

April 25, 2000

Revenue Impacts of MPP Branded Funds: A Firm Level Analysis

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**Paper to be presented at the Annual Meeting of the
American Agricultural Economics Association
Tampa, FL
July 30-Aug. 2, 2000**

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Acknowledgments

We thank, without implicating, Ju-Chin Huang for helpful comments on this manuscript. We also thank participants at the NEC-63 Spring 2000 meeting held in Denver, CO. This study was funded in part by The University of Tennessee Agricultural Experiment Station and the USDA National Research Initiative Program. The views expressed here do not necessarily reflect those of the funding institutions.

Abstract

The USDA recently redirected the Market Access Program (MAP) to allocate all branded products export promotion funds to small firms and cooperatives. The redirection was, in part, a response to reports by the General Accounting Office that were critical of past allocations of export promotion funds to large, experienced exporters. This study uses a firm level analysis to examine firms' effectiveness in using Market Promotion Program (MPP, which is now the MAP) funds to increase revenues. Whereas point estimates suggested that smaller firms were more effective in translating MPP funds into increased revenue than larger firms, these point estimates for small firms were statistically indistinguishable from zero. In contrast, large firms showed an increase in revenue of greater than one dollar for every dollar of MPP funds. Further, the revenue increase was statistically significant. Thus, the firm level analysis supports neither the GAO hypotheses nor the recent program changes.

Keywords: export promotion programs, export sales, export revenues, Market Promotion Program, firm-level analysis, joint estimation

Revenue Impacts of MPP Branded Funds: A Firm Level Analysis

One of the most visible export promotion programs for the USDA is the Market Access Program (MAP), formerly known as the Market Promotion Program (MPP). The MAP uses funds from the Commodity Credit Corporation to assist U.S. firms by cost sharing promotional activities abroad for U.S. agricultural products (USDA/FAS). An overall objective of the MPP/MAP program is to increase the value of exports. The MAP is also designed to give special priority to firms that face undue trade barriers for their products or face buyer awareness problems that may necessitate more intense promotional efforts.

Throughout the 1990's the Government Accounting Office (GAO) offered a number of criticisms of the MPP/MAP (GAO 1993a, 1993b, 1995, 1997, 1998,1999), but this paper focuses on only two. The first criticism is that the funds have not been targeted at firms most in need of export assistance. Because small and/or "new-to-export" firms may have more difficulty accessing international markets than larger or more export experienced firms, the argument has been made that smaller and less export experienced firms should receive the greatest share of the MPP/MAP funds. Closely related to this "equity" argument is an "efficiency" argument. GAO has contended that funds allocated to small firms and/or "new-to-export" firms would result in greater export sales per dollar funding than would allocations to larger, more experienced firms.

In recent years Congress has passed legislation designed to address these criticisms. Beginning with the Omnibus Budget Reconciliation Act of 1993, greater priority has been placed on providing MPP/MAP funds to small firms facing exporting problems.¹ In 1998, Agriculture

1. Most of this legislation is found in the Omnibus Budget and Reconciliation Act of 1993, the FAIR Act, the Agricultural, Rural Development, Food and Drug Administration, and related Agencies Appropriation Act of 1996, and the Government Performance and Results Act of 1993.

Secretary Dan Glickman announced that *all* MAP funds for export promotion of branded products would be allocated to cooperatives and small domestic companies (USDA, 1998). The MAP is now exclusively targeted at small firms (fewer than 500 employees), firms relatively new-to-exporting, and firms facing consumer awareness and import restriction problems in foreign markets. These decisions have been made in the absence of strong empirical evidence that smaller, less export experienced firms are more effective than larger, more experienced firms in converting MPP/MAP funds into export sales. While several studies have considered the aggregate effectiveness of the Market Promotion Program, none have addressed the GAO criticisms that deal with differences in how effectively MPP/MAP funds are converted to revenues at the firm level. These criticisms can not be answered with an aggregate market analysis.

This study reports the first firm level analysis of the impacts of MPP/MAP branded funds on firm sales. Marginal revenue and average revenue measures are constructed, with point estimates and 95% confidence intervals (CI) reported for the full sample and for firms of different size. This study also makes a methodological contribution by developing an econometric model that integrates and jointly estimates *direct* and *indirect* methods to estimate the revenues added by MPP/MAP funds. Using data collected by both methods in the same econometric model results in more efficient parameter estimates. The modeling procedure should prove useful when designing similar surveys and analyzing the responses.

Previous Studies of Export Promotion

Several studies have examined the returns from export promotion to the promoting industries at an aggregate market level. Studies by Halliburton and Henneberry and by Kinnucan and Christian examined the effectiveness of export promotion in the market for almonds in Japan,

South Korea, Taiwan, Hong Kong, and Singapore. A portion of the export promotion funds were funded through the Market Promotion Program (branded and generic). These studies examined aggregate returns to promotion using market level elasticity estimates of export and domestic promotion, export and domestic demand, and domestic supply. Halliburton and Henneberry's study showed mixed results regarding promotion effectiveness across the countries studied. Whereas Kinnucan and Christian's results showed positive returns on export promotion, these authors noted problems associated with stability of the promotion elasticity estimates and factors affecting profitability. Halliburton and Henneberry's estimates of returns per promotion dollar ranged from \$3.69 to \$5.94 for Hong Kong, Japan, and Taiwan. However, no significant returns were found for Singapore or South Korea. Kinnucan and Christian's surplus estimates of returns per promotion dollar ranged from \$9.80 to \$16.30. However, a comparison with returns to domestic promotion by Kinnucan and Christian suggested that higher sales returns to the industry could have been achieved if more had been allocated to domestic promotion, rather than export promotion. A study of generic promotion of walnuts to Japan by Weiss, Green, and Havenner also found positive returns found returns of \$5.85 per promotion dollar through the Market Promotion Program.

Richards, Van Ispelen and Kagan examined the effectiveness of apple export promotion in the United Kingdom and Singapore. As with the previously cited studies, they examined market level impacts. In particular, they sought to answer the question of whether MPP funds provided an "international public good" through spillover benefits accrued by non-U.S. sources of apples in markets where U.S. apples were promoted. Hence, they examined how promotion funds impacted total apple consumption and U.S. import shares in the two importing markets. The results from their study showed that export promotion did increase apple consumption in

both importing markets, but increased U.S. share only in the United Kingdom, suggesting a "free rider" problem in the Singapore market, *i.e.*, spillover benefits accrued to non-U.S. apple suppliers. Richards and Patterson examined the impacts of MAP funds on export supply of apples, almonds, grapes, and wine. The results from their study showed that investment in establishing and maintaining a product's image has spillover effects on other promoted products.

Each of the studies provides important information regarding the aggregate market impacts by examining industry returns and spillover effects from export promotion. While each study cites criticism of the MPP/MAP on the bases of export sales effects and issues associated with firm size and export experience, market level data allows researchers to evaluate the MPP/MAP program only in the aggregate. As indicated in the introduction, however, many of the policy changes in the MPP/MAP focused on exploiting a perceived difference in the ability of firms with different characteristics (*i.e.*, size and export experience) to increase export sales. Firm level data are needed to answer these questions.

Survey Design and Data

Participants in the 1994 MPP program were surveyed for this study. This year was selected because GAO's criticisms of the program funds allocation were presented in 1993 and the Budget Reconciliation Act and related legislation were passed in 1993. Foreign Agriculture Service records were used to compile a mailing list of the population of 764 U.S. firms that participated in the 1994 program year MPP (branded portion). During the year in which this study was conducted the export promotion program was still called the MPP, so henceforth we refer to the MPP exclusively.

To obtain estimates of the impact of MPP funding on export sales, two approaches were considered and implemented in the survey design. The *indirect* approach was to ask several

questions that would provide the information needed to estimate the impact of firm level MPP funding on firm level export sales through regression analysis. The dependent variable in the regression would be export sales. Because another aspect of the study required total sales, export sales were obtained by asking firms what percent of total sales in 1994 were from exports. To obtain the amount of total sales, firms were asked the interval into which their total sales fell in 1994 (*e.g.*, between \$0 and \$100,000, between \$100,000 and \$249,000, etc.). The total sales question was expressed as an interval question because of the proprietary nature of sales figures for many firms. The actual level of MPP funds received by each firm was available from FAS records. Based on the new legislation, the important firm characteristics were firm size, as measured by the number of employees, and export experience, as measured by number of years exporting.

In addition to the indirect approach just described, another method to evaluate the impact of MPP funding on export sales was simply to ask respondents a *direct* question. The question was, “In 1994, the value of my firm’s export sales WITHOUT MPP funds would have been Less by _____ percent, About the Same, Greater by _____ percent, or Zero (No export sales)”. The information yielded by the two different approaches can be linked mathematically, as will be shown below.

With the exception of a pretest group of 25 firms, the survey was mailed to all 764 firms participating in the branded MPP program in 1994. Approximately one week after the initial mailing a follow up postcard was sent to non-respondents and about two weeks later, a second mailing was sent to non-respondents. In conjunction with the second mailing, reminder phone calls were placed to non-respondents. Of the firms surveyed, 150 provided usable responses to all survey questions needed for this analysis.

Variable definitions and summary measures for the sample are shown in Table 1.²

Fifteen percent of the firms had total sales (*TS*) of less than \$1 million, 38% between \$1 million and \$10 million, and the remainder greater than \$10 million. Approximately 33% of total sales were earned from exports (*e*), with firms receiving an average of almost \$43,000 in MPP funds. Had firms not received MPP funds, respondents estimated that export sales would have fallen by almost 12% (*k*). On average, firms had been in business for over 30 years (*Years in Business*). Firms employed an average of about 340 people (*Employees*), with just under 85% having fewer than 500 employees (*Small Firm*). About 43% of firms had exported for five or fewer years (*New to Export*).

Statistical Model

The indirect and direct approaches described in the previous section could be used to calculate two separate estimates of the impact of MPP funds on revenues. However, these two approaches can be linked together in one model to obtain a single, more efficient estimate. The general idea is that one model measures the level of a variable and the other model measures the change in that variable due to some other variable. Consequently, the models can be estimated simultaneously. The approach is similar in spirit to estimating a cost function and factor demand functions simultaneously, where the first derivative or change of the cost function yields the factor demands via Shephard's lemma. Similarly, joint estimation of two different models is increasingly common in the environmental economics literature, where the theoretical links underlying direct and indirect valuation methods are exploited in the estimation process (see, for example, Huang, *et al*).

2. Data reported in Table 1 are measured in units scaled for use in the maximum likelihood estimation. The units used in the survey (e.g., dollars rather than \$10,000) were more straightforward for respondents.

Let TS represent a firm's total sales, X be a vector of factors influencing total sales, and Z be a vector of all MPP variables (*e.g.*, linear, quadratic, or interaction variables) that influence total sales. Because total sales information was collected as interval data variable, the model for total sales would be

$$(1) \quad TS(MPP) = X\beta + Z\gamma + \sigma\lambda(MPP)$$

where β and γ are estimated coefficients, σ is the estimated standard deviation, and λ is an adjustment factor (similar to an inverse Mill's ratio) accounting for upper and lower censoring inherent in the interval data (See Greene or Stewart).³ The variable λ is a function of all variables and estimated coefficients, but the above notation makes explicit its functional dependence on the MPP allocation. The *marginal* impact of MPP can be estimated by taking the derivative of this function with respect to Z , including the λ term.

The goal is to connect this model to the proportional change in firm level export sales due to loss of MPP funds (k). First, note that total sales without MPP can be written as $TS(No\ MPP) = X\beta + \sigma\lambda(No\ MPP)$. The *total* impact of MPP can then be derived from an interval data model of equation (1) using the relation,

$$(2) \quad \Delta TS = TS(MPP) - TS(No\ MPP),$$

where the censoring adjustment $\lambda(\cdot)$ in the “No MPP” case is evaluated with $Z = 0$. By definition total sales is equal to domestic sales plus export sales (*i.e.*, $TS = DS + ES$). By law, MPP funds

3. For the interval data model the inverse Mill's type correction factor takes the form,

$$\left[\phi\left(\frac{L - X\beta - Z\gamma}{\sigma}\right) - \phi\left(\frac{U - X\beta - Z\gamma}{\sigma}\right) \right] \div \left[\Phi\left(\frac{U - X\beta - Z\gamma}{\sigma}\right) - \Phi\left(\frac{L - X\beta - Z\gamma}{\sigma}\right) \right]$$

where U and L represent the upper and lower truncation limits, respectively, and ϕ and Φ are the normal density and distribution functions, respectively.

cannot be used on domestic sales, so that, if there are no production constraints relating domestic and export sales,

$$(3) \quad \Delta TS = TS(MPP) - TS(No MPP) \\ = [ES(MPP) + DS] - [ES(No MPP) + DS] = ES(MPP) - ES(No MPP).$$

Also, by definition, export sales are equal to the proportion of total sales from exports (e) times total sales, or $ES(MPP) = e \cdot TS(MPP)$.

Another equation relating firm level export sales with and without MPP funds can be obtained by noting the respondents' subjective evaluation of the proportional change in export sales due to the MPP, k , is by definition

$$(4) \quad k = [ES(No MPP) - ES(MPP)] \div ES(MPP).$$

Substituting (3) into (4) then yields $k = -\Delta TS \div [e \cdot TS(MPP)]$, or in terms of equations (1) and (2),

$$(5) \quad k = -\{Z\gamma + \sigma[\lambda(No MPP) - \lambda(MPP)]\} \div e[X\beta + Z\gamma + \lambda(MPP)].$$

By exploiting the internal consistency requirements implied by equations (1) and (5), the most efficient model to estimate is a full information maximum likelihood (FIML) model for equations (1) and (5). However, the likelihood function must adjust for complications due to (a), the doubly censored nature of the total firm sales (TS) data and (b), firms' sales (TS) and the proportional change in sales due to MPP (k) may be distributed according to a bivariate distribution, with correlation between TS and k .

Let the bivariate density of TS and k be represented by $\phi_2(TS, k)$, where the scale and correlation parameters are temporarily suppressed. The bivariate density can be re-written in terms of its univariate marginal and conditional densities, $\phi_2(TS, k) = \phi(k) \times \phi(TS | k)$ (Tsokos).

Introducing the scale and correlation parameters, σ_{TS}^2 , σ_k^2 , and ρ , which denote the variances of

TS , k , and the correlation between the two, respectively, then the marginal and conditional densities are given by (6) and (7),

$$(6) \quad \phi(k) = \frac{1}{\sqrt{2\pi\sigma_k^2}} \exp\left[-\frac{1}{2}\left(\frac{k - f(X\beta, Z\gamma)}{\sigma_k}\right)^2\right]$$

$$(7) \quad \phi(TS | k) = \frac{1}{\sqrt{2\pi\sigma_{TS}^2(1-\rho^2)}} \exp\left[-\frac{1}{2}\left\{\left(\frac{TS - X\beta - Z\gamma}{\sigma_{TS}}\right)\frac{1}{\sqrt{1-\rho^2}} - \rho\sigma_{TS}\frac{\left(\frac{k - f(X\beta, Z\gamma)}{\sigma_k}\right)}{\sqrt{\sigma_{TS}^2(1-\rho^2)}}\right\}^2\right]$$

where $f(X\beta, Z\gamma)$ is the right hand side of (5).

The variable TS was collected as interval data, and the upper (U) and lower (L) limits are known. Integrating the conditional density function (7) from $-\infty$ to U gives the conditional probability of being below the upper limit, $\Phi(TS < U | k)$, and integrating from $-\infty$ to L gives the conditional probability of being below the lower limit, $\Phi(TS < L | k)$. The difference between the two gives the probability of being between the two limits, conditional on the value of k , $\Phi(L < TS < U | k) = \Phi(TS < U | k) - \Phi(TS < L | k)$. The likelihood function for the model then becomes, $L = \prod_i \phi_i(k) \times \Phi_i(L < TS < U | k)$, where i denotes the firm. Note that the likelihood function naturally imposes parameter restrictions on β , γ , the scale parameters and the correlation such that the total impact of MPP, as implied by k , and the marginal impact of MPP, as implied by the derivative of TS with respect to Z , are internally consistent.⁴

4. This likelihood function is very similar to that presented in Maddala (pp 266-7). The only difference is that Maddala's first term adjusts for truncation, a problem not found in our data. It is also similar to the generalized Tobit models discussed in Amemiya.

Empirical Results

Specification Issues. The goal of the empirical model is to estimate the impact that MPP funding has on firm sales but, as is the rule rather than the exception, the exact specification is unknown. With respect to explanatory variables, the controversy surrounding the MPP program suggested that important variables would be a direct measure of the MPP funds received by the firm, firm size and “newness-to-exporting”. The level of MPP funding was clearly part of the **Z** vector, as were variables that interact MPP funds with the firm size and “newness to export” variables. The interaction terms allow the model to disentangle the effects of MPP funding by key firm characteristics. Empirically, firm size was measured two ways: with a dummy variable and by directly including the number of employees. The dummy variable represents the size cutoff for Small Business Assistance for most firms in the industry. Another factor expected to influence firm sales was business experience, so a measure of experience was also included. Business experience, firm size and newness to export were hypothesized to influence firm sales regardless of the level of MPP funding (these variables formed the core of the **X** vector).

With respect to functional form issues, models that were both linear and non-linear in variables were estimated. Non-linearity of a quadratic form was introduced by using the square root of the continuous right-hand-side variables. The four different models reported in Table 2 and Table 3 differed with respect to explanatory variables and functional form. The final three models (Models #2 through #4) were nested versions of the specification reported in the first column.

Grouped Data Model Results. Simple grouped data models corresponding to equation (1) were estimated first. These models represent a simple interval data regression of the MPP funds (and other variables) against the total sales interval reported by survey respondents, ignoring the

additional information provided by respondent's subjective evaluation of how the MPP allocation influenced a firm's sales. In all models the \mathbf{Z} vector was composed of *MPP Funds*, the square root of *MPP Funds*, and the interactions between the funding level and a firm size dummy variable, and the funding level and *New to Export*.

In Model #1, *Small Firm* and *New to Export* were in the \mathbf{X} vector, along with linear and square root terms for *Years in Business* and *Employees*. All \mathbf{X} vector variables were statistically significant except the non-linear term for business experience and the dummy variable *New to Export*. The \mathbf{Z} vector was composed of linear and square root terms for *MPP Funds*, and two terms that interact *MPP Funds* with *Small Firm* and *New to Export*. Two of these terms were statistically significant: *MPP Funds* and the interaction between *MPP Funds* and *Small Firm*.

The second specification kept the \mathbf{X} vector in its most simple form: a linear term for years in business and dummy variables for firm size (*Small Firm*) and exporting experience of 5 years or less (*New to Export*). Several variables were significant in Model #2: *Years in Business*, *Small Firm*, *MPP Funds* and the interaction term between *MPP Funds* and *Small Firm* were all significant at conventional levels (P-values of less than 0.10). The estimate of the standard deviation of firm sales, the " σ " coefficient in equation (1), was also significant.

Model #3 replaced the dummy variable *Small Firm* in the \mathbf{X} vector with a continuous measure of firm size (the number of employees divided by 100). Both linear and quadratic terms for employment were used, each of which was statistically significant in explaining firm sales. *Years in Business* and the interaction between *MPP Funds* and *Small Firm* were also significant. Model #4 introduced non-linearity in *Years in Business*, with the remainder of the specification identical to Model #3. The new non-linear term was insignificant, and had little effect on the

coefficients and standard errors of the remaining variables with the exception of the linear term for *Years in Business*.

The grouped data models are encouraging from the perspective of explaining the impact of *MPP Funds* on firm sales. In all models the interaction term between the MPP funding level and firm size was statistically significant, whereas the linear term for *MPP Funds* was significant in two specifications. These empirical models, however, did not take advantage of the additional information provided by survey respondents: a subjective evaluation of the impact of MPP funding on firm sales. An empirical estimation procedure that uses both types of information may have two differences in comparison to the models reported in Table 2. First, the coefficient estimates may change in magnitude and/or sign, especially if respondents' subjective evaluations reflect firm level influences that could not be included in the **X** and **Y** vectors. Second, a full information approach should be more statistically efficient, so that smaller standard errors should be observed.

*Bivariate Model Results.*⁵ The bivariate approach was applied to the same specifications used for the grouped data models (Table 3). In comparison to the grouped data results, the two expected effects of the additional information were observed. First, the magnitudes of the coefficients did indeed change. For example, the coefficient on the interaction between *MPP Funds* and *Small Firm* in the **Y** vector changed from roughly 620 to 90 in Model #1, a factor of about seven. Even larger changes can be seen (*e.g.*, *MPP Funds* in Model #2, or *Square Root Employees* in Models #3 and #4). A few changes in coefficient sign were also observed, but in all cases these variables were not significantly different from zero under both estimation methods

5 Due to scaling problems in the maximum likelihood estimation, the empirical version of the bivariate model used $k \times e \times TS$ as the dependent variable rather than k . This transformation can be achieved by multiplying both sides of equation (5) by the denominator on the right hand side.

(e.g. *New to Export* in Model #1, *Square Root MPP Funds* in Model #1). Second, the additional information used in the bivariate model did result in more efficient parameter estimates. The standard errors were smaller for all coefficients for all models.

The additional information used by the bivariate model provided a more “stable” story regarding the relationship between *MPP Funds* and firm sales. In general, the key variables that were statistically significant in one specification were significant in all specifications. The linear term for *MPP Funds* was negative and significant in all models, whereas the interaction term between *MPP Funds* and *Small Firm* was positive and significant in all models. The interaction between *MPP Funds* and *New to Export* was never significant. In the \mathbf{X} vector, both the linear and quadratic terms for the number of employees were statistically significant in all the models in which these terms appeared. *Years in Business* was significant in the second two models, but not in the first and last, perhaps because these models also included a quadratic term for *Years in Business*.

The bivariate modeling strategy also provided parameter estimates for the standard deviation of the interval data [*Sigma (Total Sales)*] and the standard deviation of the model of respondents’ subjective evaluations [*Sigma($k \times e \times Total Sales$)*]. In all models these parameter estimates were positive (as required by statistical theory) and significant. The correlation parameter, *Rho*, was also estimated. The estimate for *Rho* did fall in the $\{-1, 1\}$ interval as required by statistical theory, but was significant in only one model (model #3). In models #1 and #4, however, the estimated correlation coefficient had P-values of less than 0.15.

Marginal and Average Revenue Analysis. The discussion of the previous section carefully avoided using the signs of each coefficient to predict what would happen to firm sales as that variable changes (i.e., we did not state that firms sales were negatively related to *MPP Funds*,

only that the sign was negative). This was because one cannot make such a simple statement when interval data are used (see Greene for a discussion). Instead, the impact of MPP on firm sales was calculated for each firm using two different methods. First, marginal effect of the MPP funding was calculated by evaluating the derivative of the total sales function at the exact value of each firm's characteristics.⁶ Thus, this directly measures the marginal revenue (MR) generated by the last dollar of MPP funding. Second, an average revenue (AR) measure can be constructed by comparing the change in total sales with and without MPP to the MPP Funds.⁷ For any given firm, AR per dollar of MPP funding was

$$[TS(MPP) - TS(No\ MPP)] / MPP\ Funds$$

where total sales were estimated at the value of the explanatory variables for each firm. The first term in the numerator used the actual MPP funding received by the firm, whereas the second term assumed this funding was zero (*i.e.*, no MPP funds). All other variables were held constant. The estimated mean MR and AR measures are presented in Table 4. Because of the statistical superiority of the bivariate model, all MR and AR results were calculated using results from the bivariate model.

Confidence intervals (CI) were estimated for both measures using the bootstrap technique developed by Krinsky and Robb (1986). The Krinsky-Robb method was used because the measures of interest—namely, marginal revenue and average revenue of MPP funding—were nonlinear functions of random variables (*i.e.*, the maximum likelihood estimates). The technique uses the information about the parameter estimates contained in the variance-covariance matrix

6. Appendix A shows that the marginal effect for any variable X is given by,

$$\frac{\partial TS}{\partial X} = \beta + \beta \left[\frac{(\alpha_L \phi_L - \alpha_U \phi_U)}{\sigma(\Phi_U - \Phi_L)} - \lambda^2 \right]$$

7. Recall that, by equation (3), the change in total sales is equivalent to the change in export sales.

to develop an empirical distribution for the marginal and total effects of MPP. The Krinsky-Robb approach uses a random draw from the multivariate normal distribution implied by the variance-covariance matrix to generate parameter estimates that are “reasonably likely” alternatives to the original estimates, given the standard errors and covariance terms of the estimated variance-covariance matrix. MR and AR are calculated for each firm at the new parameter vector implied by a given random draw, and the mean for the sample calculated. If this is done a sufficiently large number of times (5000 in this case), an empirical distribution for the measure of interest can be generated (i.e., 5000 estimates of the mean marginal effect). After ordering the empirical distribution from smallest to largest, the 95% confidence interval can be established by finding the cutoff points for the top and bottom 2.5%.

The largest MR effects of MPP funding were produced by estimates from the most restrictive model (#2), with the marginal dollar of MPP funding being worth, on average, about \$7.14 in additional export sales. The marginal dollar of MPP funding had an impact of \$7.40 in additional export sales for small firms (with 95% CI between \$0.31 and \$14.75), whereas MPP had an estimated MR for large firms of \$5.73 (95% CI between \$2.28 and \$9.44). The MR estimates for the other model specifications were slightly smaller than those calculated for model #2. For all specifications, the mean and confidence interval estimates for AR followed the same general pattern as for the MR measure. The largest AR estimate for the full sample, 23.81, also came from model #2. This indicated that, on average, every dollar of MPP funding generated \$23.81 in export sales. The 95% CI was between \$2.01 and \$46.22. The mean AR varied by firm size: firms with more than 500 employees had an estimated mean AR of \$16.81, while smaller firms had a mean AR of \$25.08.

Other specifications yielded smaller estimates of AR, but followed the same pattern as the first specification. An important aspect of Models #1, #3, and #4 concerns the confidence intervals. In general, the 95 percent CI for small firms was much wider than that for large firms, indicating there was much more variation in the data for small firms than for large firms. In fact, the CI for small firms included a negative lower bound for all specifications except the second. This means that the estimated AR for small firms was statistically equal to zero for all specifications except the second. In contrast, the 95 percent CI for large firms was not only strictly greater than zero, it was strictly greater than one. This indicated that large firms generated more than \$1 in export sales for every dollar of MPP funding.

Conclusions

This study had two goals: (1) estimate firm level impacts of export promotion funds on export revenues and (2) jointly estimate a model using two different types of data, *direct* and *indirect*. With respect to the first goal, the results do not support the GAO contention that larger, more export experienced firms were less effective than small firms in using export promotion funds to increase firms' export sales. Regardless of model specification, MPP funds provided a positive marginal impact on large firms' export revenues. Further, the confidence intervals for both marginal revenue and average revenue generated by MPP funding allow us to conclude with great confidence that large firms have a greater than one-to-one revenue payoff for each dollar of MPP funding. The same cannot be said of small firms. While it was true that the point estimate of the MPP revenue payoff for small firms (both MR and AR) was larger than the corresponding point estimate for large firms, the confidence interval surrounding these point estimates included the value of zero for three of the four specifications. It cannot be stated with great confidence that, on average, small firms received a payoff from MPP funding. Thus, the recent

programmatic change requiring that all MPP funds be distributed to small firms and cooperatives (based on the efficiency argument of the GAO) was not supported by the data.

Furthermore, the fact that the average overall and small firm effects, except for one model, were insignificant suggests that moving program preferences toward small firms will make the revenue effects even more insignificant, on average. Of course, the reported measures are each the mean of a distribution, and each distribution has firms in either the left tail or the right tail of the distribution. This phenomenon may help explain, in part, why there is so much disagreement about whether export promotion is effective in increasing sales and for whom. The relatively large variation in AR for small firms compared with large firms suggests that other screening criteria for the MAP, such as viability of an export marketing plan, may be more critical for small firms than for large firms to ensure effective use of the funds. The results also point to the importance of calculating confidence intervals for any measure of program effectiveness, which is usually not done in the promotion evaluation literature. It should be noted that just reporting the mean MR and AR effects would have given a misleading impression of significance, when statistically, most MR and AR estimates for small firms were not significantly different from zero.

Another GAO hypothesis was that new-to-export firms (those firms with fewer than six years of exporting experience) would use MPP funds more effectively than experienced exporting firms to increase export sales. The measure for export experience was never significant in any model, indicating that inexperienced firms are no more or less effective than experienced firms in converting MPP funds into increased export revenues.

The second goal of the study was to combine two different types of data in a single econometric model. The indirect data—respondents' subjective evaluation of the impact on

sales of export promotion funds—supplemented the primary modeling approach. Combining the two data sources into a single model resulted in more efficient parameter estimates. Such a modeling strategy represents a promising approach for future firm level studies.

As a final caveat, this study is a cross-sectional snapshot in time and it is well known that promotion effects usually have distributed lag effects. Hence, it would be expected that the effects as measured in this study would underestimate the longer-term effects. It may be conjectured that these distributed lag effects would tend to shift the distribution of the marginal effects and benefit/cost measures toward more positive values. However, verification of this conjecture would require time series firm level data of the type used here. To date, these types of data are not publicly available or collected, making quantification of firm level distributed lag effects infeasible at this point in time.

Table 1. Variable Definitions and Summary Statistics (N=150)

Variable Name	Definition	Units	Percent or Mean
<i>TS</i>	Interval measure of total sales in \$10,000, percent of sample in category	1 if $TS < 10$ 2 if $10 \leq TS < 24.9$ 3 if $25 \leq TS < 49.9$ 4 if $50 \leq TS < 99.9$ 5 if $100 \leq TS < 199.9$ 6 if $200 \leq TS < 499.9$ 7 if $500 \leq TS < 999.9$ 8 if $1,000 \leq TS < 4,999.9$ 9 if $5,000 \leq TS < 9,999.9$ 10 if $TS \geq 10,000$	0 .66% 6.00% 3.33% 4.67% 7.33% 16.67% 14.00% 22.67% 12.00% 12.67%
<i>e</i>	Share of total sales from exports	Share (.01 to 1)	.327
<i>k</i>	Proportion by which exports would have changed if firm had not received MPP funds	Proportion ($-\infty$ to $+\infty$)	-.119
<i>MPP Funds</i>	Value of 1994 program year MPP allocation from FAS, in \$10,000	Dollars/10,000	4.269
<i>Small Firm</i>	Fewer than 500 employees	1 if fewer than 500 employees, 0 otherwise	.847
<i>New to Export</i>	Exporting 5 years or less	1 if exporting 5 years or less, 0 otherwise	.433
<i>Years in Business</i>	Years in business	Years/10	3.249
<i>Employees</i>	Number of full-time employees in 100's	Employees/100	3.408

Table 2. Grouped Data Models^a

	Model #1	Model #2	Model #3	Model #4
Intercept	3295.170 (2190.936)	8181.763** (1599.887)	-1648.687* (915.154)	708.633 (1696.937)
X Variables				
<i>Years in Business</i>	831.221* (433.625)	520.360** (92.029)	166.119* (89.592)	865.645* (435.880)
<i>Square Root (Years in Business)</i>	-2515.509 (1711.793)			-2809.864 (1713.732)
<i>Small Firm</i>	-2704.496* (1457.041)	-8876.656** (1204.357)		
<i>Employees</i>	-412.401** (68.864)		-406.845** (64.195)	-442.342** (67.374)
<i>Square Root (Employees)</i>	4376.669** (620.361)		4669.231** (502.899)	4979.496** (534.689)
<i>New to Export</i>	114.228 (621.707)	-159.133 (688.262)	495.049 (601.328)	185.215 (623.219)
Z Variables				
<i>MPP Funds</i>	-500.426** (239.415)	-859.751** (270.322)	-283.066 (211.873)	-278.495 (209.736)
<i>Square Root (MPP Funds)</i>	-265.053 (829.075)	993.149 (943.081)	-208.494 (835.400)	-362.843 (832.228)
<i>MPP Funds × Small Firm</i>	622.001** (171.350)	736.362** (193.443)	383.944** (128.309)	409.788** (128.011)
<i>MPP Funds × New to Export</i>	-21.399 (93.054)	-15.611 (108.358)	-34.049 (94.635)	-29.147 (93.714)
<i>Sigma (Total Sales)</i>	2383.376** (162.399)	2817.042** (189.481)	2429.638** (163.928)	2402.381** (162.399)
ln L	-390.066	-412.521	-393.145	-391.813

^a Number in parentheses is the asymptotic standard error. ** significant at $\alpha=.05$, * $\alpha=.10$.

Table 3. Bivariate Models^a

	Model #1	Model #2	Model #3	Model #4
Intercept	-1460.740 (1813.851)	5208.660** (627.764)	-1817.573** (659.177)	-1484.500 (1509.505)
X Variables				
<i>Years in Business</i>	367.145 (414.146)	543.595** (80.919)	261.041** (65.665)	367.671 (412.968)
<i>Square Root (Years in Business)</i>	-419.473 (1620.832)			-423.237 (1612.721)
<i>Small Firm</i>	-23.353 (767.860)	-5559.341** (606.453)		
<i>Employees</i>	-308.610** (60.243)		-304.538** (45.647)	-309.150** (46.074)
<i>Square Root (Employees)</i>	3621.135** (591.728)		3590.947** (401.175)	3629.656** (406.788)
<i>New to Export</i>	-56.396 (479.262)	-166.548 (432.570)	-10.409 (411.726)	-56.221 (478.675)
Z Variables				
<i>MPP Funds</i>	-115.495* (67.580)	-185.531** (88.568)	-115.264* (66.047)	-115.285* (66.075)
<i>Square Root (MPP Funds)</i>	324.953 (208.339)	551.792** (274.667)	323.703 (206.789)	324.497 (207.378)
<i>MPP Funds × Small Firm</i>	89.678* (51.391)	107.745* (56.228)	89.394* (47.784)	89.616* (47.638)
<i>MPP Funds × New to Export</i>	-10.288 (38.141)	12.259 (45.109)	-10.306 (38.167)	-10.381 (38.104)
<i>Rho</i>	-0.250 (0.172)	-0.167 (0.191)	-0.254* (0.151)	-0.250 (0.168)
<i>Sigma (Total Sales)</i>	2296.217** (155.044)	2650.071** (170.277)	2298.933** (141.695)	2296.191** (149.024)
<i>Sigma ($k \times e \times$ Total Sales)</i>	201.639** (5.696)	200.923** (7.610)	201.391** (5.552)	201.649** (5.548)
ln L	-1267.326	-1289.449	-1267.363	-1267.326

^a Number in parentheses is the asymptotic standard error. ** significant at $\alpha = 0.05$, * $\alpha = 0.10$.

Table 4. Impact of MPP Funding on Total Sales

	Mean $\partial TS / \partial MPP$ (Marginal Revenue)	Mean $\Delta TS / MPP$ (Average Revenue)
Model #1		
Overall (n=150)	6.35 (0.13 – 12.65)	18.68 (-1.68 – 38.69) ^a
Firms with > 500 employees (n=23)	5.54 (2.12 – 9.03)	13.84 (2.32 – 25.61)
Firms with < 500 employees (n=127)	6.50 (-0.46 – 13.43)	19.55 (-2.42 – 41.02)
Model #2		
Overall (n=150)	7.14 (0.76 – 13.80)	23.81 (2.01 – 46.22)
Firms with > 500 employees (n=23)	5.73 (2.28 – 9.44)	16.81 (3.77 – 30.46)
Firms with < 500 employees (n=127)	7.40 (0.31 – 14.75)	25.08 (1.61 – 49.08)
Model #3		
Overall (n=150)	6.21 (0.43 – 11.98)	18.28 (-1.29 – 7.29)
Firms with >=500 employees (n=23)	5.42 (2.14 – 8.75)	13.51 (2.55 – 24.66)
Firms with <500 employees (n=127)	6.35 (-0.10 – 12.75)	19.15 (-2.09 – 39.83)
Model #4		
Overall (n=150)	6.25 (0.25 – 12.14)	18.31 (-1.40 – 37.13)
Firms with > 500 employees (n=23)	5.47 (2.02 – 8.98)	13.59 (2.50 – 24.81)
Firms with < 500 employees (n=127)	6.39 (-0.37 – 13.04)	19.17 (-2.01 – 39.39)

^a 95% CI calculated using the Krinsky-Robb bootstrap technique with 5000 random draws.

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Appendix A: Marginal Effects for Continuous Variables in Total Sales Equation

Following Maddala p. 366-368,

$$\text{let } \begin{aligned} \alpha_L &= L - X\beta - Z\gamma \\ \alpha_U &= U - X\beta - Z\gamma \end{aligned}$$

Using footnote 3 on page 7, define λ as,

$$\lambda = \frac{\phi\left(\frac{\alpha_L}{\sigma}\right) - \phi\left(\frac{\alpha_U}{\sigma}\right)}{\Phi\left(\frac{\alpha_U}{\sigma}\right) - \Phi\left(\frac{\alpha_L}{\sigma}\right)} = \frac{\phi_L - \phi_U}{\Phi_U - \Phi_L} = \frac{N \text{ (Numerator)}}{D \text{ (Denominator)}}.$$

Using the quotient rule for derivatives, the derivative of λ with respect to any variable, say X , is

$$1. \quad \frac{\partial \lambda}{\partial X} = \frac{\frac{\partial N}{\partial X} D - \frac{\partial D}{\partial X} N}{D^2}.$$

The term $\frac{\partial N}{\partial X}$ can be expressed as

$$2. \quad \frac{\partial N}{\partial X} = \left[\frac{\partial \phi_L}{\partial \alpha_L} \times \frac{\partial \alpha_L}{\partial X} \right] - \left[\frac{\partial \phi_U}{\partial \alpha_U} \times \frac{\partial \alpha_U}{\partial X} \right].$$

Now,

$$3. \quad \frac{\partial \phi_i}{\partial \alpha_i} = -\frac{\alpha_i}{\sigma^2} \phi_i \quad i = L, U : \text{Maddala p. 368}$$

and

$$4. \quad \frac{\partial \alpha_i}{\partial X} = -\beta \quad i = L, U ,$$

so substituting (3) and (4) into (2) yields

$$2.1 \quad \frac{\partial N}{\partial X} = \frac{\beta}{\sigma^2} (\alpha_L \phi_L - \alpha_U \phi_U).$$

The term $\frac{\partial D}{\partial X}$ can be expressed as

$$5. \quad \frac{\partial D}{\partial X} = \left[\frac{\partial \Phi_U}{\partial \alpha_U} \times \frac{\partial \alpha_U}{\partial X} \right] - \left[\frac{\partial \Phi_L}{\partial \alpha_L} \times \frac{\partial \alpha_L}{\partial X} \right].$$

Since

$$6. \quad \frac{\partial \Phi_i}{\partial \alpha_i} = \frac{1}{\sigma} \phi_i \quad i = L, U \quad : \quad \text{Maddala p.367}$$

and

$$7. \quad \frac{\partial \alpha_i}{\partial X} = -\beta,$$

substituting (6) and (7) into (5) yields

$$5.1 \quad \frac{\partial D}{\partial X} = -\frac{\beta}{\sigma} (\phi_U - \phi_L) = \frac{\beta}{\sigma} (\phi_L - \phi_U).$$

Substituting (2.1) and (5.1) into (1) gives

$$\begin{aligned} 1.1 \quad \frac{\partial \lambda}{\partial X} &= \frac{\frac{\beta}{\sigma^2} (\alpha_L \phi_L - \alpha_U \phi_U) \cdot [\Phi_U - \Phi_L] - \frac{\beta}{\sigma} (\phi_L - \phi_U)^2}{(\Phi_U - \Phi_L)^2} \\ &= \frac{\beta}{\sigma^2} \frac{(\alpha_L \phi_L - \alpha_U \phi_U)}{\Phi_U - \Phi_L} - \frac{\beta}{\sigma} \left(\frac{\phi_L - \phi_U}{\Phi_U - \Phi_L} \right)^2 \\ &= \frac{\beta}{\sigma} \left[\frac{(\alpha_L \phi_L - \alpha_U \phi_U)}{\sigma(\Phi_U - \Phi_L)} - \lambda^2 \right]. \end{aligned}$$

Finally, inserting 1.1 into

$$8. \quad \frac{\partial TS}{\partial X} = \beta + \sigma \frac{\partial \lambda}{\partial X},$$

gives

$$9. \quad \frac{\partial TS}{\partial X} = \beta + \beta \left[\frac{(\alpha_L \phi_L - \alpha_U \phi_U)}{\sigma(\Phi_U - \Phi_L)} - \lambda^2 \right].$$