Credit Guarantee Programs and U.S. Market Share in Selected Wheat Import Markets

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Credit Guarantee Programs and U.S. Market Share in Selected Wheat Import Markets

Abstract

Export credit guarantee programs are under increasing scrutiny, as policymakers seek assurance that the budgetary costs and risks borne by taxpayers are justified by expanded agricultural exports. This study provides empirical estimates of the effects of credit guarantees on U.S. wheat exports to major recipient countries.

Keywords: Credit Guarantee Programs, Wheat Exports, Armington Demand Models.
Executive Summary

Export credit guarantees are beneficial in expanding and sustaining foreign markets, particularly those with short-run foreign exchange problems. The effectiveness of these programs is under scrutiny, as policymakers seek assurance that the budgetary costs and risks borne by taxpayers are justified by expanded exports. This study provides empirical estimates of the effects of credit guarantees on U.S. wheat exports to major recipient countries.

An Armington demand specification, with the U.S. share of the wheat import market as the dependent variable, is extended to include the value of credit guarantees as an additional explanatory variable. The model is estimated separately for six import markets: Algeria, Brazil, Korea, Mexico, Morocco, and Tunisia. Historical data on the U.S. share, credit guarantees, and relative wheat import prices for 17 years since the inception of the GSM-102 program are used in the analysis.

Regression results indicate that export credit guarantees raise the U.S. share in all six import markets. The marginal effect is highest for Brazil and lowest for Korea. Mexico appears to hold some promise for expanding the U.S. market share, given its high marginal response to credit guarantees and the small allocations it has received (relative to market potential) in past years.

The allocation of credit guarantees is also addressed within an optimization framework. Given Armington demand estimates for six import markets, the Commodity Credit Corporation is hypothesized to allocate its funds for credit guarantees in order to maximize U.S. export revenue. In each market, expenditures on wheat from non-U.S. sources and relative prices are taken as exogenous. Also, it is assumed that competing exporters’ response to U.S. actions would remain neutral. The sum of guaranteed sales to six markets is constrained to be less than the actual total for each fiscal year. Seven first order conditions are derived and solved, yielding “optimal” guaranteed credit allocations.

Optimal guaranteed credit allocations are compared to actual allocations in each market. In the early 1980s, the analysis suggests Algeria and Tunisia should have received larger allocations, while Korea and Brazil should have received lower allocations. Between FY 1987 and FY 1993, guaranteed sales to Korea and Morocco were higher than optimal, while those to Algeria, Brazil, and Tunisia were lower than optimal. Since FY 1995, Mexico has received much larger guaranteed credit allocations than justified by the export revenue criterion. With allocations at optimal levels, export revenue from sales to the six markets would have been higher by over $200 million in FY 1997.
Credit Guarantee Programs and U.S. Market Share in Selected Wheat Import Markets

Vidyashankara Satyanarayana and D. Demcey Johnson

1. Introduction

The United States uses several government programs to promote the export of wheat and other agricultural commodities. Among these are the export credit guarantee programs, GSM 102 and GSM 103, administered by the Commodity Credit Corporation (CCC) of the U.S. Department of Agriculture. These programs have assumed more importance for U.S. wheat exports as direct price subsidies (through the Export Enhancement Program, EEP) have been curtailed. Recent crises in Asia have also focused attention on the role that credit guarantees can play in maintaining U.S. exports in the face of financial turbulence and economic downturns in foreign markets.

While other export promotion programs (particularly EEP) have been extensively studied by economists, credit guarantees have received less attention. That is partly due to the fact that, unlike price subsidies, export credit programs did not figure into agricultural trade negotiations under the Uruguay Round. Nor have the budgetary costs of these programs been so conspicuous. Nevertheless, in an era of tight budgets and general withdrawal of public support for agriculture, GSM programs are coming under more scrutiny in terms of their economic contribution and cost-effectiveness.

Several types of economic justification have been advanced for export credit programs. Credit guarantees are used to relax importers' foreign exchange constraints (Smith and Ballenger; Grigsby and Jabara), to correct market failures (Raynauld), and to counter the export promotion strategies of competing exporters (Baron). Most of the empirical work on credit guarantees falls into two categories. One group focuses on additionality: the additional export volume that can be attributed to credit programs. Studies by Diersen et al., Koo and Karamera, Ackerman and Smith, Anania et. al, and Haley provide empirical estimates of the additionality associated with

1Research Assistant and Associate Professor in the Department of Agricultural Economics at North Dakota State University, Fargo, ND.

2A useful review of export promotion programs is provided by the General Accounting Office.

3In FY 1996, the CCC provided guarantees on agricultural exports valued at $3.2 billion. This represented an estimated subsidy value of $327 million. For comparison, expenditures on direct price subsidies (mainly EEP, but also including DEIP, SOAP, and COAP) averaged $980 million per year during FY 1991-95. Although the Commodity Credit Corporation (CCC) now has authority to extend $5.5 billion in export credit guarantees annually, actual budgetary costs are incurred only if claims are paid to US financial institutions as a result of a foreign default or debt rescheduling. In 18 years since the inception of the Export Credit Guarantee Program, these claims totaled $2.1 billion. Source: GAO, 1997 pp. 39-40.
GSM programs. The second group focuses on the value of credit guarantees to importers. Examples are studies by Dahl et al. and Skully, who estimate the implicit interest subsidy provided to foreign importers under these programs, and Dahl and Wilson, who use option-valuation methods to assess other program features.

The present study relates more closely to the literature on additionality. Most studies have measured additionality with econometric demand models or within a spatial equilibrium framework. This study obtains estimates of market share gains from empirical demand functions derived from importer utility maximization. It incorporates a credit guarantee variable as a utility shifter, along lines suggested by Soloman and Kinnucan. The analysis is applied to six wheat-importing countries, all of which have made extensive use of GSM programs.

In addition to estimating the impact of credit guarantees on the U.S. market share, we consider the ‘optimal’ allocation of credit guarantees across importing countries. Optimal allocations of credit guarantees are derived using empirical demand functions for six importers on the assumption that the CCC seeks to maximize the U.S. net export revenue. These are compared to actual credit guarantee allocations, by country, during the period under study.

Section 2 provides some background on U.S. export credit programs. This is followed by a description of the empirical model and data used in the analysis. Empirical results are presented in the fifth section, and the paper concludes with a summary and discussion of implications.

2. Background on GSM-102 and 103

Both the Export Credit Guarantee Program (GSM-102) and the Intermediate Export Credit Guarantee Program (GSM-103) were developed to expand U.S. agricultural exports. Under these programs, the CCC acts as guarantor of credits issued by U.S. banks for foreign purchases of U.S. agricultural commodities. Credit guarantees are issued for terms up to three years under GSM-102 and for terms from three to ten years under GSM-103.

The programs operate in cases where credit is necessary to increase or maintain U.S. exports to a foreign market and where private U.S. financial institutions would be unwilling to provide financing without CCC’s guarantee. The programs are operated in a manner intended not to interfere with markets for cash sales. The programs are targeted toward those countries where the guarantees are necessary to secure financing of the exports, but which have sufficient financial strength so that foreign exchange will be available for scheduled payments.

The credit facility created by these programs is the CCC payment guarantee. The payment guarantee is an agreement by CCC to pay the exporter or the U.S. financial institution that may take assignment of the exporter’s right to proceeds, specified amounts of principal and interest due from, but not paid by, the foreign bank issuing an irrevocable letter of credit in connection with the export sale to which CCC’s guarantee coverage pertains.
Further details on various aspects of guarantee program may be obtained from Dahl et al (1995) and Diersen et al (1997).

3. Empirical Model

The Armington model serves as an alternative to ad hoc econometric specifications. This approach is based on utility maximization and distinguishes goods by country of origin. Conceptually, the model entails a two-step decision-making process. In the first step, an importing country, treated as the decision-making unit, determines the total demand of a commodity need for consumption. In the second step, quantities to be imported from various sources (and adding up to total demand) are determined. Two assumptions regarding elasticities of substitution are made to make the framework amenable to empirical work: 1) elasticities of substitution in each market are constant and 2) the elasticity of substitution between any two products competing in a market are the same as elasticity of substitution between any other pair of products in the same market. The commonly used empirical demand specification is

\[ S_{ij} = b_{ij}^{\sigma_i} \left( \frac{P_{ij}}{P_i} \right)^{-\sigma_i} \]

where \( S_{ij} \) is the market share of country \( j \) in importing country \( I \), \( P_{ij} \) is the price of the commodity from country \( j \) in country \( I \), \( P_i \) is the average price of the commodity imported into country \( I \) from various sources, \( \sigma_i \) is the country-specific elasticity of substitution between the commodity from country \( j \) and the same commodity from other exporters, and \( b_{ij} \) are country-specific constants.

The share equation (1) permits incorporating additional variables. In particular, the country-specific constant (\( b_{ij} \)) could be represented as a function of a set of variables that determine market shares. For this study, we represent the constant as

\[ b_{ij} = A_{ij} c_{ij}^{\beta_i} \]

where \( c_{ij} \) is the value of credit guarantees (GSM sales in $ millions), \( A_{ij} \) and \( \beta_i \) are parameters to be estimated. This representation is fairly common and can be found in Duffy, et al; Babula; Sirhan and Johnson; and Solomon and Kinnucan.

The value of credit guarantees (\( c_{ij} \)), used as a utility shifter, is intended to proxy the net transfer received by the importer under the program. This net transfer entails an interest subsidy, which is not directly observed, and expanded access to credit, which may be more significant for
These concepts are developed by Johnson (1995). Basically, credit guarantees allow U.S. banks to expand their lending to targeted countries without increasing their risk exposure. Substituting (2) in (1) we obtain

\[ S_{ij}^* = \left( \frac{P_{ij}}{P_i} \right) \left( A_{ij} c_{ij}^* \right)^{\sigma_i} \]

Taking natural logarithms of both sides of (3) yields the estimation equation:

\[ S_{ij}^* = A_{ij}^{\*} - \beta_i c_{ij}^{\*} + \sigma_i P_i^{\*} + \epsilon \]

where \( S_{ij}^* \) is ln \( S_{ij} \), \( A_{ij}^{\*} \) is ln \( A_{ij} \), \( \beta_i \) is \( \sigma_i \beta_i \), \( c_{ij}^{\*} \) is ln \( c_{ij} \), and \( P_i^{\*} \) is ln \( \left( \frac{P_i}{P_i} \right) \).

4. Data and Study Countries

The analysis requires time series data on quantity and value of wheat from various sources shipped into an importing country and the value of exporter credit guarantees. Wheat export quantity and values were obtained from the World Grain Statistics, USDA Wheat Yearbooks, and USDA, FAS, BICO reports. Information on the value of credit guarantees (i.e., guaranteed loan value) were obtained from USDA/FAS publications. The analysis was conducted for 1981 through 1997. The US market shares of in each importing country were developed using the total import value and the value of imports from the United States using data from the World Grain Statistics. These were updated using the information from Wheat Yearbooks, PS & D View, and the USDA, FAS, BICO reports. Information on value of wheat exports covered under the Credit Guarantee Programs were obtained from the Notice to Recipients (for various years) that contained the summary of export values and quantities for GSM-102 and GSM-103.

Wheat accounts for the largest share in total guarantee sales (30 percent). Wheat sales worth approximately $15 billion have been guaranteed since the beginning of the GSM-102 program. In fact, wheat has dictated the trend in sales of bulk commodities under credit guarantees. Major importers of wheat under credit guarantee are Korea, Brazil, Mexico, Morocco, Algeria, Tunisia, and Egypt. Russia, the Soviet Union, and Pakistan have also used the program sporadically to buy large quantities of wheat.

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4These concepts are developed by Johnson (1995). Basically, credit guarantees allow U.S. banks to expand their lending to targeted countries without increasing their risk exposure.
Algeria, Brazil, Korea, Mexico, Morocco, and Tunisia were selected for the analysis. These six countries have consistently received export credit guarantees from the United States, and typically accounted for 30 to 65 percent of guaranteed wheat sales during the period under study. Table 1 presents wheat exports from the U.S. under GSM credit guarantee programs for fiscal years 1981 through 1996.

Table 1. U.S. Export/Intermediate Export Credit Guarantee Wheat Sales ($ Millions)

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Algeria</th>
<th>Brazil</th>
<th>Korea</th>
<th>Mexico</th>
<th>Morocco</th>
<th>Tunisia</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>80/81</td>
<td>0</td>
<td>195.24</td>
<td>0</td>
<td>0</td>
<td>51.25</td>
<td>0</td>
<td>471.98</td>
</tr>
<tr>
<td>81/82</td>
<td>0</td>
<td>283.24</td>
<td>126.44</td>
<td>0</td>
<td>76.36</td>
<td>0</td>
<td>611.46</td>
</tr>
<tr>
<td>82/83</td>
<td>0</td>
<td>310.79</td>
<td>125.20</td>
<td>0</td>
<td>19.34</td>
<td>0</td>
<td>950.77</td>
</tr>
<tr>
<td>83/84</td>
<td>0</td>
<td>284.67</td>
<td>127.21</td>
<td>0</td>
<td>19.13</td>
<td>0</td>
<td>1184.27</td>
</tr>
<tr>
<td>84/85</td>
<td>0</td>
<td>443.44</td>
<td>106.96</td>
<td>0</td>
<td>67.87</td>
<td>0</td>
<td>1146.80</td>
</tr>
<tr>
<td>85/86</td>
<td>44.57</td>
<td>52.30</td>
<td>153.98</td>
<td>0</td>
<td>99.48</td>
<td>6.44</td>
<td>878.12</td>
</tr>
<tr>
<td>86/87</td>
<td>112.62</td>
<td>34.80</td>
<td>152.97</td>
<td>1.34</td>
<td>32.29</td>
<td>38.06</td>
<td>616.34</td>
</tr>
<tr>
<td>87/88</td>
<td>175.60</td>
<td>5.71</td>
<td>162.40</td>
<td>90.47</td>
<td>0</td>
<td>29.07</td>
<td>840.75</td>
</tr>
<tr>
<td>88/89</td>
<td>219.64</td>
<td>16.89</td>
<td>168.69</td>
<td>76.40</td>
<td>0</td>
<td>0</td>
<td>1268.09</td>
</tr>
<tr>
<td>89/90</td>
<td>131.34</td>
<td>5.63</td>
<td>161.32</td>
<td>46.58</td>
<td>0</td>
<td>0</td>
<td>962.87</td>
</tr>
<tr>
<td>90/91</td>
<td>167.87</td>
<td>0</td>
<td>148.65</td>
<td>33.04</td>
<td>0</td>
<td>0</td>
<td>805.02</td>
</tr>
<tr>
<td>91/92</td>
<td>166.24</td>
<td>0</td>
<td>150.51</td>
<td>46.53</td>
<td>0</td>
<td>0</td>
<td>1733.26</td>
</tr>
<tr>
<td>92/93</td>
<td>131.35</td>
<td>0</td>
<td>168.57</td>
<td>98.86</td>
<td>0</td>
<td>0</td>
<td>936.08</td>
</tr>
<tr>
<td>93/94</td>
<td>133.94</td>
<td>0</td>
<td>154.56</td>
<td>88.15</td>
<td>0</td>
<td>0</td>
<td>635.45</td>
</tr>
<tr>
<td>94/95</td>
<td>4.77</td>
<td>10.13</td>
<td>99.18</td>
<td>101.27</td>
<td>0</td>
<td>16.31</td>
<td>592.59</td>
</tr>
<tr>
<td>95/96</td>
<td>103.51</td>
<td>54.74</td>
<td>4.40</td>
<td>140.89</td>
<td>0</td>
<td>33.51</td>
<td>1042.20</td>
</tr>
<tr>
<td>96/97</td>
<td>10.10</td>
<td>0</td>
<td>0</td>
<td>101.30</td>
<td>0</td>
<td>0</td>
<td>459.14</td>
</tr>
</tbody>
</table>

5. Results

This section presents results of the import demand estimation for six wheat importing countries. Using these estimates, the allocation of credit guarantees is addressed within an optimization framework.

Credit Guarantees and Market Shares in Select Import Markets
Table 2 presents results of the Armington demand equation estimation for six countries. Sample size, $R^2$ and $\text{Adj } R^2$, adjusted for degrees of freedom are shown, along with parameter estimates and their $t$-values. The credit guarantee variable (GSM program sales in million dollars) has positive effects on U.S. market share in every instance, although the magnitude of response varies from a low of 0.013 for Korea to a high of 0.313 for Brazil. Diersen et. al., and Koo and Karamera also report differences in importer responses to credit guarantees. Except for Korea, all countries in Table 2 show a significant response to credit guarantees at conventional levels of significance.$^5$

Table 2. Econometric Estimates of Armington Import Share Equations

<table>
<thead>
<tr>
<th>Country</th>
<th>Intercept</th>
<th>USGSM</th>
<th>Rel. Price</th>
<th>$R^2$</th>
<th>Adj $R^2$</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algeria</td>
<td>-1.321</td>
<td>0.088</td>
<td>-0.187</td>
<td>0.63</td>
<td>0.58</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>(-2.51)</td>
<td>(2.46)</td>
<td>(-0.25)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td>-3.1166</td>
<td>0.313</td>
<td>-3.05</td>
<td>0.45</td>
<td>0.37</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>(-5.95)</td>
<td>(3.29)</td>
<td>(-0.82)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Korea</td>
<td>-0.42</td>
<td>0.013</td>
<td>-1.23</td>
<td>0.65</td>
<td>0.61</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>(-2.75)</td>
<td>(0.59)</td>
<td>(-3.18)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mexico</td>
<td>-1.1026</td>
<td>0.1486</td>
<td>-4.5796</td>
<td>0.67</td>
<td>0.63</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>(-3.27)</td>
<td>(2.18)</td>
<td>(-3.28)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morocco</td>
<td>-1.4</td>
<td>0.073</td>
<td>-0.6</td>
<td>0.47</td>
<td>0.39</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>(-2.27)</td>
<td>(1.73)</td>
<td>(-0.34)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tunisia</td>
<td>-1.04</td>
<td>0.083</td>
<td>-0.89</td>
<td>0.42</td>
<td>0.34</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>(-1.65)</td>
<td>(2.71)</td>
<td>(-0.83)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Numbers in parentheses are the $t$-values.

* These models are corrected for first order autocorrelated errors.

Figure 1 illustrates the sensitivity of the U.S. share to increasing credit guarantee levels for the six countries. The diagram plots the U.S. share on the vertical axis and the guarantee amount (GSM sales) along the horizontal axis. For each importer, the U.S. share is obtained by evaluating the estimated Armington demand equation at average relative prices while varying the level of credit guarantees. The levels of credit guarantees to individual countries are not allowed to exceed historical maximums. (In the figure, points furthest to the right correspond to maximum GSM sales for the indicated country.) For example, GSM wheat sales to Brazil have not exceeded $500 million in any year, while those to Korea have not exceeded $200 million.

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$^5$The log-linear relationship between credit guarantees and market shares is imposed by the underlying Armington preference assumptions. This procedure for obtaining credit guarantee response parameters from explicitly derived demand equations is a departure from past studies which used ad hoc import demand equations to compute additionality. Although not pursued here, comparisons could be made with parameter estimates under alternative preference structures, such as AIDS, Rotterdam, or CBS.
Figure 1. GSM Credit Sales and U.S. Share in Six Wheat Import Markets
The marginal impact of credit guarantees on the U.S. market share can be gauged by the slope of the line for each importer (Figure 1). The marginal impact is highest (has steepest slope) at low levels of GSM sales and declines as the value of GSM sales increases. Evidently, the marginal impacts vary across importers; Tunisia, Brazil, and Mexico show much greater sensitivity to credit guarantees than Korea, where the U.S. share ranges between 60 and 65 percent.

If the CCC were to provide credit guarantees above the historical maximum for each country, there would be little perceptible gain in Korea or Brazil. Based on Figure 1, Mexico and Tunisia appear to hold more promise for expanding the U.S. market share.

In general, these results support a strategy of providing smaller amounts of credit guarantees to a large number of importing countries, rather than providing large amounts of guarantees to fewer countries. This accords with early trends in GSM country allocations. When the program began in FY 1981, only nine countries bought U.S. wheat under credit guarantees. This number increased to 22 by FY 1989 and has since fluctuated from year to year. Over 50 countries have used GSM programs for wheat imports at least once since inception of the program.

The relative price parameter is negative in every model, although four of six estimates are non-significant. Relative price parameters for Korea and Mexico are significant at conventional risk levels. The negative parameters show that as relative price increases, the U.S. share of wheat imports in a given country decreases.

The estimates of $R^2$ adjusted for degrees of freedom indicate reasonable explanatory power for the models. This summary statistic ranges from a low of 0.34 for Tunisia to a high of 0.63 for Mexico. Low R-squared values in some of the equations indicate missing explanatory variables. Among these are the value of credit offerings by competing exporters, for which reliable data are not available. Omission of these competing programs may cause the estimated response parameters for GSM sales to be somewhat overstated.

Optimal Allocations of Credit Guarantees

In this section, we use the empirical model to identify optimal allocations of credit guarantees across importing countries. The objective is to maximize U.S. export sale revenue, subject to estimated demand relationships and a predetermined budget for credit guarantees. Export prices are taken as given, as are the importers’ total expenditures on wheat from non-U.S. sources. In this setting, the CCC influences buyers (and U.S. trade volumes) through a non-price incentive, the credit guarantee; however, it does not exert market power in the standard sense.

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6Export price subsidies are reflected in the price variable. Thus, effects of EEP and EU export restitutions, by importer, are captured in the analysis.
Credit guarantees must be allocated among six importers in each fiscal year. For each year, the available budget is the sum of actual program sales for the six countries. (This has varied substantially through time.) Optimal credit guarantee sales, for each year, are derived as the solution to a set of seven first order conditions. Numerical solutions were obtained from the non-linear simultaneous equation solver in version 7 of SHAZAM (1996). Details of the framework and first order conditions are presented in the Appendix.

Figure 2 compares the actual and optimal guaranteed sales for the six countries between FY 1981 and FY 1997. In most periods, the geographic distribution of GSM sales was substantially different than would be predicted by the optimization model. In the early 1980s, the model suggests that Algeria and Tunisia should have been targeted for larger GSM sales, while Korea and Brazil should have received smaller amounts. Between FY 1987 and FY 1993, actual GSM sales to Korea and Morocco were higher than optimal, while those to Algeria, Brazil, and Tunisia were lower than optimal. Since FY 1995, Mexico has received much larger GSM allocations than would be justified by the export revenue criterion.\(^7\)

Figure 3 compares actual export revenue to the value that would have been observed if credit had been allocated optimally. Optimal revenue is significantly higher than the actual revenue in the initial years of the program and again in FY 1997 when the difference amounts to over $200 million. Averaged over the study period, the potential increase in export revenue amounts to about $120 million annually.

**Summary and Conclusions**

Export credit guarantees are beneficial in expanding and sustaining foreign markets, particularly those that have short-run foreign exchange problems. This study provides empirical estimates of the effects of credit guarantees on U.S. wheat exports to major recipient countries. Further, it examines the potential gains from optimal targeting of credit guarantees across importing countries.

An Armington demand specification, with U.S. share as the dependent variable, is extended to include the value of credit guarantees as an additional explanatory variable. The model is estimated separately for six import markets: Algeria, Brazil, Korea, Mexico, Morocco, and Tunisia. Historical data on U.S. shares, credit guarantees, and relative wheat import prices for 17 years since the inception of GSM programs are used in the analysis.

Regression results indicate that export credit guarantees raise the U.S. share in all six import markets. The marginal effect is highest for Brazil and lowest for Korea. Mexico and Tunisia appear to hold some promise for expanding the U.S. market share, given their high

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\(^7\)Recent GSM allocations for Mexico are probably best explained as a component of US financial support in wake of the peso crisis.
Figure 2. Actual and Optimal Credit Guarantees to Selected Importing Countries
Figure 3. Actual and Optimal Revenue from U.S. Wheat Sales to Selected Countries
marginal response to credit guarantees and the small allocations they have received (relative to market potential) in past years.

The allocation of credit guarantees is also addressed within an optimization framework. Given Armington demand estimates for six import markets, the CCC is hypothesized to allocate its funds for credit guarantees to maximize U.S. export revenue. In each market, expenditures on wheat from non-U.S. sources and relative prices are taken as exogenous. The sum of guaranteed sales to six markets is constrained to be less than the actual total for each fiscal year. Seven first order conditions are derived and solved, yielding optimal guaranteed credit allocations.

Optimal GSM sales are compared to actual GSM sales across markets and through time. The distribution of optimal sales varied substantially during the study period, but seldom matched the pattern of actual sales. With credit allocations at optimal levels, export revenue from sales to the six markets would have been higher by over $200 million in FY 1997 and by about $120 million on average for the study period.
References


Appendix

Let $Q_{Q_{oi1}}^{US}$ and $Q_{Q_{gi1}}^{US}$ be US cash and credit guarantee wheat sales to importing country I such that $Q_{Q_{oi1}}^{US} + Q_{Q_{gi1}}^{US} = Q_{Q_{i1}}^{US}$. Also, the import demand function for the wheat imported from US be:

$$Q_{Q_{i1}}^{US} = f \left( \frac{P_{i1}^{US}}{P_{i1}}, c_{i1} \right)$$

Here, $P_{i1}^{US}$ is the landed price of US wheat in the importing country, $P_{i1}$ an index of wheat prices from different sources imported into country I, and $c_{i1}$ is the credit guarantee amount, where it equals $P_{i1}^{US} \times Q_{Q_{gi1}}^{US}$. The problem of allocating a given amount $C$ of guarantees to $N$ importers with an objective to maximize sales revenue, the corresponding lagrangean function and first order conditions may be written as:

$$\max \ R = \sum_{i=1}^{N} R_{i1} \ s. \ t. \ C = \sum_{i=1}^{N} c_{i1}$$

$$\frac{\partial Q_{Q_{i1}}^{L}}{\partial c_{i1}} = \sum_{i=1}^{N} R_{i1} + \lambda \left[ C - \sum_{i=1}^{N} c_{i1} \right]$$

$$\frac{\partial Q_{Q_{i1}}^{L}}{\partial \lambda} = C - \sum_{i=1}^{N} c_{i1} = 0;$$

The first order conditions of the lagrangean corresponding to $c_{i1}$ with constrained revenue functions based on the Armington framework with CES functional form may be written as:

$$\beta_{i1} \sigma_{i1} \sum_{k=1}^{M} P_{i1}^{k} Q_{k1}^{L} \left[ A_{i1} c_{i1} \right]^{\beta_{i1} \sigma_{i1}} \left( \frac{P_{i1}^{US}}{P_{i1}} \right)^{-\sigma_{i1}} - \lambda \left[ 1 - \left( A_{i1} c_{i1} \right)^{\beta_{i1} \sigma_{i1}} \left( \frac{P_{i1}^{US}}{P_{i1}} \right)^{-\sigma_{i1}} \right] = 0;$$
There will be N of these equations and one guarantee constraint equation which may be simultaneously solved to obtain revenue maximizing guarantee sale levels among N importing countries.