of a second guarantee onto the basic export credit guarantee. A second option model was assumed for estimating the fair market value of this potential change in coverage. A general model for valuation of put options on foreign currency exchange based on spot exchange rates is as follows (Ritchken):

$$P(X) = Xe(-rT)N(-d_2) - S_o e(-rT)N(-d_1)$$

where

P(X) is the value of the exchange rate guarantee,
X is the strike price,
S_o is the spot rate,
σ 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,
N (.) is the cumulative normal density function,
$d_1 = \{\ln(S_o/X) + (r - r^* + \sigma^2/2)T\} / \sigma\sqrt{T}$, and
$d_2 = d_1 - \sigma\sqrt{T}$.

The total value of credit guarantees is assumed to be the sum of the two estimated option values where applicable. This does not consider the interaction of variables affecting each of the option valuations. However, it 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. Thus, solutions should approach the sum of the two individual option values.

DATA

Data required for estimation of the value of export credit guarantees were gathered from several sources. FOB and freight and insurance values were gathered for the countries examined by Landes and Ash. Exchange rates and interest rates (London Interbank Offer Rates-LIBOR and local lending rates) were gathered from the International Monetary Fund. Current forfaiting rates[4] were obtained from issues of International Trade Finance.

Model parameters for the base case were taken to be representative of a typical importing country using credit, in particular, those in the base case are representative of Pakistan. Simulations were conducted on critical model parameters to evaluate their sensitivity. Data used for the initial parameter values are shown in Table 2. Principal and interest coverage, down payments, and the term of the guarantee represent 1994 provisions for GSM programs (Table 1). Interest rates for the GSM program were assumed to be 25 basis points over the London Interbank Offer Rates (LIBOR) (Skully, Hyberg et al.). The current value for 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 data on the value of the importers' letter of credit, an initial value of .3 was assumed for the volatility. The annualized volatility of exchange rates for the base country was estimated from monthly observations of exchange rates over the 3-year period 1991-1993.

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[4]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.

Table 2. Initial Parameters for Option Valuation of GSM Guarantees.

Item	Value	Units
FOB Value of Exports	156.78	$/MT
Freight and Insurance	26.00	$/MT
GSM Interest rate (Libor + 25)	6.875	%
Risk Free Interest rate - Importer	13.05	%
Percent principal coverage	98.00	%
Percent of interest covered	2.8	% pts.
Down payment	0.0	%
Current value of letter of credit	903.125	$/1000
Volatility of letter of credit	0.30	Std Dev.
Current value of exchange rate	24.58	Local cur/Dollar
Volatility of exchange rate	0.042	Std Dev.
Term	3	Years

RESULTS

The value of credit guarantees was estimated using provisions in place for GSM-102 in Fiscal Year 1994. Credit guarantees covered 98 percent of the FOB value of exports and 2.8 percent interest for up to 3 years. No down payment was required, and premiums ranged from .16 to .67 percent of the value of exports depending on the term of the guarantee. Coverage for freight, insurance, and exchange rates were not included in the initial valuation.

Results from the initial valuation and alternative types of flexibility are shown in Table 3. The value of GSM credit guarantees extended to the base country was 13.76 percent of the export value ($21.58 per MT). Adding coverage for freight and insurance increases the value of GSM credit guarantees by $3.50 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 $21.78 per MT and $25.31 per MT, respectively. These results suggest that adding coverage for freight would have the greatest impact on the value of credit guarantees. An exchange guarantee adds minimal additional value to the GSM guarantee.

Table 3. Fair Market Value of Credit Guarantees, By Type of Coverage.

Guarantee	Option Value	Change from Base	
		Actual	Percent
	$/MT	$/MT	%
Base Case	$21.58	--	--
Base Case + Freight	$25.08	$3.50	16.2
Base Case + Exchange	$21.78	$0.20	0.9
Base Case + Freight + Exchange	$25.31	$3.73	17.3

Sensitivity Analysis

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

Changes in Default Risk

An important parameter affecting the value of a credit guarantee is the default risk of the importer. In this model, this is represented by the volatility and price level of the underlying asset (value of the letter of credit). Importers with greater default risk would have larger volatilities in the value of the letter of credit and/or lower price levels. The model was simulated to analyze impacts of these parameters on the value of GSM credit guarantees.

Decreasing the price level of the underlying asset increases the value of GSM credit guarantees (Figure 2). As the price level for the underlying asset decreases, the value of the credit guarantee increases at an increasing rate. Strictly interpreted, these results illustrate that the value of a GSM credit guarantee would be $21.74 for a country whose letter of credit has a current value of $900. For a higher risk country whose letter of credit would be $450, the value of the GSM guarantee would be $61.62.

There is a positive relationship between the volatility of the letter of credit and the value of the GSM guarantee (Figure 3). Increases in the volatility of price changes for the underlying asset increases the value of extending credit guarantees but, at a decreasing rate. In our base case, the volatility was assumed at .3 and the value of the guarantee was $21.58/MT. For a higher risk country whose volatility would be .6, the value of the guarantee increases to $47.64/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, has a dramatic impact on the value of credit guarantees.

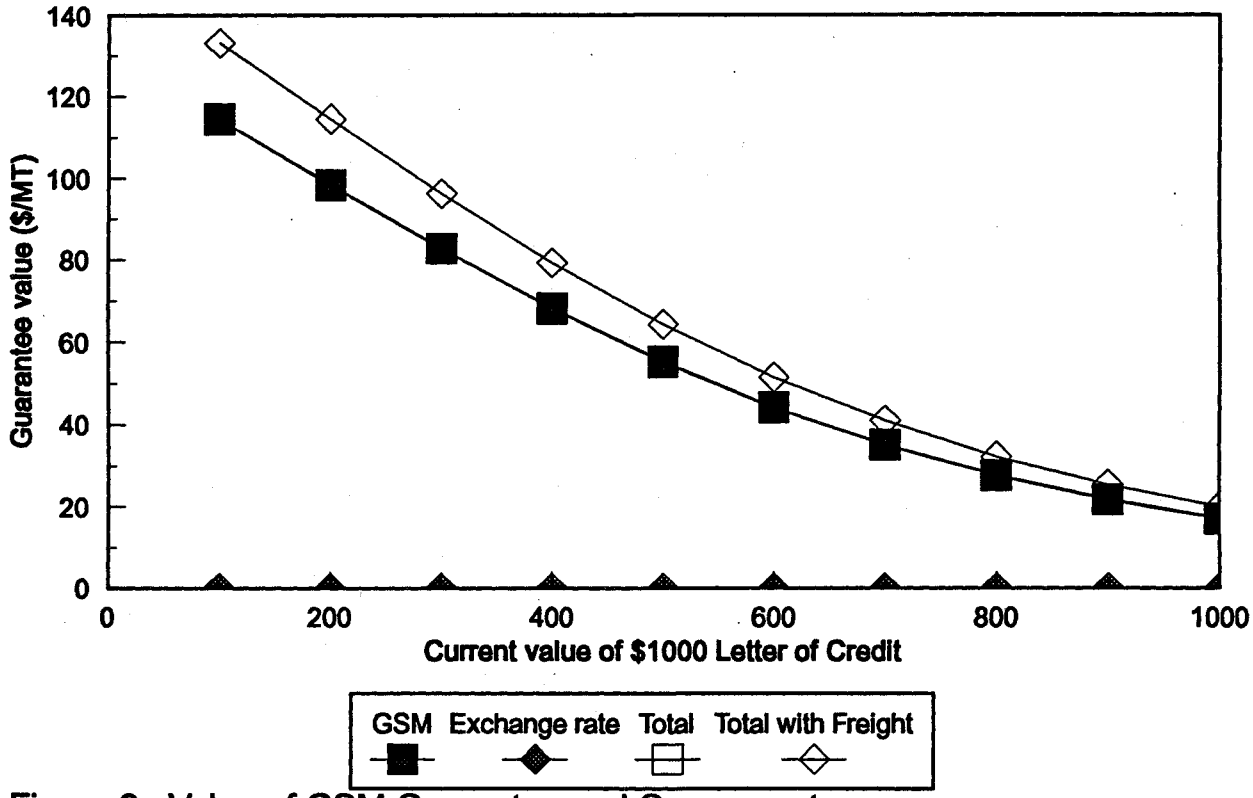

Figure 2. Value of GSM Guarantee and Components, By Current Value of Letter of Credit

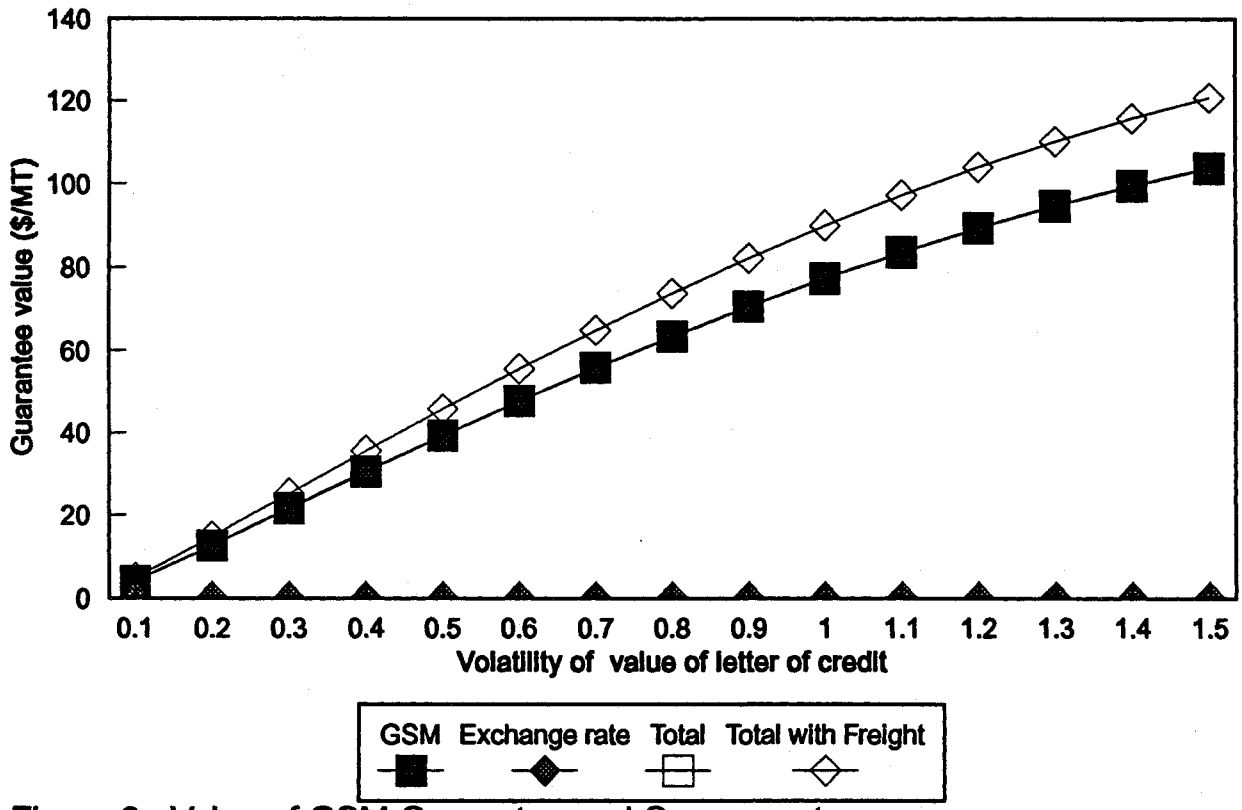

Figure 3. Value of GSM Guarantee and Components, By Volatility of Letter of Credit

Figures 2 and 3 also illustrate that adding coverage for freight and insurance to the base guarantee increased the sensitivity of the value of the guarantee to changes in default risk. As default risk increased, the value of the guarantee including coverage for freight and insurance increased 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 importer 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.

Commodity Value and Freight

Changing the FOB value of exports does not affect the percentage value of credit guarantees. However, on a per MT basis, as the FOB value of exports increases, the value of the guarantee increases to maintain the same percentage value (Figure 4). Thus, everything else the same the value of the implicit guarantee is higher at times when the FOB price is greater. Similarly, changing the cost of freight and insurance increases the value of a credit guarantee that covered freight (Figure 5). Doubling the cost of freight and insurance from $25 to $50 per MT increases the value of the guarantee by $3.40 per MT ($25.17 versus $28.57).

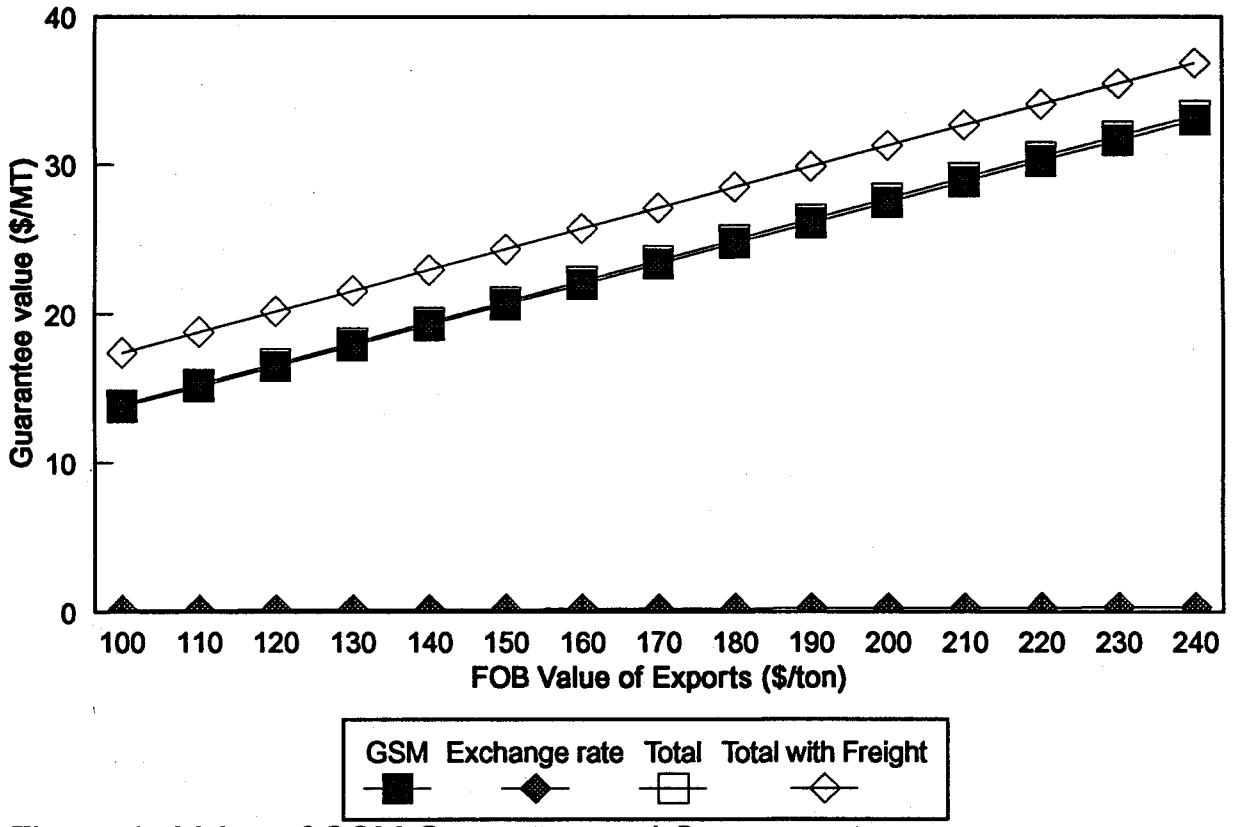

Figure 4. Value of GSM Guarantee and Components, By FOB Value of Exports

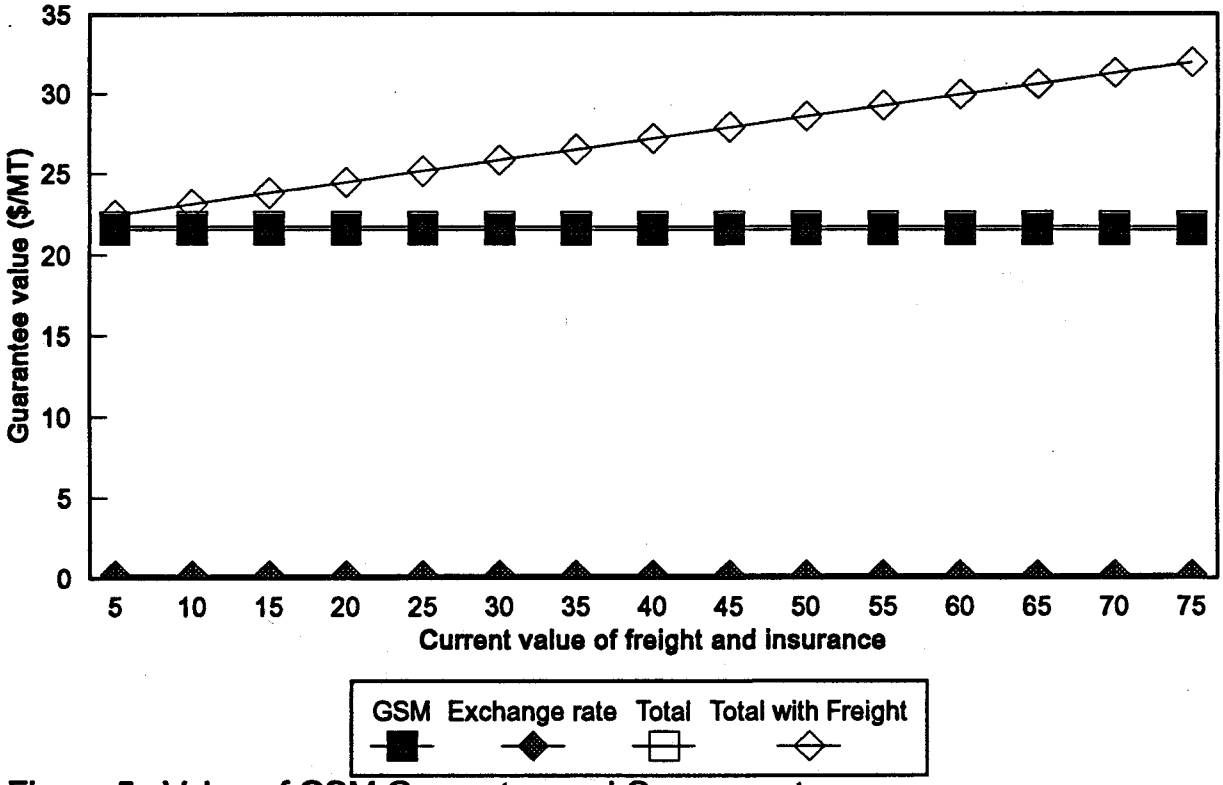

Figure 5. Value of GSM Guarantee and Components, By Current Value of Freight and Insurance

Down Payment, Principal, and Interest Covered

The amount of down payment, principal, and interest covered varies across exporting counties' programs. The model was simulated to evaluate the effects of changes in these variables on the value of the GSM guarantee. Increasing the down payment as a percent of the value of exports required for GSM guarantees reduces the value of guarantees (Figure 6). Specifically, in the base case, the GSM guarantee has no down payment and has a value of $21.58/MT. Increasing the down payment to 10 percent reduces the value of the guarantee to $19.47/MT. Similarly, reducing the percent of the principal covered by a GSM credit guarantee by 10 percent has the same effect (reduced the value of the guarantee to $19.47/MT) on the value of credit guarantees (Figure 7). These results illustrate that changes in the principal covered or down payments required for credit guarantees can have significant impacts on the value credit guarantees.

The effect of changes in down payments and the percent of principal covered when adding an exchange rate guarantee and/or freight and shipping to the base case reflect a similar percentage change in value with percentage change in coverage. This largely reflects the limited impact of adding an exchange rate guarantee to the base case in this example. In cases where the value of the exchange rate guarantee is more costly, increases in down payments or reductions in principal coverage would reduce the value of guarantees to a lesser extent.

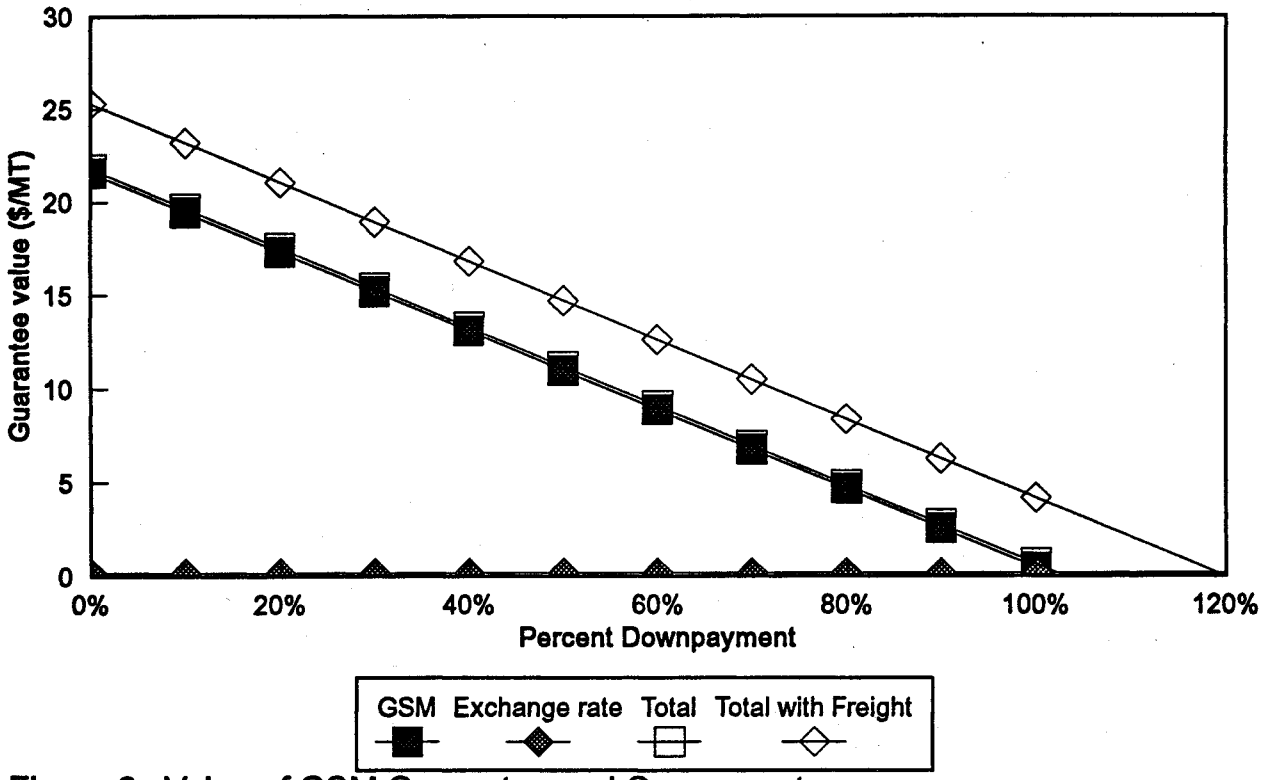

Figure 6. Value of GSM Guarantee and Components, By Percent Down Payment

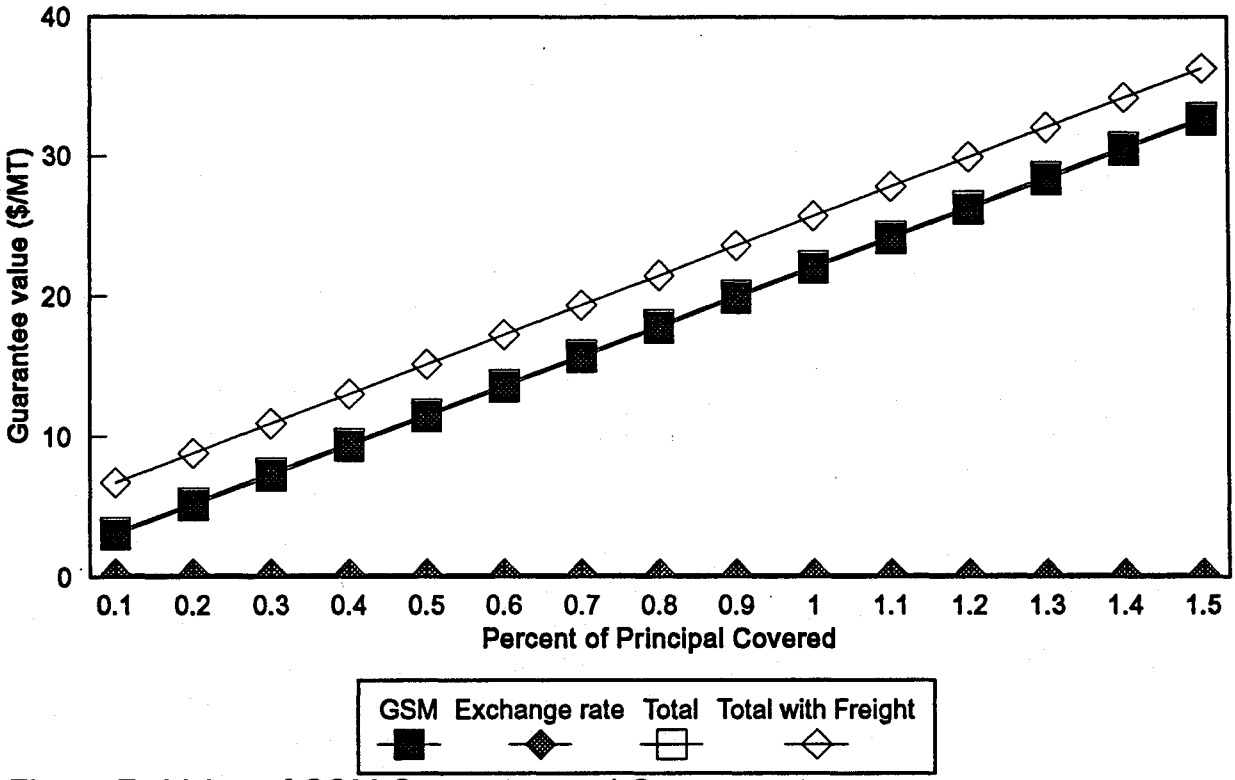

Figure 7. Value of GSM Guarantee and Components, By Percent of Principal Covered

The U.S. GSM guarantees the interest accrued at a specified rate, or percentage points of interest. This is unlike other exporters who guarantee a percentage of the total interest charged. The model was simulated to examine the effect of changing the percentage points of interest covered by the guarantee. Changes in the percentage points of interest covered have limited impact on the value of credit guarantees (Figure 8). Increasing the percentage points of interest covered from .028 to .06 percent increases the value of guarantees by $1.01 per MT. However, changing the term of the guarantee has more dramatic results (Figure 9). Either lengthening the term or shortening the term from the initial 3-year guarantee reduces the value of credit guarantees (basic, with freight, and with exchange rate guarantees). However, the value of the exchange rate guarantee by itself was highest for short-term guarantees and decreased as the term increased.

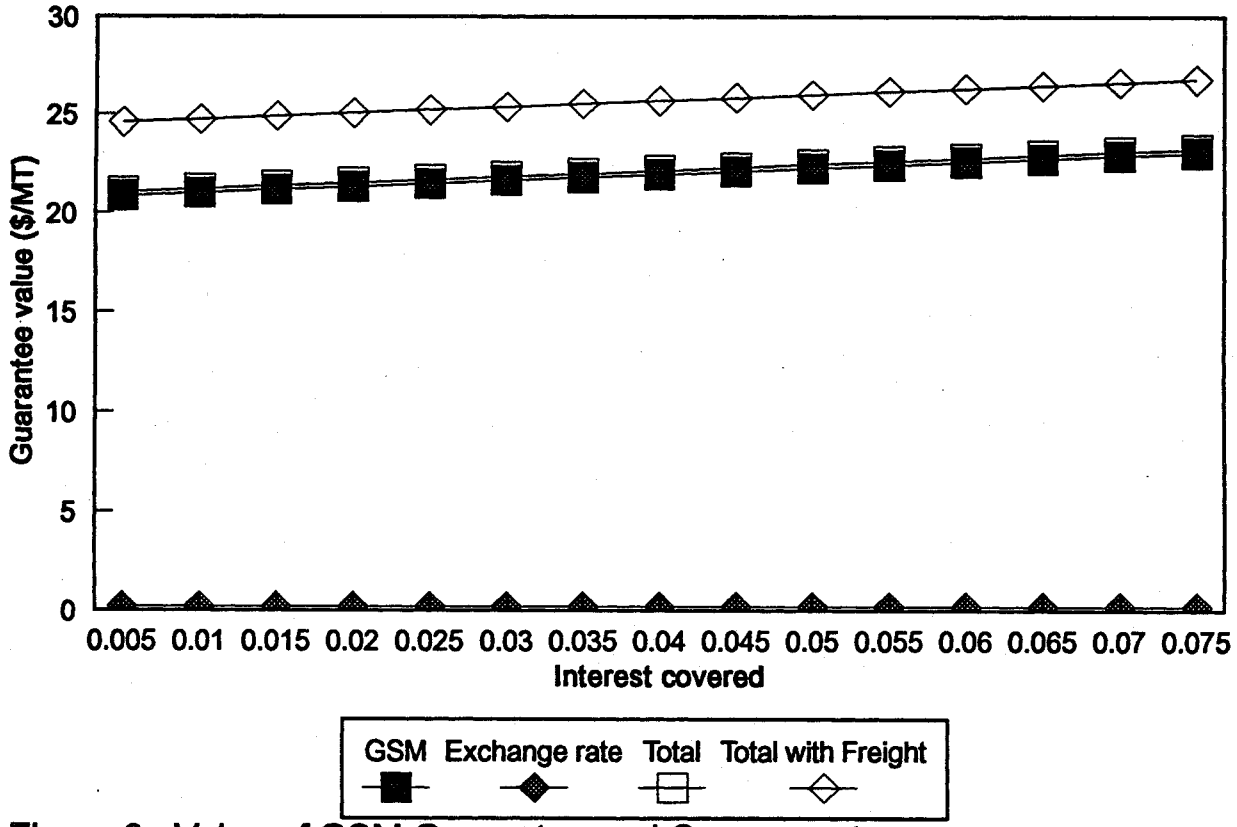

Figure 8. Value of GSM Guarantee and Components, By Percent of Interest Covered

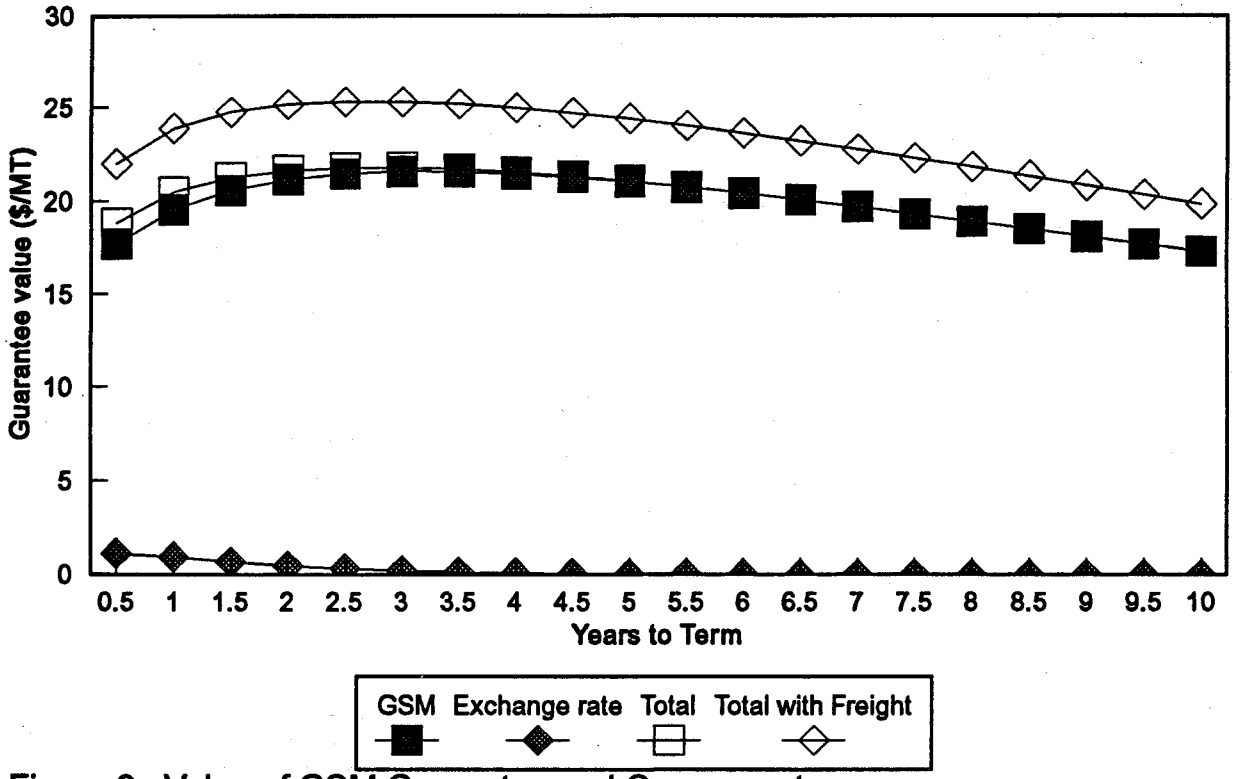

Figure 9. Value of GSM Guarantee and Components, By Term of Guarantee

Effects of Alternative Lending Interest Rates on Credit Guarantee Value

The interest rate charged for GSM credit guarantees and the spread between the guarantee rate and the alternative cost of money in the importing country have interesting effects on the value of credit guarantees (Figures 10-11). Changes in the GSM interest rate affects the value of the basic guarantee, however changes in the interest rate spread have no affect on the value of the basic guarantee. For example, increasing the GSM interest rate from 6 percent to 7 percent decreases the value of the basic guarantee from $23.43/MT to $21.32/MT (Figure 10), while increasing the importers interest rate, which increases the interest rate spread, has no effect on the value of the base guarantee (Figure 11).

If an exchange rate guarantee is added, the value of the guarantee is affected by changes in the interest rate spread. For example, in the base case, the GSM interest rate is .06875 percent and the alternative cost of borrowing in the importing country is .1305 percent, resulting in an interest rate spread of .06175 percent. As the GSM interest rate is increased to .1305 percent, the spread between interest rates declines and the value of the guarantee including an exchange rate guarantee increases (Figure 10). Beyond .1305 percent, the interest spread becomes negative and the value of the guarantee with the exchange rate coverage declines. Similarly, as the importers alternative cost of borrowing declines to .06875 percent, the spread in interest rates declines and the value of the exchange rate guarantee increases. Below .06875 percent, the spread becomes negative and the value of the exchange rate guarantee declines.

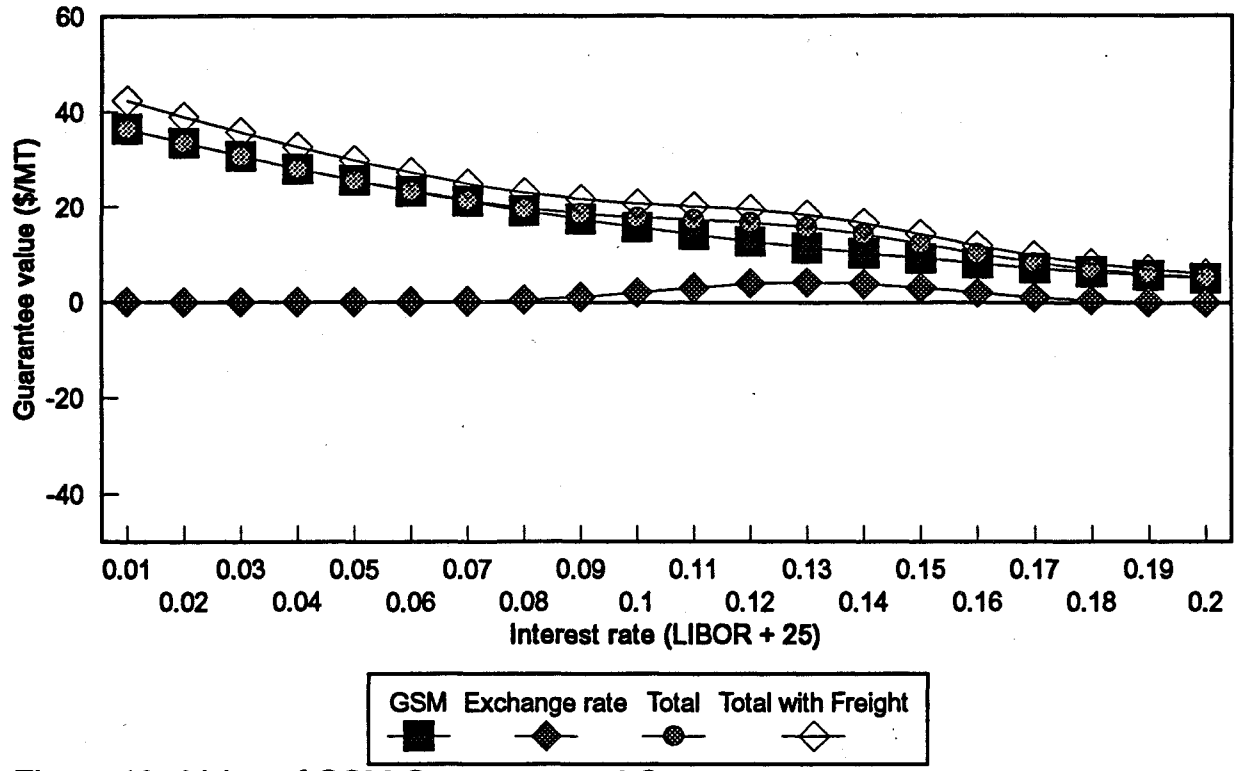

Figure 10. Value of GSM Guarantee and Components, By GSM Interest Rate

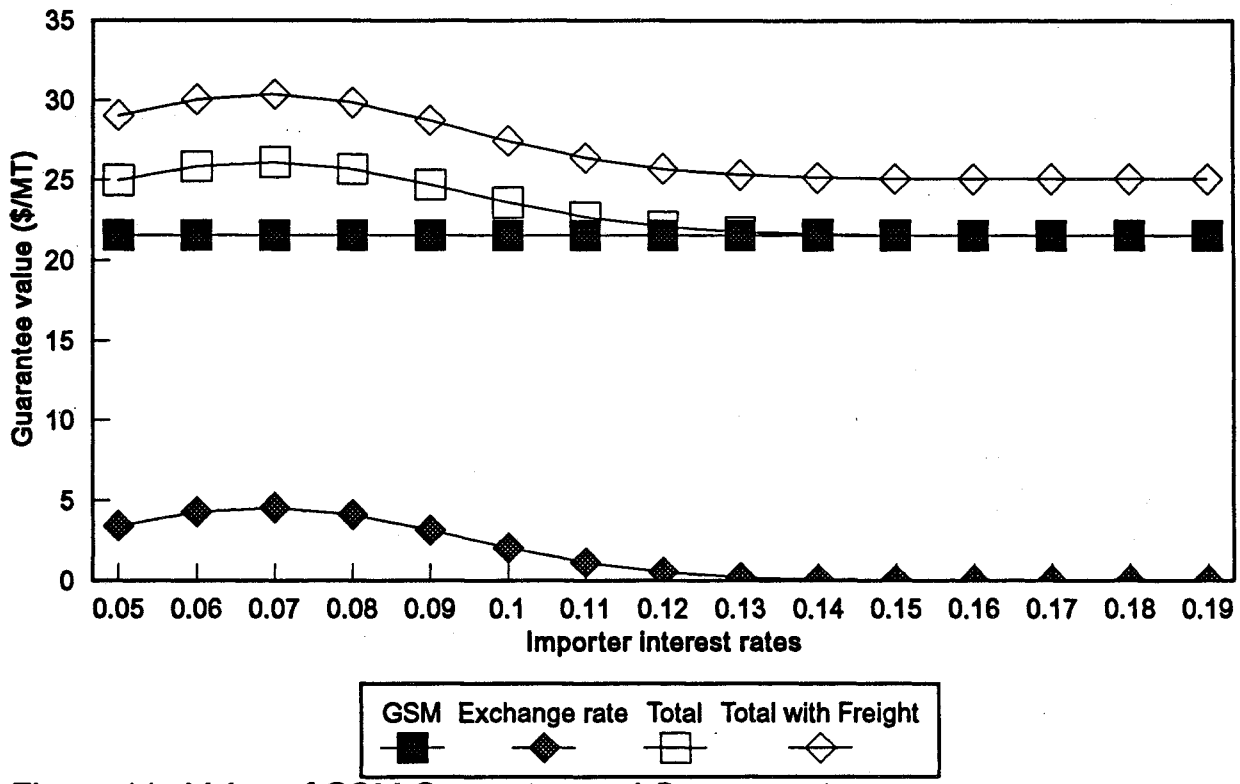

Figure 11. Value of GSM Guarantee and Components, By Importer Interest Rates

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 (Figure 12). In this case, a 20 percent decrease in the current value of the exchange rate would more than double the value of the credit guarantee. Similarly, increasing the exchange rate volatility produces a similar increase in the value of extending an exchange rate guarantee (Figure 13).

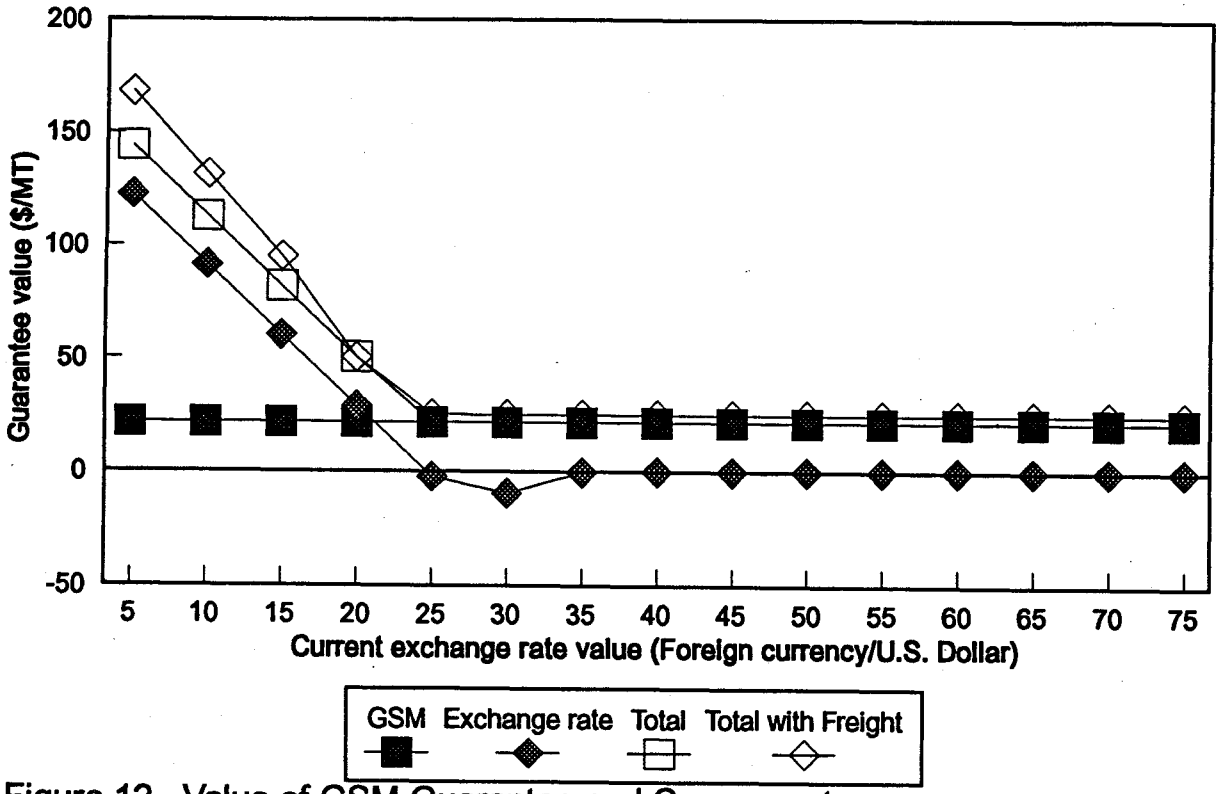

Figure 12. Value of GSM Guarantee and Components, By Current Value of Exchange Rate

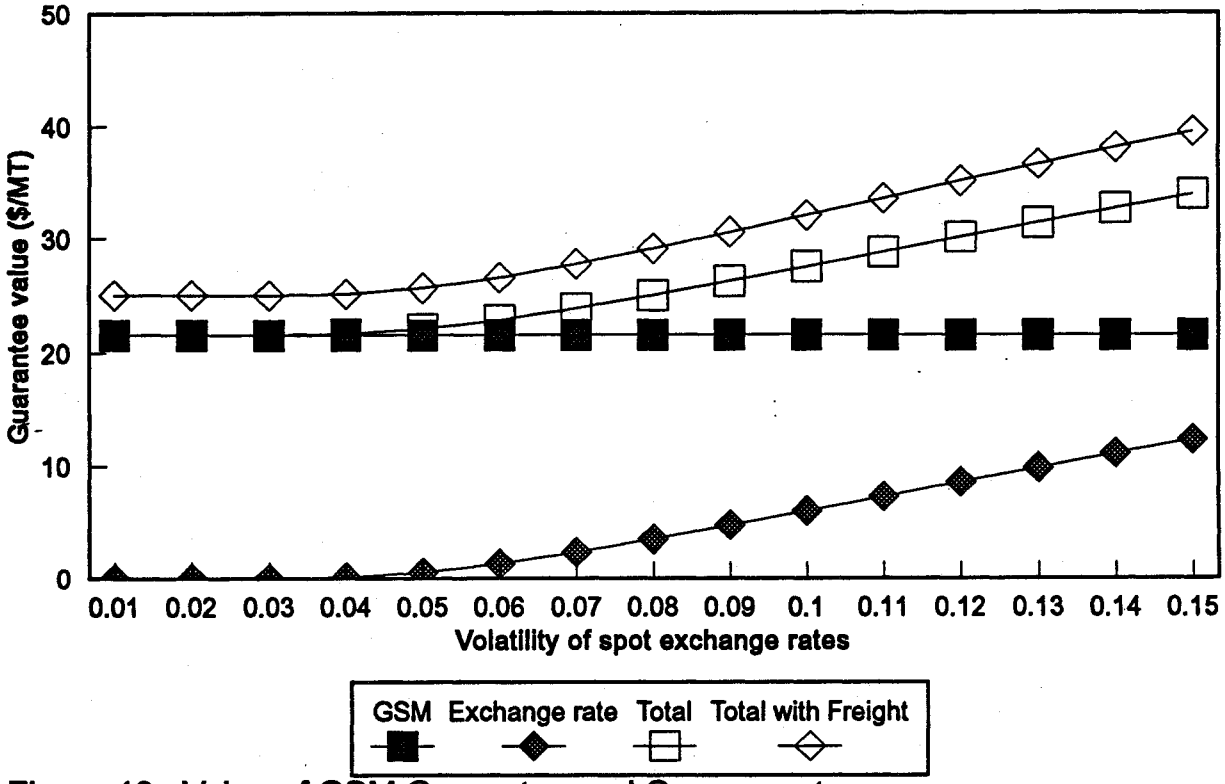

Figure 13. Value of GSM Guarantee and Components, By Volatility of Exchange Rate

Comparisons Among Competing Countries' Programs

The terms of the export credit programs vary across competing exporters and have an important effect on their value to importers. The model was used to determine the value of each of the programs. This provides insight into the relative value to the importer implied in each of the exporting countries' guarantee programs. Programs for 4 major exporters of wheat were examined (Canada, Australia, France, and the U.S.). A base case with importer characteristics equivalent to those in the previous analysis was assumed. Shipping costs were assumed equal for each exporting country to provide a general comparison of the difference in value provided by each of the programs. This focused on true differences in program valuation rather than representing differences in comparative advantage for shipping costs.

Individual parameters for each of the major exporting countries' programs are shown in Table 4. and denominated in local currency. Parameters represent program provisions for each of the programs. The most important differences among the programs are reflected in principal and interest coverage and the percent of down payment required, however, the France/COFACE program also covers freight and insurance.

Table 4. Initial Parameters for Comparisons of Export Credit Programs for Major Exporters.

Item	U.S.	Canada	France	Australia	Units
Value of exports for coverage	156.78	184.56	1007.17	118.07	Exp.Cur./MT
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 principal coverage	98.0	100.0	95.0	100.0	%
Percent pts. interest covered	2.8				% pts of interest
Percent of interest coverage		100.0	95.0	75.0	% of interest
Down payment	0.0	25.0	0.0	0.0	%
Current value of $1000 letter of credit	903.125	1063.0	4976.0	680.0	Exp. Cur.
Volatility of letter of credit	0.30	0.30	0.30	0.30	Standard Dev.
Current value of exchange rate	24.58	21.58	4.62	32.02	Imp.Cur./Exp.Cur
Exchange rate volatility	0.042	0.054	0.094	0.069	Std Dev.
Term	3.0	3.0	3.0	3.0	Years

The value of export credit guarantees was estimated for the programs offered by Canada (Canadian Wheat Board), Australia, France-COFACE, and the U.S. Results for the base case are shown in Table 5. The credit guarantee provided by the Canadian Wheat Board had the lowest value ($18.36/MT), followed by the U.S. ($21.57/MT), Australia ($23.23/MT), and France-COFACE ($26.32/MT). The Canadian guarantee had the lowest value primarily because of the large down payment required on guaranteed sales. The value of U.S. and Australian guarantees comprise a middle ground, and differences in values between the two programs are largely due to different coverage levels for principal and interest. The French-COFACE guarantee had the highest value largely because the COFACE guarantee includes coverage for freight and shipping. Further, 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. Value of Export Credit Guarantees for Major Wheat Exporters.

Country	Basic Guarantee	Exchange Rate (if offered)
	(US$/MT)	
United States	21.57	
Canada (CWB)	18.36	
Australia	23.23	
France-COFACE*	26.32	4.98

*Includes coverage for freight and shipping.

Since the volatility of the importer's letter of credit was an assumed value, the sensitivity of valuations of the export credit programs for the major exporters to changes in related parameters was examined. These results are shown in Figures 14 & 15. As the current value of the importer's letter of credit declines (increase in potential default), the value of the export credit programs for each of the major exporters increases (Figure 14). The ranking of values for the export credit programs (lowest to highest value) remains the same, but the spread among values for individual exporters' programs becomes wider. For example, with a current value for the letter of credit of $1000, the value of Canadian, U.S., Australian, and French (COFACE) guarantees was $14.58, $17.11, $18.45, and $20.90, respectively. For more risky countries, where a $1000 letter of credit has depreciated in value to $500, the value of Canadian, U.S., Australian, and French (COFACE) values is $46.54, $55.13 $58.88, and $66.72, respectively. This represents a spread of $20.18 per MT between the Canadian and French programs. Therefore, the advantage of the French (COFACE) guarantee increases for riskier importing countries.

Increasing the volatility of the importer's letter of credit, also implies an increased potential for default. Increases in the volatility results in increased spreads between the major exporters' programs (Figure 15). For example, when the volatility of the value for the importer's letter of credit is .3, the value of the Canadian, U.S., Australian, and French (COFACE) programs was $18.36, $21.58, $23.23, and $26.32, respectively. For more risky countries, where the value of the importer's letter of credit was more variable (volatility = .5), values of the Canadian, U.S., Australian, and French (COFACE) programs were $33.10, $39.22, $41.88, and $47.45, respectively. Thus, as the probability of default increased, the credit guarantee provided by France (COFACE) became more valuable in comparison to other exporters' programs.

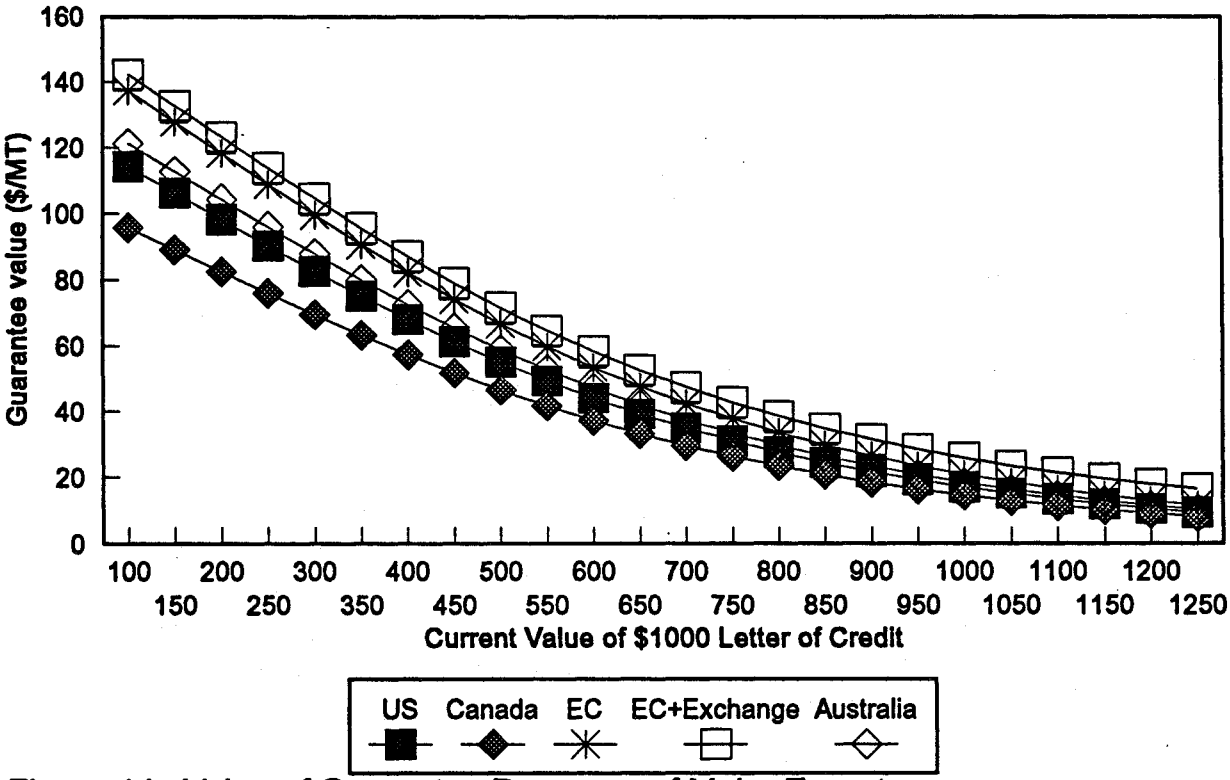

Figure 14. Value of Guarantee Programs of Major Exporters, By Current Value of Letter of Credit

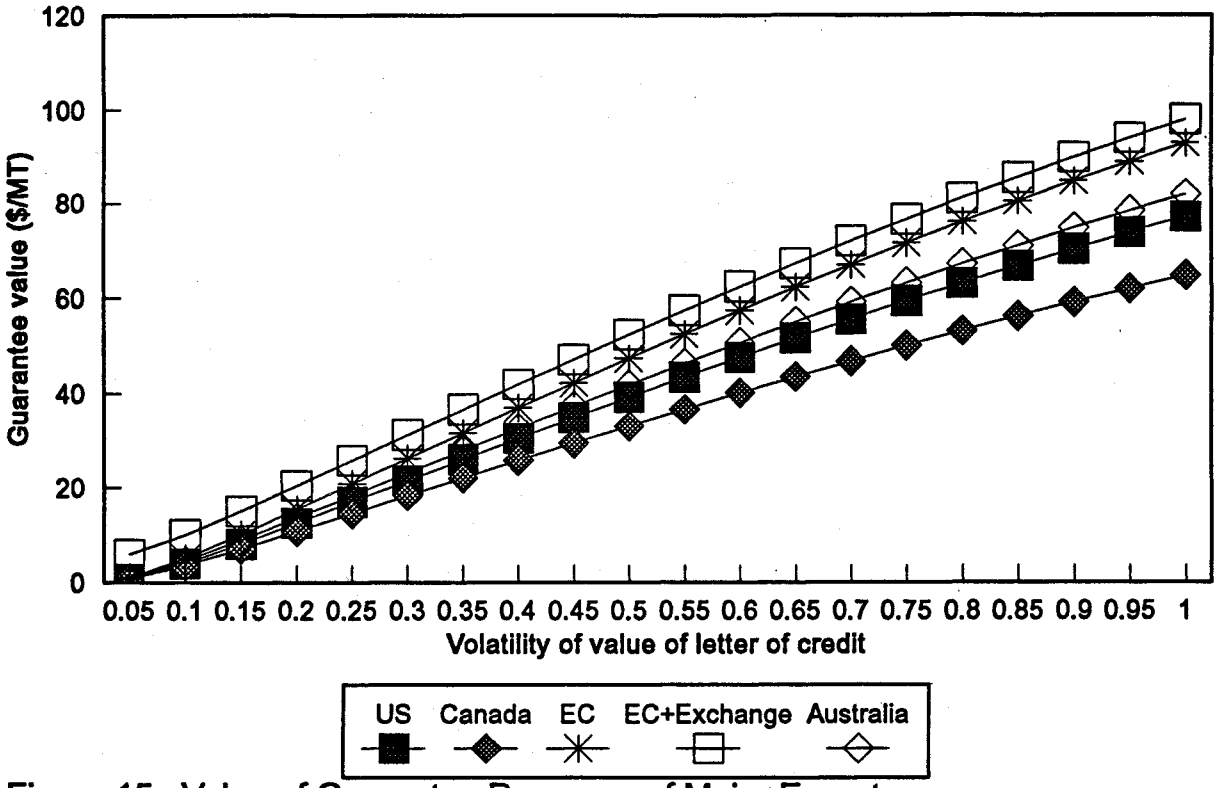

Figure 15. Value of Guarantee Programs of Major Exporters, By Volatility of Letter of Credit

CONCLUSIONS AND IMPLICATIONS

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

The value of the basic GSM credit guarantee was most sensitive to the current price level and volatility of the importers' letter of credit (assets guaranteed). Adding an exchange rate guarantee to the GSM program generally increased the value of the guarantee minimally ($0.2 per MT). In addition, the value of credit guarantees with an exchange rate guarantee were highly sensitive to the current value, strike price, and volatility of exchange rates. This indicated that the value of a credit guarantee extended to an importer is largely a function of the default probability.

Adding coverage for freight and insurance increased the value of a credit guarantee by $3.50 per MT (16%). Percentage changes in principal, interest coverage, term, and down payment for the GSM program resulted in equal or smaller percentage changes in the value of extending guarantees. Increasing the GSM interest rates decreased the value of the base guarantee by $2.11/MT, while, decreases in the interest rate spread between the GSM rate and the importers alternative rate increased the value of an exchange rate guarantee. Therefore, introducing flexibility by modification of terms, adjusting the percent 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.

Comparisons of the value of export credit guarantees implied in programs offered by Canada, Australia, France, and the U.S. indicated differences inherent in each. 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 (COFACE) 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 importers' letter of credit. Further, the spread between valuations of individual exporters' programs became wider as the potential for default increased, giving a greater value to the French/COFACE program.

With premiums for credit guarantees at .15 to .67 percent of the value of exports for U.S. guarantees (Table 1), the "fair market value" of export credit guarantees is larger than income received from premiums. Therefore, governments are not charging an actuarially fair rate for credit guarantees and in fact an implicit subsidy would be embedded in exports in this case. This is not surprising. In fact, Funatsu, who examined extending insurance guarantees for Eximbank loans, indicated 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 percent. 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 ranged from .89 percent to 12.43 percent of the value of imports. Our estimate for the base case is on the high side of this range (13.76% -.67% = 13.09%), yet is highly sensitive to critical variables that were unobtainable (volatility of the letter of credit).

These results are highly dependent on the initial parameters specified. This focuses attention on one of the major problems associated with option valuation of guarantees. An important problem 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, 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.

In retrospect, values for letters of credit and exchange rates may be correlated. Therefore, holding one of these constant while moving the other in a sensitivity analysis framework may not be representative. Further, the degree of interaction of items affecting both the valuation of the basic guarantee and the exchange rate guarantee is unknown. Trigeorgis presented a potential methodology that considers the interaction of terms in multiple options, but this was beyond the scope of this study. Finally, further research is also required on the valuation of changes in program provisions from the perspective of participating banks and importers.

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