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Exploring the Heterogeneous Effects of Export Promotion

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Abstract

A semiparametric varying coefficient model is used to explore the heterogeneity in returns to export promotion across countries. Differences in characteristics of export-promotion agencies drive the heterogeneity in returns. Interestingly, characteristics that matter for export growth do not necessarily matter for GDP per capita growth. A 1 percent increase in export-promotion budgets is associated with an average increase in exports of 0.10 percent and an average increase in GDP per capita of 0.06 percent. However, these average returns hide a lot of heterogeneity. Returns in terms of exports vary from 0 percent in Cyprus and Vietnam to 0.22 percent in Portugal. Returns in terms of GDP per capita show less heterogeneity, varying from 0.05 in Malawi to 0.10 percent in Portugal and Nicaragua.

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1. Introduction

Export-promotion agencies (EPAs) are present in most countries. EPAs' activities include financial assistance (credit, insurance), market intelligence (firms and products), technical assistance for transport logistics, product certification, and participation in trade fairs. They differ in their economic size and their governance, and they engage in different types of activities. For instance, the export-promotion budget to export ratio varies from 4.84 percent in Rwanda to 1 percent in Brazil, 0.04 percent in Chile and 0.01 percent in Vietnam. The budgets vary from USD 500 million in the United Kingdom to USD 60,000 in Sierra Leone. Few are fully financed by the private sector (Hong Kong), while most are fully financed by the government (Chile). Some EPAs spend more than 75 percent of their budget on established exporters

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(Canada); others only focus on new or non-exporters. Some only focus on small and medium-size firms (Uruguay); others spend more than 75 percent of their budget on large firms (Honduras). Some promote exports across all sectors (Philippines) while others focus on a more limited range of sectors (France). The objective of this project is to find out which of these EPAs' characteristics are associated with more exports and higher GDP per capita growth.

Merging data from three rounds of EPAs' surveys conducted between 2005 and 2014, the study obtains an unbalanced panel across developing and developed countries with information on EPAs' budget, funding sources, and activities. To better understand why some EPAs may be more efficient than others, the study explicitly models with the help of a semi-parametric varying coefficient model (see Park et al. 2015 for a recent review) the heterogeneity in returns to export-promotion budgets as a function of EPAs's characteristics. The study finds that the returns in terms of export growth associated with a 1 percent increase in export-promotion budgets varies from 0 percent in Cyprus and Vietnam to 0.22 percent in Portugal. The returns in terms of GDP per capita vary from 0.05 in Malawi to 0.10 percent in Portugal and Nicaragua. These differences at the country level are explained by differences in agencies' characteristics. The study finds that EPAs that have a larger share of their budget coming from fees for services provided, or spend a larger share of their budget on marketing activities as well as nonmatching grants, or have a strategic mandate to target export promotion of a few sectors or destinations have larger returns in terms of exports. Of all these characteristics only the share of expenditure on marketing activities matters for GDP per capita returns.[1]

These results are important for at least three reasons. First, they help identify the export-promotion strategies and EPAs' characteristics that are associated with higher returns. They are therefore a valuable guide to EPAs that want to help exporters, and can help define best practices in export promotion. Second, to the authors' knowledge, this is the first study to quantify returns in terms of GDP per capita. This is important because export growth cannot be the ultimate goal of export-promotion policies, but rather an instrument to achieve broader social and economic welfare, which is here proxied by GDP per capita. Interestingly, the results highlight that what may be good for export growth may not necessarily be good for GDP per capita growth. This is crucial and suggests that the exclusive focus on exports in the evaluation of EPAs may be misleading. Some interventions, such as expenditure in nonmatching grants, may generate export growth, but they do not lead to GDP per capita growth. Third, by explicitly modeling the heterogeneity in returns this study's identification strategy addresses the problem of causality in a statistically more satisfying manner than existing studies that simply focus on average returns.[2]

To see this, note that in most studies measuring average returns causality is established through the use of an instrumental-variable estimator, which assumes that returns to export promotion are homogeneous across countries (see, for example, Lederman, Olarreaga, and Payton 2010). As any export-promotion expert would argue, this is unlikely given that export promotion agencies differ significantly in their institutional set-up and programs. The use of instrumental variables will then identify the average returns associated with variations in export-promotion budgets that are caused by variations in the instrumental variables (or IVs). Clearly, the larger the unexplained heterogeneity in the returns to EPA budgets, the larger the difference between the returns identified by altering IVs (the so-called local average treatment effects, or LATE, which vary with the choice and values of IVs), and the larger their difference with respect to the average returns over the entire population (the so-called average treatment effect, or ATE). In other words, the returns to export promotion that are identified are a function of the choice and value of the instruments that are used.[3]

1 In the survey, the study explicitly defines marketing activities as including trade fairs, trade missions, follow-up services offered by representatives abroad, and importer missions.

2 As usual, there is no free lunch, and the authors discuss limitations to their methodology in the conclusion.

3 This and its consequences have been thoroughly discussed by Heckman, Urzua, and Vytlacil (2006) among others.

It is also important to note if the impact of export promotion depends on EPA's characteristics, and this heterogeneity is not modeled by the econometricians, it will necessary appear in the error term. In this case, it is difficult to imagine that an instrument exists that will pass both the inclusion and exclusion restrictions. Indeed if the instrument is highly correlated with the EPA's budget and therefore passes the inclusion restriction, it will also very likely be highly correlated with the unmodeled heterogeneity of the impact of EPA's budget, which appears in the error term. This violates the exclusion restriction.

To explicitly capture the heterogeneity in returns and circumvent the problems described above, this study relies on an identification strategy based on a semi-parametric varying coefficient model that explicitly models the heterogeneous impact of the export-promotion budget on exports and GDP per capita as a function of EPA's characteristics. The varying coefficient model has at least two interesting properties:[4] First, by reducing the extent of unexplained heterogeneity, it reduces the variation of the LATE (and thus its distance to the ATE). To see this, note that if it were possible to explicitly model all the heterogeneity in returns, the LATE would necessarily be equal to the ATE. In such a case, the identified returns no longer depend on the choice of instruments, although the estimates (numerically) do. Typically, however, there is a huge overlap between effect modifiers (the factors driving the varying coefficients) and the IVs. This is why Moffitt (2008) recommends to include them all.[5] This explains why only a reasonable modeling of the heterogeneity correlated with the IVs provides a reasonably interpretable parameter estimates. It also makes the required assumptions on the IV estimator more credible: In a model where coefficient β_c varies over countries, say $Y_c = \beta_0 + \beta_c \ln(\text{budget})_c + \varepsilon_c$, one needs all instruments for budget to be independent of this variation (noncausality is not sufficient) unless the variation in β_c is modeled. To find instruments that are independent from budget-returns but can predict budget well is extremely unlikely. In sum, the explicit modeling of the heterogeneous impact as a function of EPAs' characteristics helps to simultaneously address the potential endogeneity bias, and disentangle which agencies' characteristics are correlated with higher returns.

Early assessments of the impact of EPAs (Keesing and Andrew 1991; Keesing and Singer 1991) were quite critical of their performance in developing countries. EPAs in those countries were criticized for being inadequately funded, suffering from government involvement, and hiring staff that was bureaucratic rather than client oriented. As a result, many development institutions withdrew their support to EPAs. These criticisms of early EPAs led to important reforms in the ways EPAs operate in most countries today. Moreover, the antiexport bias due to protectionist policies in most developing countries up to the 1980s has been significantly reduced. When EPAs were evaluated 20 years later, quantitative assessments of the role of export promotion were more positive. Rose (2007) stated that the presence of a diplomatic representation (e.g., a consulate) can increase bilateral exports by 6 to 10 percent. Lederman, Olarreaga, and Payton (2010) estimated that on average a 1 percent increase in export-promotion budgets leads to a 0.05 percent increase in exports.

These early quantitative assessments of export-promotion programs focus on the average impact of export-promotion programs, and ignore in their quantification the heterogeneity of the impact due to different types of governance, funding sources or activities of EPAs. They also exclusively focus on the impact of the programs on exports, and ignore the broader question of the impact of export promotion in terms of GDP per capita. All these are important unanswered questions for policy makers and export-promotion experts. This paper fills these gaps.

There is also a large and growing literature using firm-level data that explores which are the types of firms that benefit the most from export promotion. Volpe and Carballo (2008) found that export promotion affects exports mainly along firm's extensive margin in terms of both new export markets

4 For details and more discussion, see Sperlich and Theler (2015) or Benini, Sperlich, and Theler (2016).

5 This idea is actually related to the so-called local instrumental variable estimator of Heckman (2010). Both focus on the heterogeneity of returns with respect to propensity scores.

and products, but has little impact on the intensive margins of exports in a sample of Peruvian firms. Volpe and Carballo (2010) found that smaller firms are more likely to benefit from export-promotion services in Chile. Broocks and Van Biesebroeck (2017) confirm that export promotion works mainly through the extensive margin in a sample of Belgian firms, but experienced exporters observe increases in their intensive margin. Cruz (2014) and Broocks and van Biesebroeck (2017) provide evidence of export promotion helping firms enter export markets in Brazil and Belgium, respectively. Lederman, Olarreaga, and Zavala (2016) show in a sample of Latin American firms that export promotion helps firms enter into and survive in export markets, but has little impact on the intensive margin. Van Biesebroeck, Konings, and Martincus (2016) show that export promotion has helped Belgian and Peruvian firms survive in export markets during the great recession. Cadot et al. (2015) show a positive impact of export-promotion programs in Tunisia, but it tends to be short-lived.

More recently, randomized experiments at the firm level have shown that the returns to export promotion can be large. Atkin, Khandelwal, and Osman (2017) conduct an experiment where they offer to a random set of firms the opportunity to export high-quality carpets to retailers in the United States and Europe. They found that treated firms had an increase in profits of around 20 percent and larger increases in the quality of goods they produced, which is consistent with learning-by-exporting. Breinlich et al. (2015) also conduct a controled trial by providing targeted information to a randomly selected set of firms regarding the benefits and costs of exporting. Their objective is to assess the role that information plays on the perceptions that firms have about the costs and benefits of selling in international markets. They found that treated non-exporters become less likely to export, whereas treated exporters become more likely to export, suggesting that the provision of information can have an impact on firms' behaviour.

The advantage of the literature using firm-level data is that it can better identify the type of firm or worker that is benefiting from the program, and the channels through which export promotion affects export growth (e.g., extensive versus intensive margins). The disadvantage of microdata is that it is not clear how to aggregate results from individual firms or workers to obtain an impact on total exports or GDP. This is important, because the cases for and against export promotion are often based on externalities (positive and negative). By simply observing that firms benefiting from export promotion tend to export larger amounts than firms that do not benefit from the program, it is not possible to assess how big the aggregate impact is and not even the sign of that impact. It is potentially conceivable that badly designed export-promotion schemes will lead to a larger fall in exports of firms not benefiting from the program than the increase in exports of firms that benefit from the program. This paper takes the alternative route, which is to work with aggregate data directly. But it should be clear that these two types of analysis complement each other as they help address different questions.

Section 2 discusses the surveys of EPAs used to construct the dataset, and provides some descriptive statistics regarding budget, sources of funding, governance, and activities of EPAs. Section 3 presents the empirical strategy followed to estimate the heterogeneity in returns to export-promotion programs in terms of both exports and GDP per capita. Section 4 presents the results, and section 5 concludes.

2. Data Sources and Summary Statistics

The study merged information from three rounds of EPAs' surveys. The first survey was conducted in the fall of 2005 by the World Bank and was the base for the study in Lederman, Payton and Olarreaga (2010). The second round was conducted in the fall of 2010, also by the World Bank, and the final round was conducted in the fall of 2014 by the International Trade Center (ITC).

The initial survey contacted all EPAs in the ITC's contact information database available on the ITC's web page in 2005. The list was complemented with the help of World Bank country economists who provided contact information on national EPAs that were not listed in the ITC database. A total of 116 EPAs were contacted by email; 92 answered of which only 4 percent declined. In 2010, the same 116

EPAs were contacted, and 93 answered positively.[6] In the fall of 2014, the ITC survey concentrated on EPAs in 14 European countries, all of which responded positively.[7] The study therefore was left with an unbalanced panel containing information on EPAs' budget, sources of funding, governance, and activities for 94 countries.

The survey contains 19 questions in order to better understand the budget, sources of funding, governance, and activities of EPAs around the world.[8] The choice of questions was carefully designed with the the help of the best export-promotion experts in the World Bank and the International Trade Center, as well as practitioners from the European Trade Promotion Organization. The questions try to get to what are considered best practices in export promotion. Table 1 provides summary statistics for the variables used in this paper. It is important to note that this is an unbalanced panel so the averages are not necessarily for the same time period for each variable. Also, for non-European countries the sample stops in 2010, whereas for some European countries the sample only starts in 2010. The unbalanced nature of the panel is addressed using country and year fixed effects in the econometric specifications.

Also note that all questions regarding the share of the budget spent on different activities or type of firms, or coming from different sources vary in a scale from 1 to 6. It takes the value 1 if this share is 0, the value 2 if the share is between 0 and 10 percent, the value 3 if the share is between 10 and 25 percent, the value 4 if the share is between 25 and 50 percent, the value 5 if the share is between 50 and 75 percent, and the value 6 if the share is between 75 and 100 percent.

The share of the private-sector seats on the executive board is measured in percentage points by simply taking the number of seats in the hands of the private sector and dividing them by the number of total seats in the executive board.

Table 1. Summary Statistics

Variable	Mean	Std. Dev.	Min.	Max.
Log of nonoil exports of goods and services (USD)	22.910	2.427	16.251	28.51
Log of EPA budget (USD)	15.904	2.121	11.512	20.22
Log of GDP per capita (USD)	8.469	1.570	4.968	12.18
Log of population	15.924	1.726	11.123	21.01
Budget coming from fees for services	1.940	1.197	1	6.00
Public source of funding	4.924	1.656	1	6.00
Budget spent on marketing	3.512	1.087	1	6.00
Budget spent on export support services	2.658	0.976	1	6.00
Budget spent on nonmatching grants	1.77	1.22	1	6.00
Budget spent on non-exporters	2.166	1.130	1	6.00
Budget spent on established exporters	4.309	1.241	1	6.00
Budget spent on small firms	3.759	1.020	1	6.00
Budget spent on medium-size firms	3.807	0.982	1	6.00
Share of private sector over total at board	0.477	0.295	0	1.00
Rank of EPA responsibility	2.532	1.094	1	5.00
Strategy targets exports in all sectors and destinations	1.665	1.245	1	7.00

Source: Exports, GDP per capita and population are from WDI. EPA variables are from the three EPA surveys

Note: Units for nonoil exports are thousand of US dollars, units for EPA budget and GDP per capita are US dollars. For the construction of variables relating to EPA's functioning see the text.

6 The response rates is around 80 percent, which is astonishing for an email survey. The high response rate is probably explained by the numerous follow-ups done by phone.

7 These are Austria, Belgium, Bosnia, Cyprus, Denmark, Estonia, Iceland, Italy, Lithuania, Malta, Netherlands, Slovenia, Switzerland, and the United Kingdom.

8 The survey is available from the authors upon request.

The rank of EPA responsibility takes the value 1 if export promotion is the only responsibility of the agency; 2 if it is the top two priorities, 3 if it is one of the two top priorities, 4 if it is one of three or more top priorities, and 5 if it is secondary to other priorities. Thus as its number increase the focus of the agency in export promotion is diluted.

Whether the strategy of the agency is to target all sectors and destinations ranks from 1 to 8 the importance of this strategy relative to strategies that focus on certain types of products, destinations, or firms. The higher the value of this variable, the more targeted by sector and destination are EPAs' interventions.

The numbers in table 1 suggest that EPAs have an average budget of USD 8 million (exponential of 15.904), but there is a large variance behind these averages with a budget of USD 60,000 for Support for Export Developement and Investment Corporation (SLEDIC) in Sierra Leone and USD 500 million for United Kingdom Trade and Investment (UKTI) in the United Kingdom. If a distinction is made between developed and developing countries using the World Bank threshold of a GNP per capita above and below USD 12,736, the budget of EPAs in developed countries is twice as large as the budget of EPAs in developing countries. It can also be seen from the averages reported in table 1 that the average share of executive board seats in the hands of the private sector is 48 percent. But this varies between 0 and 100 percent. In fact, as can be seen in table 1 all the variables that have to do with EPA characteristics span from their minimum possible value to their maximum possible value. For example, if the share of public funding in the EPA budget is close to 5 (meaning that the share is on average somewhere between 50 to 75 percent), it spans from 0 (meaning a share of 0 percent) to 6 (meaning a share of 100 percent).

To better illustrate the variance behind some of these average numbers a supplementary ap- pendix provides several boxplot figures for these variables. An important message to take away from the figures in the supplementary appendix is that there are important differences in EPAs' characteristics in the sample. Some of these differences may matter. In this empirical exercise the study exploits these differences in EPA characteristics to examine if they help explain export-promotion returns in terms of exports and GDP per capita across countries.

3. Empirical Strategy

The EPA characteristics this study is interested in can be divided into three broad categories (summary statistics are provided for all these variables in table 1). First, characteristics regarding the sources and allocation of the export-promotion budget: share of public funding (*public − funding*); share of budget coming from user fees (*fees*); share of budget allocated to marketing activities (*marketing*), and share of budget allocated to export support services (*ESS*). Second, characteristics associated with the targeting of certain types of firms in export-promotion programs: share of budget spent on established exporters (*established − exporters*); share of budget spent on non-exporters (*non − exporters*); share of budget spent on small firms (*small*); and share of budget spent on medium-size firms (*medium*). Finally, characteristics regarding the structure and governance of EPAs: share of the executive board in the hands of the private sector (*private − board*); the extent to which export promotion is the main responsibility of the EPA (*responsibility*); the importance of the use of matching grants (*matching − grants*), and the extent to which its strategy involves targeting all sectors and destinations versus only some sectors and destinations (*strategy*).[9]

9 Note that EPA's characteristics are not the only dimensions across which heterogeneous effects of export promotion can be expected. Lederman, Olarreaga, and Payton (2010) using a fully parametric log-linear model find that the returns to increases on export-promotion budgets is larger for exports of differentiated goods and when facing more restrictive trade barriers abroad. This paper focuses on the heterogeneity of the effects due to EPA characteristics. Of course, these

To examine how these EPAs' characteristics affect returns to export-promotion budgets one could use a standard linear model with interactions between budget and EPA characteristics as explanatory variables. However, this would only be shifting the problem one step further. Such a model would imply strong assumptions regarding the functional relationship between returns and EPA characteristics. In the presence of functional misspecification, this implies an endogeneity bias due to the unmodeled heterogeneity. And as explained before, estimating and interpreting these estimated returns as *average* effects of ln(*budget*) with instrumental variables still requires that the instruments exhibit no correlation with the unmodeled heterogeneity while having a strong correlation with the log-budget itself. Again, this is very unlikely.

To circumvent this and allow the impact of export-promotion budgets on exports to vary across EPA characteristics, the study uses a semiparametric varying coefficient model. That is, instead of trying to address the endogeneity problem caused by heterogeneity in returns using instruments based on non testable assumptions, the study directly models this heterogeneity. The most general varying coefficient model version would imply letting the coefficients on the export budget to arbitrarily vary over the set of EPA characteristics that are considered to be interesting or important. While this requires few assumptions, given the large number of EPA characteristics that are being considered, it will be difficult then to draw any further conclusions regarding the type of characteristics that are associated with higher or lower returns. Indeed, if the number of characteristics is equal to three, then the coefficient on the export budget would be a three-dimensional surface that could only be made visible with 3D contour plots that are difficult to interpret. But this study is interested in 12 EPA characteristics. It then becomes impossible to visualize how EPA characteristics affect returns without any further simplification. The study does this by excluding potential interactions between different EPA's characteristics (this does not exclude correlations among them). While it is true that the assumption of additive separability for varying coefficients is also a restriction, additive separability is nonetheless one of the most used simplifications in empirical economics.[10]

The equation to be estimated then becomes:

$$\begin{aligned}\ln(outcome_{c,t}) = \{&b_{con} + b_f(fees_{c,t}) + b_g(public - funding_{c,t}) + b_h(marketing_{c,t}) + b_j(ESS_{c,t}) \\ &+ b_k(non - exporters_{c,t}) + b_l(established - exporters_{c,t}) + b_m(small_{c,t}) + b_n(medium_{c,t}) \\ &+ b_o(private - board_{c,t}) + b_p(strategy_{c,t}) + b_q(matching - grants_{c,t}) \\ &+ b_r(responsibility_{c,t})\}\ln(\text{budget})_{c,t} + \delta\{\ln(\text{population})_{c,t}\} + \gamma_c + \gamma_t + \varepsilon_{c,t} \end{aligned} \quad (1)$$

where *outcome* is either exports or GDP per capita, b_{con} is a constant and b_f, ..., b_r, and δ are unknown smooth functions. For identification reasons you can either center each of them so that they integrate to zero, in which case you need to include b_{con}, or you can omit b_{con} and the centering of these function is neither interpretable nor identifiable unless you have only one coefficient-driving variable. The study opted for the second solution, and therefore no explicit estimates for b_{con} are reported. The paper estimates all functions by piecewise cubic polynomials (so-called regression splines).

More specifically, the study uses a two-stage procedure. In the first stage it uses as instrumental variables for the endogenous export-promotion budget those variables that are believed to be more likely to be mean-independent from the error term in the second stage: the share of the budget coming from fees paid

may respond to the composition of the export bundle in terms of product and destination characteristics, and vice-versa. Disentangling this is beyond the scope of this paper. Note, however, that in the results section it is found that focusing on fewer sectors and destinations does seem to improve the export returns of export-promotion budgets.

10 The study also tests whether EPA characteristics matter in a log-linear model in the spirit of Lederman, Olarreaga, and Payton (2010) by interacting EPA's characteristics with the log of the export-promotion budget and find indeed that some EPA characteristics are statistically significant in both the export and GDP per capita equations. They can therefore help explain the heterogeneity in returns to export promotion across countries. These results are available in the supplementary appendix S1.

for services ($fees_{c,t}$), the share of the budget coming from public funds ($public - funding_{c,t}$), the share of budget spent on nonmatching grants ($matching - grants_{c,t}$), and the extent to which the agencies' responsibilities focus on export promotion ($responsibility_{c,t}$). The identification of the $b(\cdot)$-function comes partly from the varying coefficient modeling,[11] and partly from the standard assumptions made when using a control function to control for endogeneity.

More formally, in the first stage the study decomposes the variation of budget additively into endogenous variation captured by ξ, and exogenous variation predicted by some EPA characteristics z_j, fixed effects and population size:

$$\ln(budget)_{c,t} = f_c + f_t + \Sigma_j f_j(z_{j,c,t}) + f_x(\ln(\text{population})_{c,t}) + \xi, \quad f_j \text{ nonparametric functions.} \tag{2}$$

The study then computes $\hat{\xi}$ from the estimates, and uses it in the second stage to control for the endogeneity of ln(budget) using a control function approach, see b_c^u in equation (3).[12]

$$\begin{aligned}\ln(outcome^u_{c,t}) = \{&b^u_{con} + b^u_f(fees_{c,t}) + b^u_g(public - funding_{c,t}) + b^u_h(marketing_{c,t}) + b^u_f(ESS_{c,t}) \\ &+ b^u_k(non - exporters_{c,t}) + b^u_l(established - exporters_{c,t}) + b^u_m(small_{c,t}) \\ &+ b^u_n(medium_{c,t}) + b^u_o(private - board_{c,t}) + b^u_p(strategy_{c,t}) + b^u_q(matching - grants_{c,t}) \\ &+ b^u_r(responsibility_{c,t})\}\ln(budget_{c,t}) + \delta^u_k(\ln population_{c,t}) + \gamma^u_c + \gamma^u_t \\ &+ b^u_c(\hat{\xi}_{c,t}) + e^u_{c,t}, \quad u = x, y\end{aligned} \tag{3}$$

where superscript $u = x$, and $u = y$ stand for the export and GDP per capita equations, respectively.

Measurement error may be a concern, especially in the case of export-promotion budgets. Indeed, none of the surveys were undertaken face to face and even though all surveys were followed up with clarifying questions with the respondents, there is always room for misinterpreting some of the questions, or answering them with more or less accuracy. The export-promotion budget is instrumented, and therefore any error associated with the measurement of export-promotion budget is accounted for (even if the used variables in the IV regression may suffer from measurement error, it is not plausible to assume these measurement errors are dependent on each other and at the same time jointly correlated with ε). Concerning EPA's characteristics, it is difficult to think of systematic measurement because of their discrete, usually qualitative (though ordered) nature. A measurement error would basically mean misreporting, which is hopefully randomly distributed (i.e., not a cause of bias).

Another important assumption when estimating (3) is that the impact of export-promotion budgets on exports and GDP per capita is contemporaneous. While this assumption may seem reasonable for exports, it is less natural for GDP per capita as the externalities associated with the impact of export-promotion budgets on GDP per capita may take time to manifest. To test this, the study introduces one-, two-, and three-year lags of export-promotion budgets in the export and GDP per capita equations, but the study did not find any statistically significant effects for exports and some nonrobust findings for GDP per capita. Given the small time dimension in the sample, the authors prefer not to over-interpret these results and present only the contemporaneous effects. Note that the fact that contemporaneous effects

11 Note that the study is only interested in the identification of the varying coefficients, not on the impact of population size.

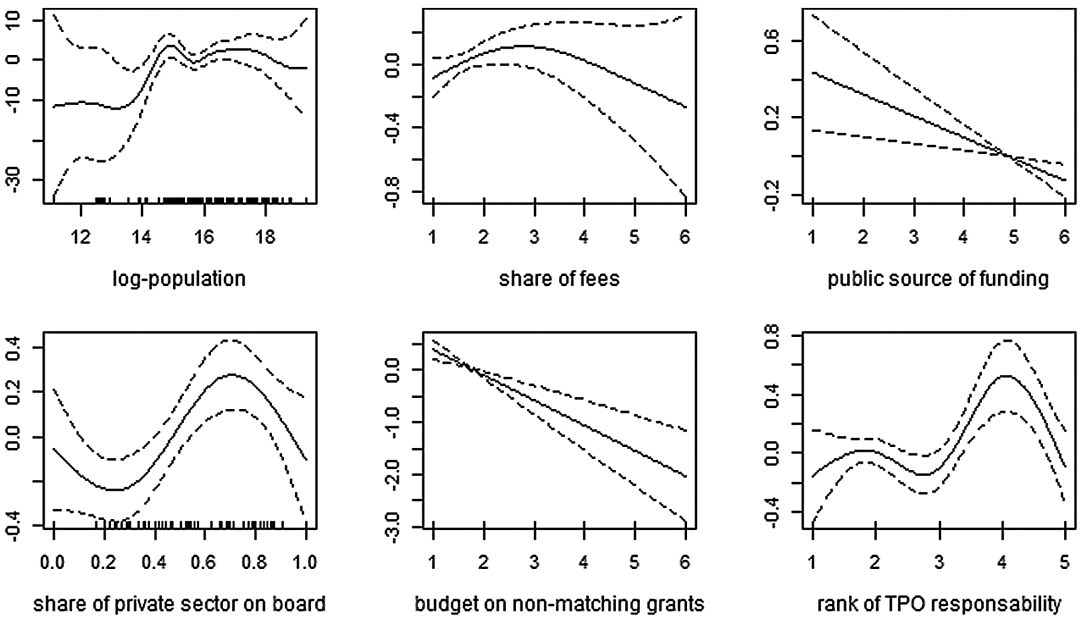
12 As shown by Terza, Basu, and Rathouz (2009) a control function approach is consistent when dealing with nonlinear models with endogenous variables, whereas the two-stage predictor substitution equivalent to the linear 2SLS is not. The assumption on the control function $b^u_c(\hat{\xi}_{c,t}) = E[\varepsilon_{c,t}|\xi_{c,t}, z_{c,t}]$ is discussed for nonparametric models, for instance, in Newey, Powell, and Vella (1999). Note that unlike the standard linear model, and because the study models the heterogeneity of the effect of export promotion, the instruments can (and should, see, e.g., Heckman, Urzua, and Vytlacil [2006] or Heckman [2010] and references therein) enter also the main equation.

are statistically significant whereas the lagged export-promotion budgets are not is also present when using a fully log-linear parametric model without any varying coefficients. In this case, the study finds that the contemporaneous effect of export-promotion budgets on exports and GDP per capita is positive and statistically significant and very close to the estimates in Lederman, Olarreaga, and Payton (2010) (in the case of the export equation). However, when lagging one, two, or three years the coefficients on export-promotion budgets are all statistically insignificant.[13]

4. Results

The study starts reporting the results of the first stage in the control function approach using equation (2). Figure 1 reports the nonparametric results of this first stage. It suggests that a reliance on public funding leads to a reduction in the total size of the budget. Similarly, a larger share spent on nonmatching grants reduces the total export-promotion budget. As the share of funding from fees for services increases the total export-promotion budget initially increases, but the relationship between the two turns negative at moderate levels of the share of funding coming from fees for services. Agencies have larger budgets when they have responsibilities other than export promotion, although the impact on broader responsibilities on the export-promotion budget is nonmonotonic. There are also some interesting nonlinearities with the share of board seats in the hands of the private sector. The larger export-promotion budgets are reached for shares around 80 percent.[14]

Figure 1. First-Stage Regression Explaining EPAs' Budgets



Source: Authors' nonparametric estimation of equation (2).

Note: The Y axis reports the estimates of function f in equation (2). The units of measurement depend on the units of measurement of each variable. This is the first stage of a two-stage procedure. The full line in each plot provides the marginal impact of the corresponding EPA characteristic on EPA's budgets. The dotted lines provide the 95 percent confidence band. The explanatory variables and their units of measurement are described in section 2.

13 Results using lagged export-promotion budgets are reported in the supplementary appendix.

14 The supplementary appendix S1 provides the post-estimation plots of the residuals, and goodness-of-fit analysis. They confirm that no anomalies can be found in the residuals (i.e., no evidence of model misspecification, outliers, poor fit, etc.).

The figure also provides 95 percent confidence bands to assess the statistical significance of the EPA characteristics in explaining variations in export-promotion budgets. It is possible to assess the confidence bands in the graphs with the help of table 2. The first column labeled 'Estimated DoF' indicates the degree of the best-fitting polynomial. The second column provides the p-value of the estimated degrees of freedom. As the spline estimator allows for piecewise polynomials, the degrees of freedom approximates do not necessarily take integer numbers. If the number equals 1, it implies a linear function in fig. 1. If it is 2, it implies a quadratic function. If 0 is included over the entire confidence band, then the degree of the polynomial is not statistically significant in table 2. The results suggest that the share of public funding, the share of board seats in the hands of the private sector, the share of the budget spent on nonmatching

Table 2. Approximate Significance of Smooth Terms of Estimates in equation (2)

	Dependent variable: ln (budget)	
	Estimated DoF	p-value
Log of population	8.241**	0.020
b_g(Public source of funding)	1.000**	0.017
b_q(Share of private sector over total at board)	2.830**	0.036
b_j(Budget spent on nonmatching grants)	1.000***	0.001
b_i(Rank of TPO responsibility)	3.869***	0.003
b_k(Budget coming from fees for services)	1.866	0.291
Observations	371	
Adjusted R^2	0.960	

Source: Authors' nonparametric estimation of equation (2).
Note: Standard errors in parenthesis. *p <0.1; **p <0.05; ***p <0.01. DoF are degrees of freedom. The explanatory variables and their units of measurement are described in section 2.

Table 3. Approximate Significance of Smooth Terms in Equation (3)

	Dependent variable:			
	ln (exports)		ln (GDP per capita)	
	(1) Est. DoF	(2) p-value	(3) Est. DoF	(4) p-value
Log of population	6.907***	0.001	4.408***	0.006
{b_f(Budget coming from fees for services)} ln(budget)	1.394*	0.063	1.083	0.189
{b_g(Public source of funding)} ln(budget)	1.083	0.198	1.083	0.197
{b_s(Share of private sector seats in board)} ln(budget)	1.145	0.198	1.083	0.193
{b_s(Budget spent of nonmatching grants)} ln(budget)	2.810**	0.013	1.083	0.720
{b_s(Agency responsibility)} ln(budget)	3.076	0.126	1.083	0.187
{b_h(Budget spent on marketing)} ln(budget)	2.984***	0.001	2.761**	0.029
{b_i(Budget spent on export support services)} ln(budget)	1.083	0.200	1.083	0.184
{b_j(Budget on non-exporters)} ln(budget)	1.441	0.791	1.084	0.578
{b_k(Budget on established exporters)} ln(budget)	1.083	0.199	1.083	0.173
{b_l(Budget on small firms)} ln(budget)	1.083	0.207	1.083	0.183
{b_m(Budget on medium-size firms)} ln(budget)	1.083	0.200	1.083	0.191
{b_o(Strategy targets exports in all sectors and destinations)} ln(budget)	1.083*	0.093	1.083	0.578
$b_p(\xi)$	1.000	0.1743	1.000	0.713
Observations	371		371	
Adjusted R^2	0.998		0.997	

Source: Authors' nonparametric estimation of equation (3).
Note: Standard errors in parenthesis. *p <0.1; **p <0.05; ***p <0.01. DoF are degrees of freedom. ξ is the control function. The explanatory variables and their units of measurement are described in section 2.

grants, and the extent to which the agency's responsibility focuses exclusively on export promotion all have an impact on the heterogeneity in returns that is statistically different from zero. In the case of the share of budget coming from fees for services, its confidence band over the entire range includes zero and is therefore not statistically significant.[15]

After estimating (2) it is possible to calculate $\hat{\xi}$, which can then be used as a control variable in the estimation of the nonparametric varying coefficient model (3). The results of the estimation of equation (3) for exports and GDP per capita are reported in figs. 2 and 3, respectively. Regarding exports, the plots suggest that increases in the share of EPAs' funding coming from user fees is associated with a higher impact of export promotion on exports. The same is true for sources of funding coming from public sources. A larger share of seats on the board of the agency in the hands of the private sector is also associated with a higher impact. A larger share of the budget spent on nonmatching grants tends to be associated with lower returns in terms of exports. A broader mandate for the agency in terms of responsibilities also seems to be associated with lower returns. A larger share of the budget spent on marketing activities is associated with higher returns, but the impact is nonmonotonic. A larger share of the budget spent on export support services is associated with higher export returns. Targeting of a few sectors, firms, or destinations rather than promoting all sectors and destinations increases marginal export returns.[16] A larger focus on established exporters relative to occasional exporters increases marginal export returns. The same tends to be true for a larger focus on non-exporters relative to occasional exporters. Targeting small firms rather than large size firms declines the marginal returns in terms of exports. On the other hand, targeting medium rather than large-size firms tend to increase the marginal export returns.

The regression plots in fig. 3 suggest that a higher share of funding obtained from fees for services provided is associated with higher returns in terms of GDP per capita. A larger share of the budget coming from public sources, on the other hand, is associated with lower returns. A larger share of seats in the hands of the private sector is also associated with higher returns. The share spent on nonmatching grants or the extent to which the agency's responsibility focuses exclusively on export promotion does not seem to affect the returns to GDP per capita. Increases in the share of the budget spent on marketing activities increases the marginal returns of export-promotion budgets in terms of GDP per capita, although the impact is nonmonotonic and tends to decrease for very high shares spent on marketing activities. Increases in the share of the budget spent on export support services reduces GDP per capita returns. A more narrow focus on a few sectors and destinations is associated with higher returns in terms of GDP per capita. A larger share of the budget spent on established exporters tends to increase GDP per capita returns relative to occasional exporters. The same is true for non-exporters. Targeting small-size firms rather than large firms does not seem to have an impact on GDP per capita returns. However, a focus on medium-size exporters is associated with higher returns in terms of GDP per capita.[17]

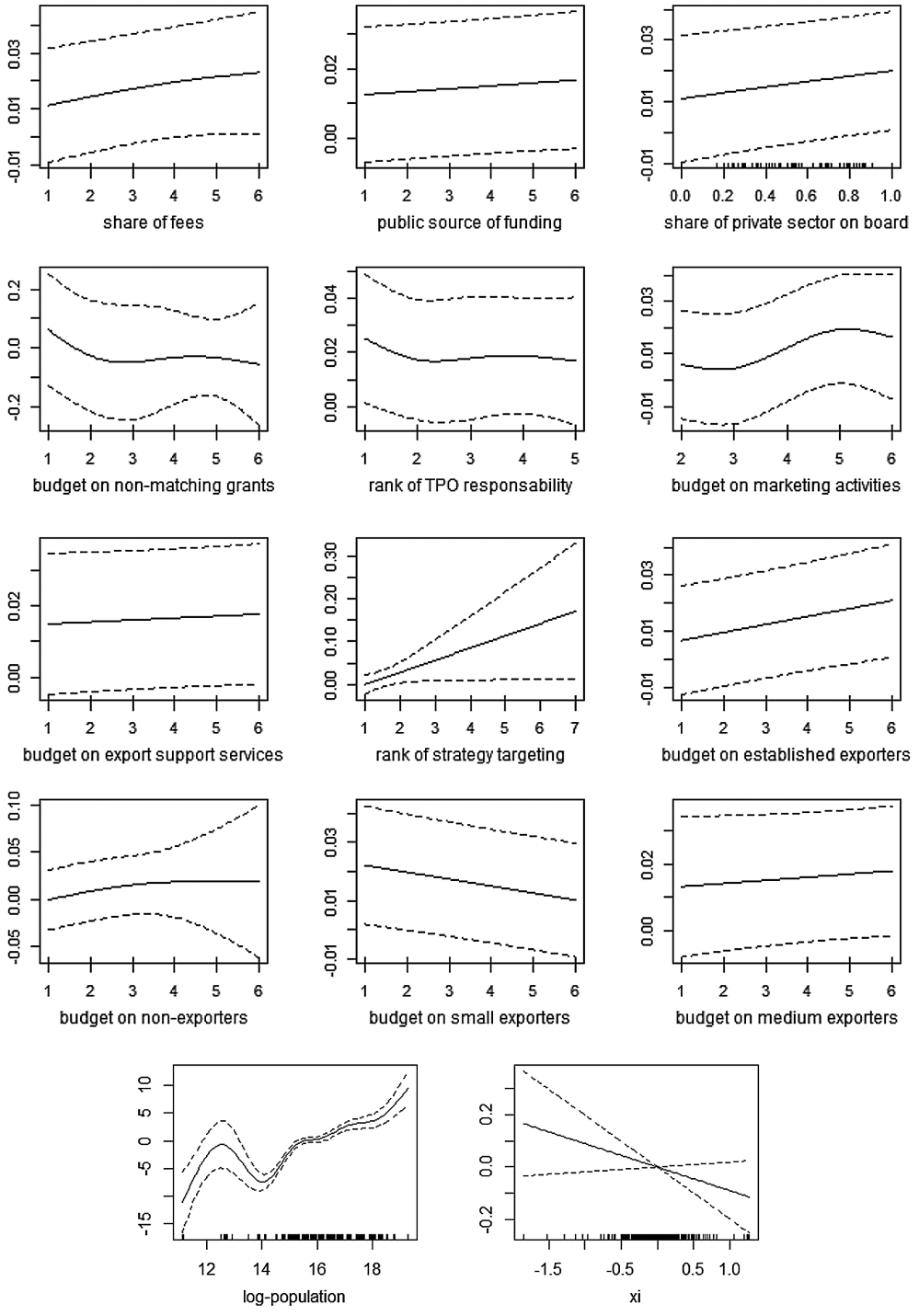
Note that some of the effects described above may not be statistically significant. Table 3 provides information regarding the statistical significance and can (as discussed above for fig. 1 and table 2) be compared with figs. 2 and 3, respectively. It can be seen then that in the export equation the only effects that are statistically different from zero at the 10 percent level are for the varying coefficients of the share of budget coming from fees for services, the share of budget spent on nonmatching grants, marketing activities, and on medium-size firms. In the case of the GDP per capita equation, the only statistically significant varying coefficients are for the share of the budget spent on marketing activities. Interestingly, the control functions

15 As the functions are all centred around zero (i.e., they integrate to zero for identification reasons), it is clear that zero is always included in the confidence band at some point.

16 Recall that a higher value in this variable indicates that the agency tends to target only a few sectors or markets.

17 The supplementary appendix S1 contains the postestimation plots of the residuals, and further goodness of fit analysis. They confirm that no anomalies can be found in the residuals (no evidence of model mis-specification, outliers, poor fit, etc.); they even exhibit normality.

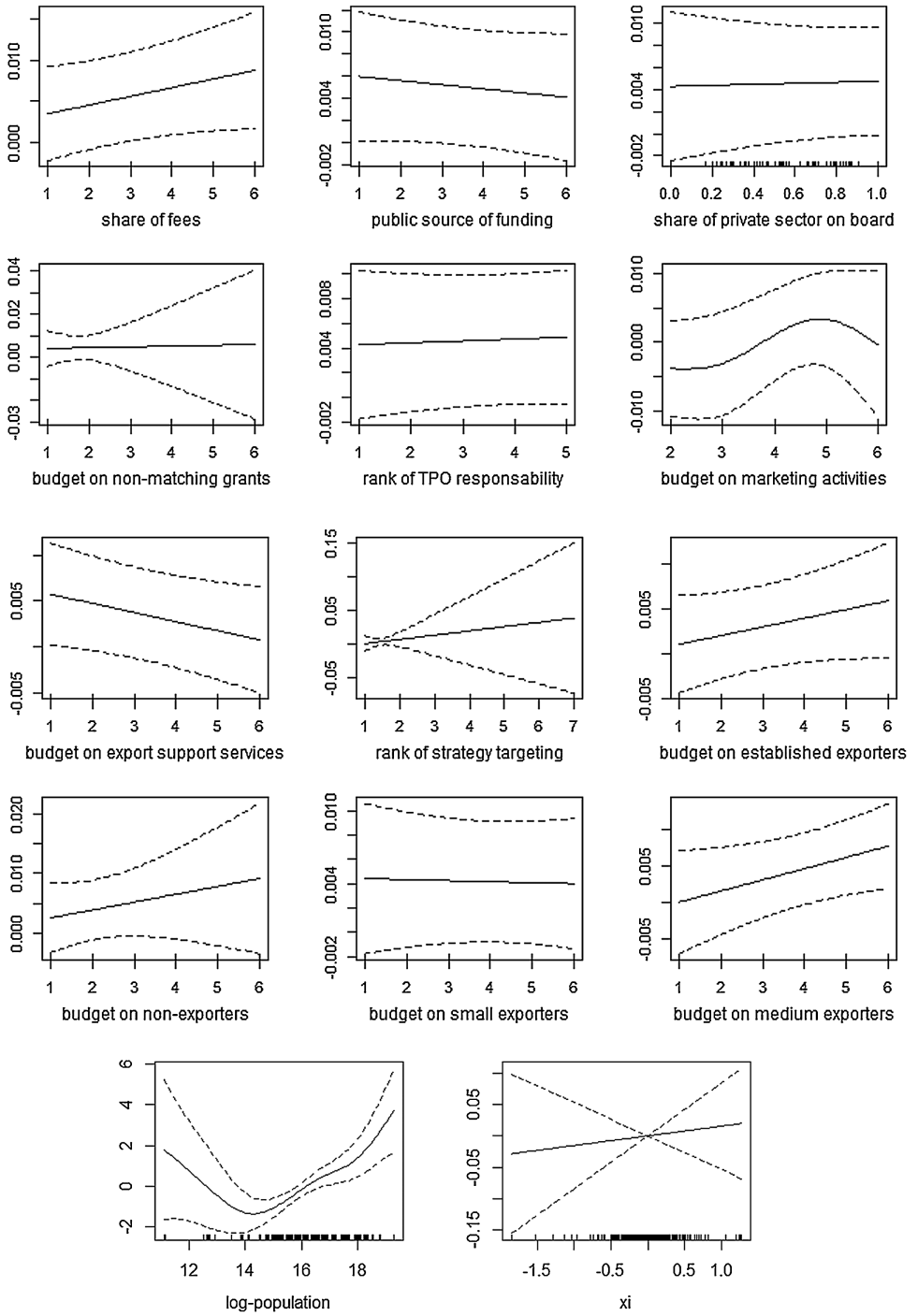
Figure 2. IV Regression Plots of Export Equation



Source: Authors' nonparametric estimation of equation (3) for exports.

Note: The Y axis report in each box reports the values of b and delta (functions of EPA characteristics) in equation (3) when the "outcome" variable is exports. Given the functional form they are all elasticities of exports with respect to EPA's budget (except for log-population and xi) and have thererefore no units. The full line in each plot provides the marginal impact on exports of an increase in EPA's budget for different values of each EPA characteristic. The dotted lines provide the 95 percent confidence band. The explanatory variables and their units of measurement are described in section 2. The last box provides the marginal impact of $\hat{\xi}$ (the error term of the first stage), which is used as a control function for endogeneity in export-promotion budgets.

Figure 3. IV Regression Plots of GDP per Capita Equation



Source: Authors' nonparametric estimation of equation (3) for GDP per capita.

Note: The Y axis report in each box reports the values of b and delta (functions of EPA characteristics) in equation (3) when the "outcome" variable is GDP per capita. Given the functional form they are elasticities of GDP per capita with respect to EPA's budget (except for log-population and xi) and have therefore no units. The full line in each plot provides the marginal impact on GDP per capita of an increase in EPA's budget for different values of each EPA characteristic. The dotted lines provide the 95 percent confidence band. The explanatory variables and their units of measurement are described in section 2. The last box provides the marginal impact of $\hat{\xi}$ (the error term of the first stage) which is used as a control function for endogeneity in export promotion budgets.

are not statistically significant in either of the two regressions. This suggests that once the heterogeneity in returns to export promotion is modeled adequately, there is no endogeneity problem left when estimating the impact of export-promotion budgets on exports or GDP per capita. This is interesting because when equation (3) is run for exports and GDP per capita but without the heterogeneous impact of the export-promotion budget along EPAs' characteristics it is found that the varying coefficients for the control functions become statistically significant. This suggests that, having all fixed effects and population size included, when explicitly modeling the heterogeneous impact of export-promotion budgets across EPA's characteristics, there is no mean-dependency left between the error term and export-promotion budgets (i.e., no endogeneity problem left). This holds for both the export and GDP per capita equations.

The results provided in figs. 2 and 3 can help design more effective EPAs. For example the fact that the larger share of the budget seem to be spent on marketing activities (see fig. 3 in the supplementary appendix S1) is comforting, given that our results tend to suggest that a larger share spent on marketing generally is associated with higher returns in terms of exports and GDP per capita, even though there seems to be some nonmonotonicity in this relationship for very high shares. Nevertheless, the plots in figs. 2 and 3 suggest that the largest returns are observed when this variable takes the value 5, that is, a share corresponding to 50 to 75 percent of the total expenditure. This suggests that there is still room for increasing the share spent on marketing activities in most countries, given that in 75 percent of the countries in the sample this share is below 50 percent (see fig. 3 in the supplementary appendix S1).

More important, it is clear from figs. 2 and 3 that what may be effective in promoting exports (focusing in a few sectors and destinations or a large share of the budget coming from fees for services, for example) may be less effective in increasing GDP per capita. One important message that comes out of this is that trying to evaluate the performance of EPAs by looking at increases in exports may create the wrong incentives when the ultimate goal of EPAs is social and economic welfare proxied here with GDP per capita.

A potential concern with the sample is that the third wave of EPA surveys for the period 2010–2014 only concerns 14 European countries. The study therefore tested the robustness of the results to the exclusion of this third wave from the sample and found that the same variables that are statistically significant in the full sample are also statistically significant for the years 2005–2010 with the exception of the strategic focus on a few sectors and destinations in the export equation. Also, the share of budget spent on established exporters becomes statistically significant in the smaller sample in both the export and GDP per capita equations. Overall the results, which are available in the supplementary appendix, are qualitatively similar in the 2005–2010 sample.

Finally, this study is interested in computing the returns to export promotion in each country as a function of EPA's characteristics. The study proceeds as follows. First, because the control function parameter is never statistically significant the control function is dropped from the estimation of (3). This makes it possible to avoid estimating standard errors over the two stages, which in this case would be inefficient. Then, for each country c and year t the returns to export promotion are estimated by adding the b_i^u functions corresponding to each characteristic i in that country and year. Finally, these yearly returns are averaged for each country. The result is provided in table 4.

To estimate the standard errors the study uses a wild bootstrap version introduced by Mammen (1992) for nonlinear cross-sectional regression models, and studied in Franke, Kreiss, and Mammen (2002) for nonlinear time series data. A main advantage in this case is that it automatically accounts for the presence of unknown heteroscedasticity and potential non-normality. The procedure is as follows; for a sample $\{(Y_{c,t},\ X_{c,t})\}_{t,c=1}^{T,n_t}$ with n_t countries in year t, and estimates $\hat{E}\ [Y_{,ct}\,|X_{c,t}\,]$ bootstrap samples are generated:

$$Y_{c,t}^{*} = \widehat{E}[Y_{c,t}|X_{c,t}] \ + \left(Y_{c,t} - \widehat{E}[Y_{c,t}|X_{c,t}]\right) \cdot \nu\,,\ \ \nu \sim N(0,1).$$

Table 4. Exports and GDP per Capita Returns to Export Promotion

Country	Exports	Wild boot. SE	GDP/capita	Wild boot. SE
Albania	0.11	0.02	0.05	0.02
Armenia	0.04	0.02	0.06	0.01
Australia	0.15	0.03	0.07	0.02
Austria	0.04	0.02	0.06	0.01
Bangladesh	0.13	0.02	0.06	0.02
Barbados	0.12	0.03	0.06	0.02
Belgium	0.06	0.02	0.07	0.02
Belize	0.12	0.03	0.06	0.02
Bosnia Herz.	0.06	0.03	0.06	0.01
Bulgaria	0.09	0.02	0.05	0.02
Burkina Faso	0.11	0.02	0.06	0.02
Costa Rica	0.04	0.02	0.06	0.01
Côte d'Ivoire	0.00	0.04	0.06	0.02
Croatia	0.13	0.02	0.06	0.02
Cyprus	0.00	0.03	0.06	0.02
Denmark	0.11	0.02	0.06	0.02
Dominica	0.10	0.02	0.05	0.02
Dominican Rep.	0.06	0.02	0.07	0.01
Ecuador	0.02	0.04	0.06	0.02
Estonia	0.03	0.02	0.06	0.02
Finland	0.17	0.03	0.07	0.03
Germany	0.14	0.03	0.07	0.02
Guatemala	0.15	0.03	0.07	0.02
Guyana	0.16	0.03	0.07	0.02
Honduras	0.18	0.03	0.07	0.03
Hungary	0.07	0.03	0.07	0.02
Iceland	0.11	0.02	0.06	0.02
Indonesia	0.17	0.03	0.08	0.03
Israel	0.01	0.03	0.06	0.02
Italy	0.15	0.02	0.07	0.02
Jamaica	0.12	0.02	0.06	0.02
Jordan	0.14	0.06	0.06	0.02
Kenya	0.16	0.03	0.07	0.02
Korea Rep.	0.05	0.02	0.06	0.01
Lebanon	0.10	0.02	0.05	0.02
Lithuania	0.13	0.03	0.06	0.02
Macedonia	0.13	0.03	0.06	0.02
Malawi	0.12	0.03	0.05	0.02
Malaysia	0.10	0.05	0.08	0.03
Malta	0.19	0.06	0.10	0.05
Mexico	0.14	0.03	0.07	0.02
Moldova	0.11	0.02	0.06	0.02
Nepal	0.13	0.03	0.06	0.02
Netherlands	0.11	0.02	0.06	0.02
Nicaragua	0.11	0.03	0.10	0.02
Oman	0.03	0.02	0.05	0.01
Panama	0.19	0.04	0.08	0.03
Paraguay	0.01	0.04	0.06	0.02
Philippines	0.13	0.02	0.06	0.02
Portugal	0.22	0.05	0.10	0.04
Rwanda	0.03	0.02	0.05	0.01
Serbia	0.09	0.03	0.07	0.02

Table 4. Continued

Country	Exports	Wild boot. SE	GDP/capita	Wild boot. SE
Slovenia	0.00	0.03	0.06	0.02
Spain	0.12	0.02	0.06	0.02
Switzerland	0.12	0.02	0.06	0.02
Tanzania	0.04	0.02	0.06	0.01
Trinidad and Tobago	0.07	0.03	0.07	0.01
Turkey	0.18	0.04	0.07	0.02
United Kingdom	0.04	0.02	0.06	0.01
Uruguay	0.02	0.03	0.06	0.02
Vietnam	−0.01	0.03	0.06	0.02
West Bank and Gaza	0.13	0.03	0.06	0.02
Yemen	0.13	0.03	0.06	0.02
Zambia	0.06	0.02	0.06	0.01
Average	0.10	0.03	0.06	0.02

Source: Authors' calculation.
Note: Wild Boot. SE are wild bootstrapped standard errors.

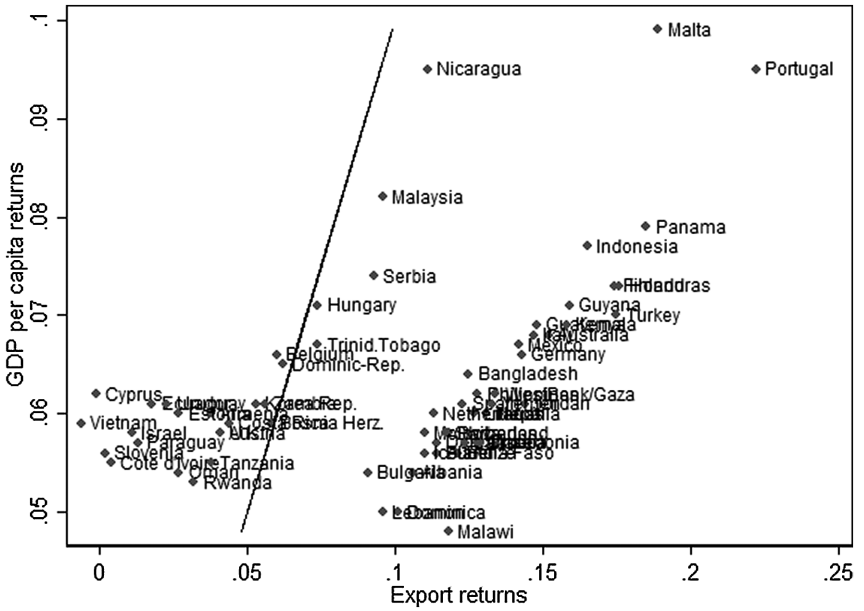
This is done for X being population size and EPA characteristics, and Y being Exports or GDP per capita, respectively. Note that for each bootstrap sample the exogenous variables are kept unchanged from the original data. That is we generate $B = 500$ bootstrap samples $\{(Y^*_{c,t}, X_{c,t})\}^{T,n_t}_{t,c=1}$ and re-estimate the parameter of interest, say β. From the original sample we have $\hat{\beta}$, and the $\{\hat{\beta}^*_b\}^B_{b=1}$ can now be used to estimate the standard errors.[18]

Note that all returns are positive and statistically significant at least at the 95 percent level with a few exceptions. There is a strong and positive correlation between export and GDP per capita returns as illustrated in fig. 4. Thus, the larger are returns in terms of exports, the larger are returns in terms of GDP per capita as well. Note that this does not imply that export and GDP per capita returns are similar within countries. Average export returns are twice as large as returns in terms of GDP per capita as can be seen at the bottom of table 4. Indeed, for the large majority of countries export returns are larger than GDP per capita returns (to the right of the line in fig. 4). However, there is a smaller set of countries for which exports returns tend to be smaller than GDP per capita returns (observations to the left of the line in fig. 4).[19] These differences in exports and GDP per capita returns across countries are explained by differences in EPA's characteristics in each country. Some of these characteristics may have a stronger impact on exports than on GDP per capita and vice-versa. This matters because if the ultimate objective of export promotion is GDP per capita growth, benchmarking policies, institutional setups, or interventions against export growth could be misleading. For example while Malawi and Nicaragua

18 Note that this would be significantly more complex if the standard errors were to be calculated over the two stages. In this case one would need to create bootstrap replicates simultaneously not only for Exports and GDP but also for log-budget, substituting the bootstrap log-budget for the original when generating Y^*, and replicating the dependence structure between ξ and the ε^u. You would then need to repeat the two-step estimation procedure for each bootstrap sample. Given that the control functions are not statistically significant, this is not needed.

19 Note that larger returns in terms of GDP per capita can be explained if, for example, the export-promotion intervention allows domestic firms to better coordinate in the supply chain in order to capture foreign markets. Assume that thanks to an intervention exports double. GDP may more than double if inputs used in the production of exports were previously imported and are now domestically produced. The impact of certain export-promotion activities may be larger on non-exporting firms as well. This may be the case, for example, of export-promotion activities that focused on improving small firms' managerial skills or productivity. Many of these small firms may not be able to circumvent the fixed cost of exporting in spite of the program having a positive impact on their productivity leading to a larger impact on GDP than onexports.

Figure 4. Correlation between Exports and GDP per Capita Marginal Returns



Source: Estimates of exports and GDP per capita returns to export promotion reported in table 4.
Note: This graph correlates the estimates of exports and GDP per capita returns to export promotion reported in table 4. The straight line is a 45° line.

have a similar return in terms of exports, the difference in EPA characteristics lead to much larger returns in terms of GDP per capita in Nicaragua.

5. Concluding Remarks

The literature on export promotion using both firm- and country-level data has focused on estimating the average impact of export-promotion programs on exports. While most of the literature tends to suggest that export promotion helps export growth, this study moves further in two important dimensions. First, it examines not only the impact of export promotion on exports, but also on GDP per capita. Indeed, the ultimate objective of export-promotion policies is not export growth, but social and economic welfare. This study used GDP per capita as a proxy for social and economic welfare and found that the returns in terms of GDP per capita are also large.

Second, the study explores whether the large differences in EPA characteristics across countries translate into differences in returns to export-promotion budgets. It was found that EPAs' characteristics matter. It was found that EPAs that have a larger share of their budget coming from fees for services provided, or spend a larger share of their budget on marketing activities as well as nonmatching grants, or have a strategic mandate to target export promotion of only a few sectors or destinations have larger returns in terms of exports. Of all these characteristics, only the share of expenditure on marketing activities matters for GDP per capita returns.

These results put together suggest that what works in terms of export revenue may not necessarily work in terms of GDP per capita. This has two important implications. First, it is important that EPAs clearly define their objective: Is it export or GDP per capita growth? This has implications for the type of policies and strategies that should be pursued. Second, when evaluating the performance of these agencies and recommending institutional or policy changes, it is important to use the correct benchmark. If agencies

are evaluated against increases in export revenue, this may create the wrong incentives when the objective of the EPA is social and economic welfare.

Finally, a few words of caution. First, while the study controlled for potential endogeneity of the export-promotion budget, when it comes to the heterogeneity of returns over over EPA's characteristics the exercise is exploratory in nature. Consequently, while the study can determine the (expected) budget returns (table 4), to attribute causal interpretations to each $b(\cdot)$-function associated with each EPA characteristics is more delicate. Researchers would need to justify why the EPA characteristics they consider are the relevant ones and why unobservable variables (such as contacts) are not biasing the functional form estimates. This study's choice of EPA characteristics was determined when elaborating the survey through discussions with export-promotion practitioners in the World Bank and ITC. This ensures confidence that unobservable variables are unlikely to be a major source of endogeneity. That said, three is no way of fully ruling out this possibility. Second, some of the characteristics may be highly correlated with each other, which may bias upwards the standard errors. This suggests that the study's estimates are quite conservative. Last, but not least, as explained in section 3 the study has not allowed for interactions among the different EPA characteristics in explaining differences in export-promotion returns. This has been left for future research.

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Supplementary Appendix

Exploring the Heterogeneous Effects of Export Promotion

Marcelo Olarreaga, Stefan Sperlich, and Virginie Trachsel

Supplementary Appendix S1: Data description, post-estimation plots, and further robustness tests

This supplementary appendix presents complementary material to the paper "Exploring the Heterogeneous Effects of Export Promotion" published in *The World Bank Economic Review*. The first section provides additional plots of data description. The second section provides post-estimation plots of the different varying coefficient regressions. The third section provides different robustness checks that we performed.

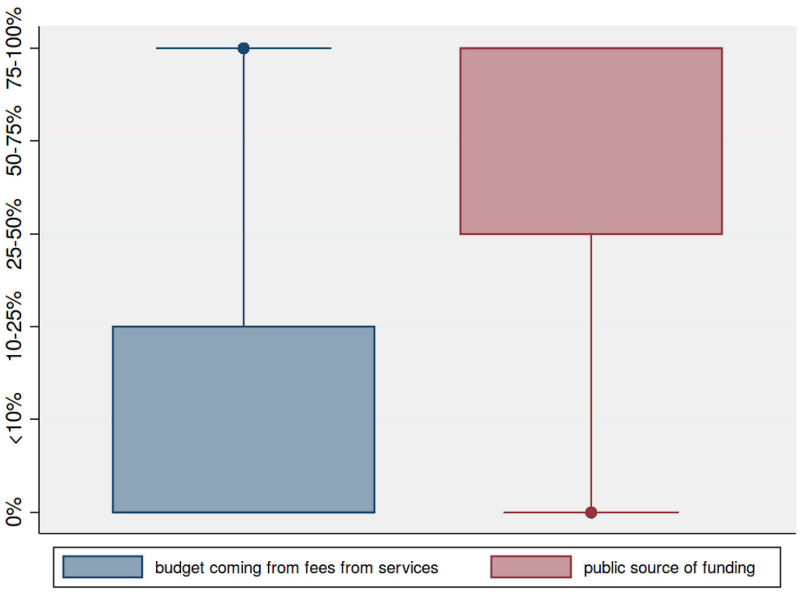
Export Promotion: Data Description

This section provides complementary information to the discussion in section 2 of the paper.

To better illustrate the variance behind some of the average numbers reported in table 1 of the main paper, figs. S1.1 to provide boxplots with the distribution of some of the variables in table 1. Figure S1.1 focuses on sources of funding. The distributions in the boxplots suggest that most agencies are financed by public funding and the source of private funding is much smaller, but there are a few agencies that are exclusively financed by private funding.

Figure S1.2 provides the distribution of EPA budgets to exports in different regions. The first important point is that the export-promotion budget represents a very small share of exports. The sampleS1.5 median is below 0.05 percent. But there is quite a bit of heterogeneity, and in a country like Rwanda the EPA budget represents as much as 4.83 percent of exports on average over 2005–2010. Importantly, the differences within regions are often larger than the differences across regions, which suggests that the heterogeneity may not be associated with geographic factors or the level of development in different countries.

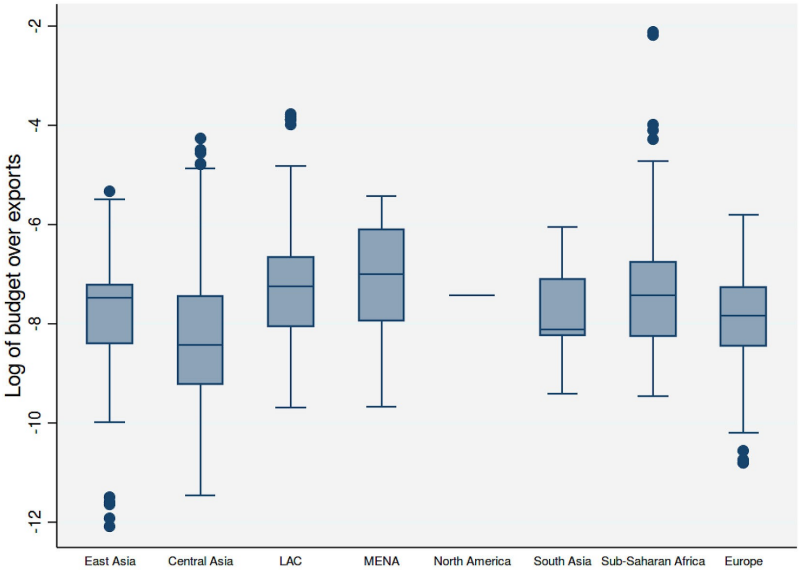
Figure S1.1. Sources of Funding



Source: The data is from the three EPA surveys described in section 2 of the paper.

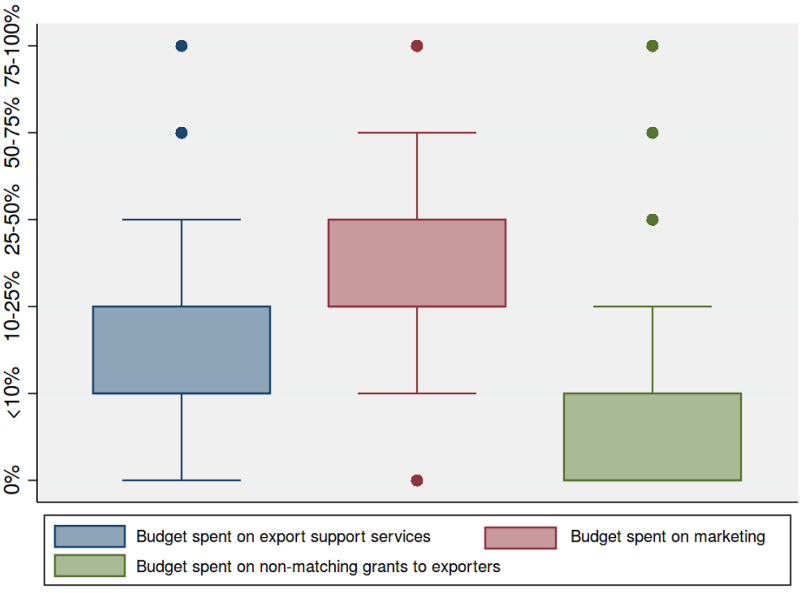
Note: The share of budget variables range from 1 to 6. It takes the value 1 if this share is 0, the value 2 if the share is between 0 and 10 percent, the value 3 if the share is between 10 and 25 percent, the value 4 if the share is between 25 and 50 percent, the value 5 if the share is between 50 and 75 percent, and the value 6 if the share is between 75 and 100 percent. The bottom of the boxplot gives the value at the 25th percentile, the top of the box the value at the 75th percentile. The line in the middle of the box provides median value. The whiskers provide the top and bottom 90th percentile, and the dots above and below the whiskers, the outliers.

Figure S1.2. Budget-to-Export Ratio by Region



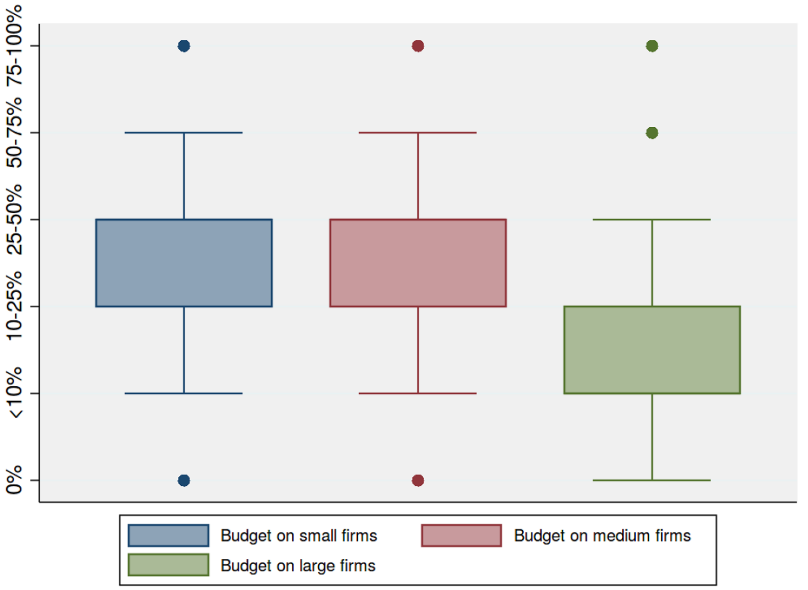
Source: The data is from the three EPA surveys described in section 2 of the paper.
Note: The bottom of the boxplot gives the value at the 25th percentile, the top of the box the value at the 75th percentile. The line in the middle of the box provides median value. The whiskers provide the top and bottom 90th percentile, and the dots above and below the whiskers, the outliers.

Figure S1.3. Share of Budget in Export Support Services, Marketing, and Nonmatching Grants



Source: The data is from the three EPA surveys described in section 2 of the paper.
Note: The share of budget variables ranges from 1 to 6. It takes the value 1 if this share is 0, the value 2 if the share is between 0 and 10 percent, the value 3 if the share is between 10 and 25 percent, the value 4 if the share is between 25 and 50 percent, the value 5 if the share is between 50 and 75 percent, and the value 6 if the share is between 75 and 100 percent. The bottom of the boxplot gives the value at the 25th percentile, the top of the box the value at the 75th percentile. The line in the middle of the box provides the median value. The whiskers provide the top and bottom 90th percentile, and the dots above and below the whiskers, the outliers.

Figure S1.4. Share of Budget Spent on Small, Medium, and Large Firms

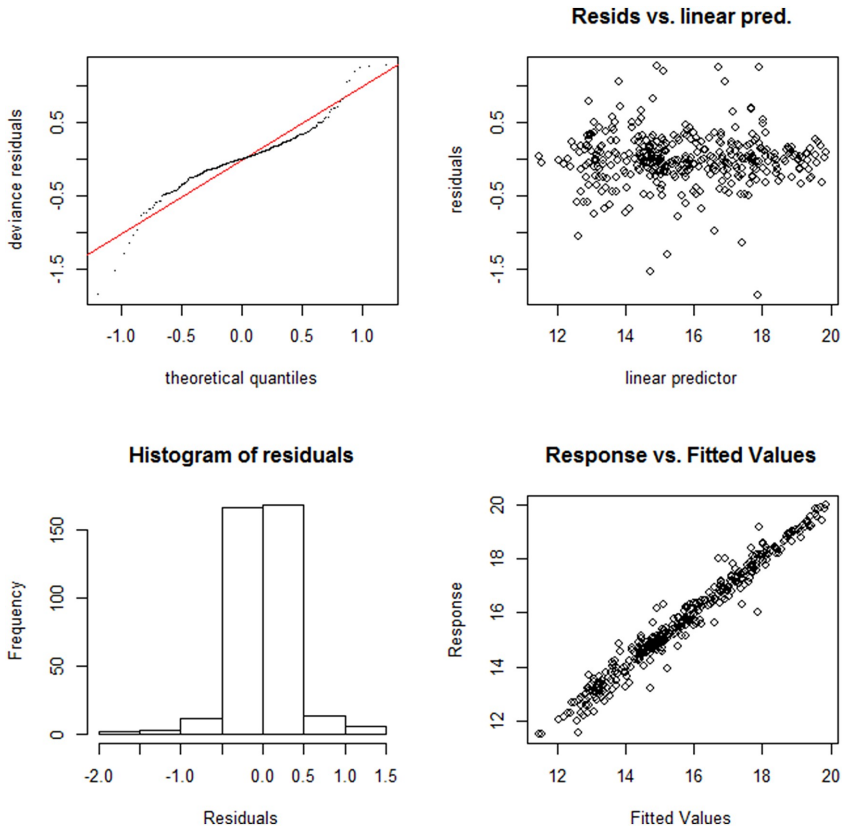


Source: The data is from the three EPA surveys described in section 2 of the paper.
Note: The share of budget variables ranges from 1 to 6. It takes the value 1 if this share is 0, the value 2 if the share is between 0 and 10 percent, the value 3 if the share is between 10 and 25 percent, the value 4 if the share is between 25 and 50 percent, the value 5 if the share is between 50 and 75 percent, and the value 6 if the share is between 75 and 100 percent. The bottom of the boxplot gives the value at the 25th percentile, the top of the box the value at the 75th percentile. The line in the middle of the box provides median value. The whiskers provide the top and bottom 90th percentile, and the dots above and below the whiskers, the outliers.

Figure S1.5. Share of Budget Spent by Type of Exporter

Source: The data is from the three EPA surveys described in section 2 of the paper.
Note: The share of budget variables ranges from 1 to 6. It takes the value 1 if this share is 0, the value 2 if the share is between 0 and 10 percent, the value 3 if the share is between 10 and 25 percent, the value 4 if the share is between 25 and 50 percent, the value 5 if the share is between 50 and 75 percent, and the value 6 if the share is between 75 and 100 percent. The bottom of the boxplot gives the value at the 25th percentile, the top of the box the value at the 75th percentile. The line in the middle of the box provides the median value. The whiskers provide the top and bottom 90th percentile, and the dots above and below the whiskers, the outliers.

Figure S1.6. Postestimation Plots of First-Stage Regression



Source:
Note: Analysis of residuals of authors' nonparametric estimation of first-stage equation (2).

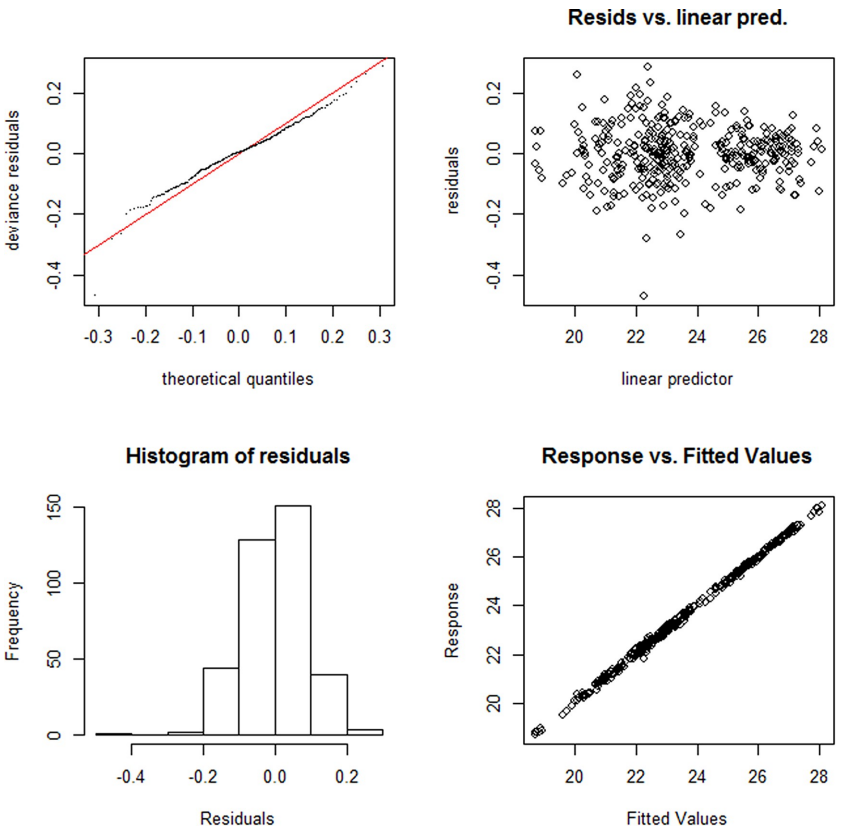
Figure S1.3 shows the relative importance of the budget spent on export support services, marketing services, and nonmatching grants. As shown in table 1, on average EPAs spend the largest share of their budget on marketing, then come export support services, and then nonmatching grants. More importantly, fig. S1.3 suggests that in most countries the largest share is spent in marketing, as the entire distribution of the share spent in marketing tends to be above the distribution of the share spent on export support services or nonmatching grants.

Figure S1.4 illustrates the share of budget spent on small, medium, and large firms. If the distributions of the share spent on small or medium size firms are quite similar, the share spent on large firms tends to have a distribution with values that are much smaller, suggesting that most EPAs tend to focus on either small or medium size firms. Note, however, that in the top 10 percent of the distribution for shares spent on large firms there are some EPAs that spend more than half of their budget on large firms.

Figure S1.5 provides the distribution of the share of the budget spent on exporters, occasional exporters, and non-exporters. The priority seems to be given to established exporters, and then on new or occasional exporters. The budget spent on non-exporters tends to be significantly smaller, but there are a few EPAs that spend all their budget on non-exporters.

An important conclusion when analyzing these figures and the summary statistics provided in table 1 of the paper is that there are important differences in EPAs characteristics in our sample.

Figure S1.7. Postestimation Plots of IV Regression on Exports



Source: Authors' nonparametric estimation of equation (3).
Note: Analysis of residuals of authors' nonparametric estimation of second-stage equation (3) for exports.

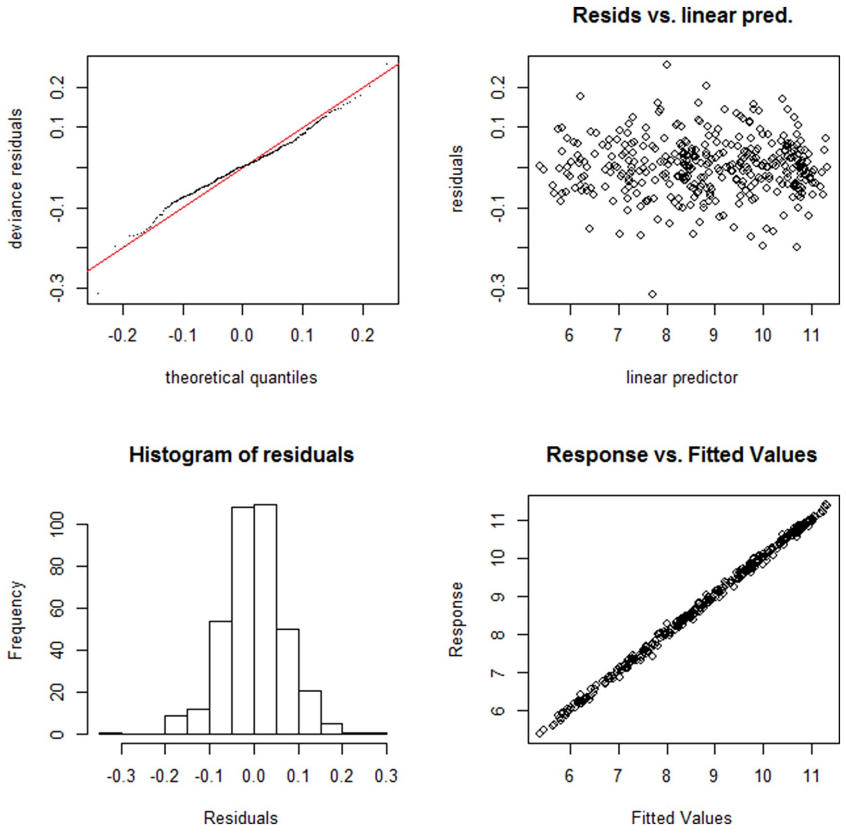
Post-Estimation Plots

This section provides the post-estimation plots of the varying coefficient regressions of the first stage explaining export promotion budgets (fig. S1.6), as well as the second stages explaining both exports (fig. S1.7) and GDP per capita (fig. S1.8). As discussed in the text of this supplement or main paper, in any of the regressions there is evidence of any type of anomaly in the residuals (i.e., no evidence of model misspecification, outliers, poor fit, etc.).

Robustness

The study undertook three different robustness tests to which references are made in the main paper. First, the study explored whether in a standard linear model the interactions between the export promotion budget and EPA's characteristics are statistically significant. The study therefore follows the approach in Lederman, Olarreaga, and Payton (2010) and interacts all the EPA characteristics with the log of the export promotion budget in a standard linear model. Results are reported in table 1 in this supplementary appendix. Columns (1) and (3) provide the estimates using a log-linear specification similar to Lederman, Olarreaga, and Payton (2010) for exports and GDP per capita. Note that in the case of exports (column 1) the study obtains returns to the export-promotion budget that are very similar to the ones obtained by Lederman, Olarreaga, and Payton (2010) (see table 2, page 262 in their paper). Columns (2) and (4) in table S1.1 explore the extent to which there is heterogeneity in export and GDP per capita

Figure S1.8. Postestimation Plots of IV Regression on GDP per Capita



Source: Authors' nonparametric estimation of equation (3).
Note: Analysis of residuals of authors' nonparametric estimation of second-stage equation (3) for GDP per capita.

returns that can be explained by EPA's characteristics. Results suggest that some EPA characteristics do indeed affect the impact of export-promotion budgets on exports and GDP per capita. For example, as with the varying coefficient estimates the share of expenditure on marketing activities does affect the returns to both exports and GDP per capita. Note, however, that the varying coefficient estimates in the paper suggest that some of the heterogeneous impacts tend to be nonmonotonic in both the exports and GDP per capita regressions. This nonmonotonicity cannot be captured in the estimates in table S1.1 in this supplementary appendix because this study imposes a log-linear interaction between the budget and EPA's characteristics. Note also that if the study were to introduce each EPA characteristic individually in the log-linear regression, then almost all of them would turn out to be statistically significant, suggesting again heterogeneity in returns along EPA's characteristics.

The second robustness check relaxes the assumption that export-promotion budgets and exports or GDP per capita are contemporaneous. This is a strong assumption as export promotion may have an impact with some time lag. The study therefore explores the possibility of export promotion having an impact on exports with lags of one, two, and three years. Table S1.2 in this supplementary appendix, which corresponds to table 3 in the main paper, reports the estimated degrees of freedom and their statistical significance using the two-year lag export-promotion budget instead of the contemporaneous export promotion budget. Results are similar for one- and three-year lags. Figures S1.9 and S1.10 in this appendix report the regression plots corresponding to figs. 2 and 3 in the main paper. For exports,

Table S1.1. Heterogeneous Returns with a Log-Linear Model

	ln (exports)		ln (GDP per capita)	
	(1)	(2)	(3)	(4)
Log of population	2.217***	2.107***	0.725**	0.525*
	(0.500)	(0.571)	(0.283)	(0.271)
Log of EPA budget in USD	0.046**	0.038*	0.056***	0.043***
	(0.022)	(0.023)	(0.014)	(0.015)
Budget x share of fees		0.002		0.001
		(0.001)		(0.001)
Budget x share of public funding		0.000		0.000
		(0.001)		(0.001)
Budget x share of private seats		0.002		0.001
		(0.003)		(0.003)
Budget x Dummy for main mandate		−0.000		0.000
		(0.001)		(0.001)
Budget x export support services		−0.000		−0.001**
		(0.001)		(0.001)
Budget x established exporters		0.002		0.000
		(0.001)		(0.001)
Budget x matching grants		0.005		0.003
		(0.003)		(0.003)
Budget x small firms		−0.001		0.000
		(0.001)		(0.001)
Budget x share of medium-size firms		0.000		0.002*
		(0.001)		(0.001)
Budget x share of non-exporters		0.001		0.001
		(0.002)		(0.002)
Budget x share of marketing activ.		0.003**		0.002**
		(0.001)		(0.001)
Adjusted R^2	0.997	0.998	0.996	0.997

Source: Authors' estimation using a log-linear model with interactions.
Note: All estimates are obtained using linear regressions with country and year fixed effects. Robust standard errors in parenthesis. *p < 0.1; **p < 0.05; ***p < 0.01.

the study does not find any statistically significant effects (apart from population) as can be seen from table S1.2 and fig.S1.1 in this supplementary appendix. Indeed all polynomial functions are (almost) flat over the entire range. For GDP per capita the significant varying coefficients are that of export support services, the share of the budget spent on small exporters, and the share of the budget spent on established exporters as can be seen from table S1.1 and fig. S1.2 below. This is different from the significant varying coefficient in the GDP per capita equation reported in table 3 and fig. 3 in the main paper, which suggests that the only statistically significant varying coefficient is the one for marketing activities. One could interpret these results as suggesting that the type of export promotion activity (marketing) that matters for GDP per capita growth within the same year is (not surprisingly) different from the export-promotion activity that matters with two-year lags (share of budget on small firms, export-support services, and established exporters). However, given the short time dimension in the sample, the authors prefer not to overemphasize the timing aspect. The lack of robustness of results is more likely to be due to the fact that the sample is too small once one, two, or three-year lags are taken. Please also note that the fact that contemporaneous effects are statistically significant whereas the lagged export promotion budgets are not is also present when using a fully log-linear parametric model without any varying coefficients. In this case the study finds that the contemporaneous effect of export promotion budgets on exports and GDP per capita is positive and statistically significant and very close to the estimates in

Table S1.2. Approximate Significance of Smooth Terms in Equation (3) Using Two-Year Lags for Export-Promotion Budget

	Dependent variable:			
	ln (exports)		ln (GDP per capita)	
	(1) Est. DoF	(2) p-value	(3) Est. DoF	(4) p-value
Log of population	2.147***	0.001	3.948***	0.006
{b_f(Budget coming from fees for services)} ln(budget)	0.000	0.861	0.000	1.000
{b_g(Public source of funding)} ln(budget)	0.109	0.248	0.000	0.739
{b_g(Share of private sector seats in board)} ln(budget)	0.000	0.461	0.000	0.731
{b_g(Share of nonmatching grants)} ln(budget)	0.000	0.382	0.000	0.374
{b_g(Agency responsibility)} ln(budget)	0.000	0.993	0.000	0.851
{b_h(Budget spent on marketing)} ln(budget)	0.000	0.393	0.000	0.516
{b_i(Budget spent on export support services)} ln(budget)	0.000	0.299	0.719**	0.043
{b_j(Budget on non-exporters)} ln(budget)	0.270	0.213	0.000	0.357
{b_k(Budget on established exporters)} ln(budget)	0.000	0.967	2.726*	0.074
{b_l(Budget on small firms)} ln(budget)	0.000	0.509	0.847***	0.005
{b_m(Budget on medium-size firms)} ln(budget)	0.000	0.356	0.000	0.934
{b_o(Strategy targets exports in all sectors and destinations)} ln(budget)	0.000	0.502	0.000	0.770
$b_p(\xi)$	0.127	0.276	1.000	1.000
Observations	199		199	
Adjusted R^2	0.996		0.996	

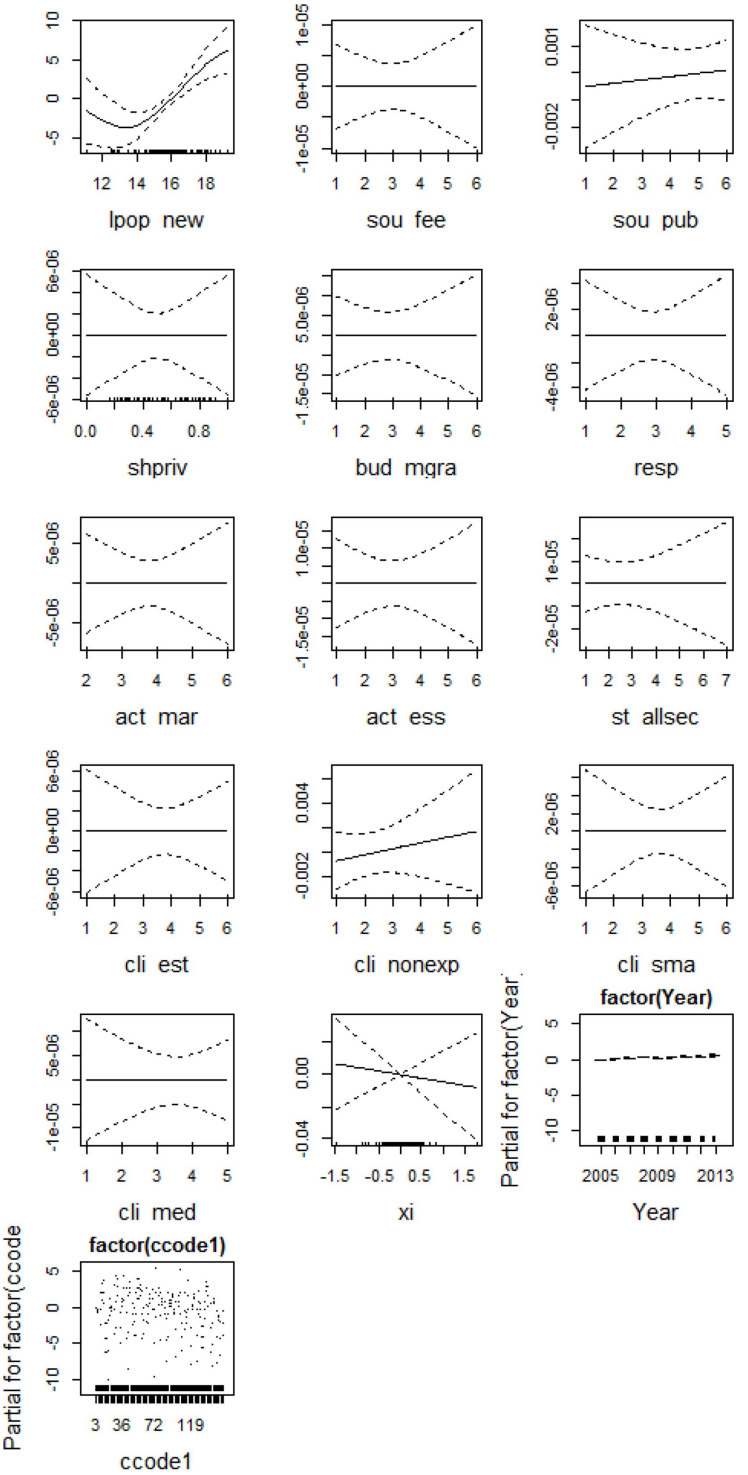
Source: Author non-parametric estimates of equation (3).
Note: Standard errors in parenthesis. *p < 0.1; **p < 0.05; ***p < 0.01.

Lederman, Olarreaga, and Payton 2010 (in the case of the export equation). However, when the study lags one, two, or three years, the coefficients on export promotion budgets are all statistically insignificant.

The third robustness check the study performed involved excluding the third wave of the EPA survey for the period 2010–2014. It only concerned 14 European countries. The study therefore tested the robustness of these results to the exclusion of this third wave from the sample and found that the same variables that are statistically significant in the full sample are also statistically significant in 2005–2010 with the exception of the strategic focus on a few sectors and destinations in the export equation. Also, the share of budget spent on established exporters becomes statistically significant in the smaller sample in both the export and GDP per capita equations. The control function is also statistically significant in the 2005–2010 sample, whereas in the full sample it was not. The reason is simple. In the reduced sample the study loses almost 30 percent of all years corresponding to 31 observations. The within variation is then dramatically reduced so that even population size becomes insignificant when explaining the size of the export-promotion budget, and only the share of fees for services and the ranking of EPA responsabilities remain significant predictors (with p-values of about 4 percent, but only the latter exhibiting some prediction power). This means, that in the reduced sample, $\hat{\xi}$ represents a much larger share of the within-variation in the export promotion budget. Consequently, if the export-promotion budget variation is important for exports and GDP, the control function is likely to become statistically significant.

Figures S1.11 and S1.12 in this appendix corresponding to figs. 2 and 3 in the main paper report the regression plots. They suggest that there are not large differences between the results in the two samples. One could argue that the small differences (i.e., the statistical significance of the budget spent on established exporters in the 2005–2010 sample) could be due to the larger presence of developed countries in the full sample, but this would probably be overinterpreting these small differences. Note that both in the 2005–2010 sample and in the full sample the impact of an increase in the export-promotion budget

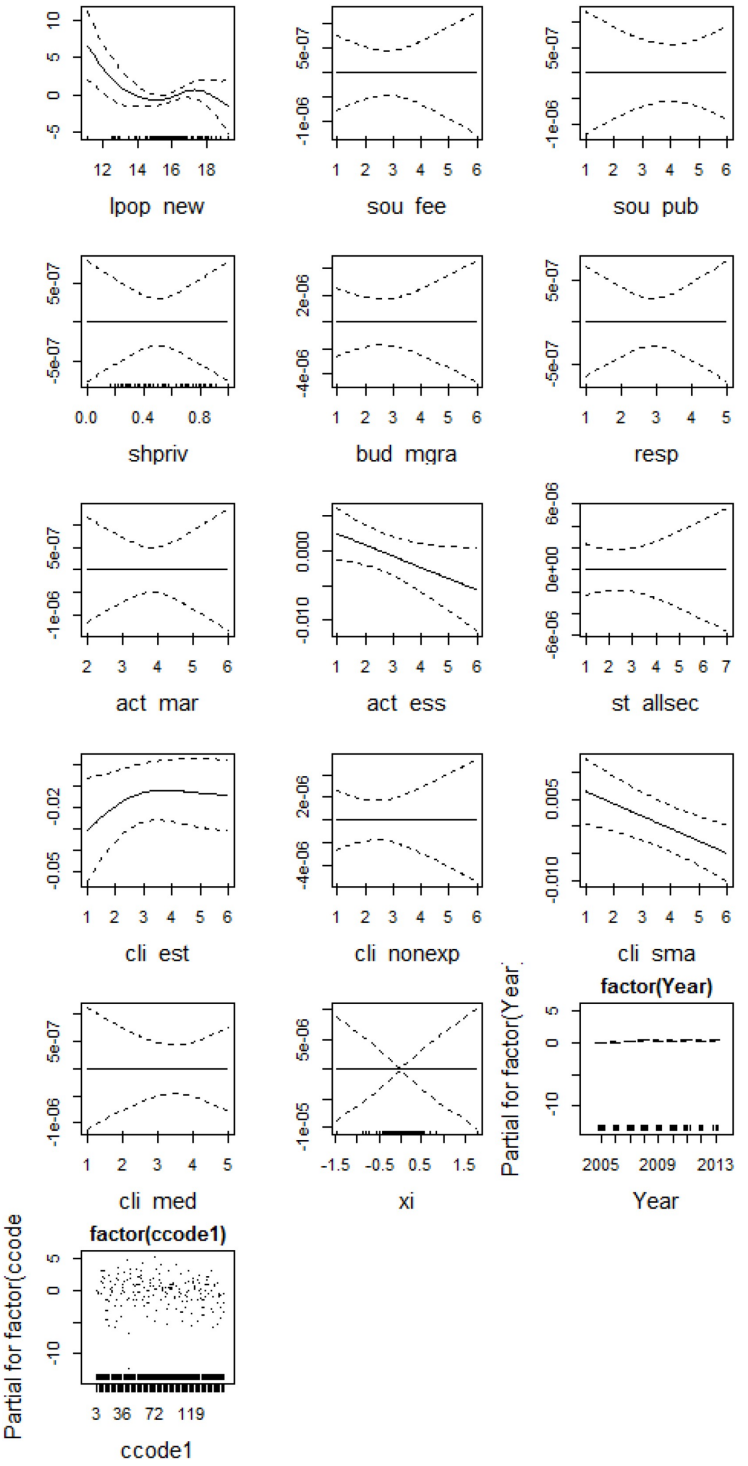
Figure S1.9. Plots of Second Stage Regression for Exports using Two-Year Lags



Source: Authors' nonparametric estimation of equation (3) for exports.

Note: The full line in each plot provides the marginal impact on exports of an increase in EPA's budget for different values of each EPA characteristic. The dotted lines provide the 95 percent confidence band.

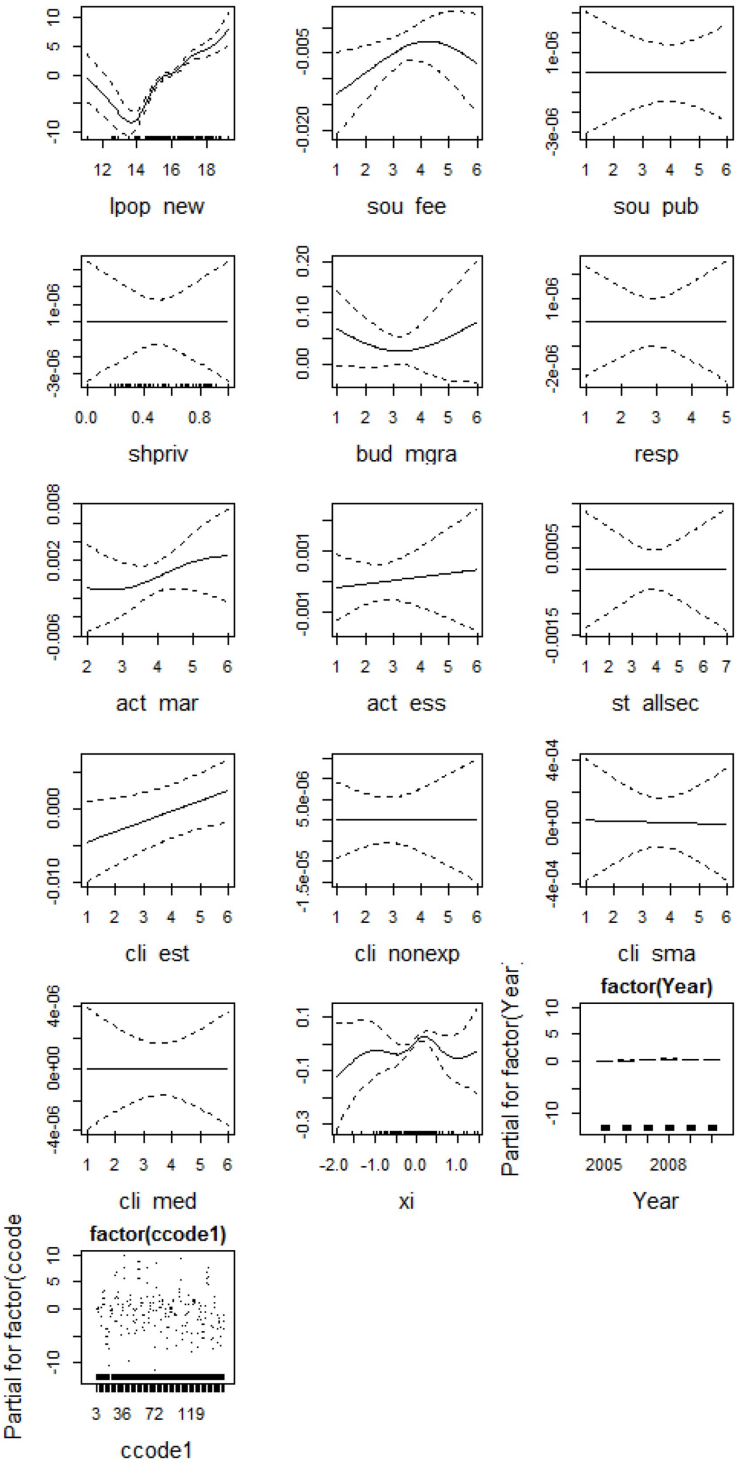
Figure S1.10. Plots of Second-Stage Regression for GDP per Capita with Two-Year Lags



Source: Authors' nonparametric estimation of equation (3) for GDP per capita.

Note: The full line in each plot provides the marginal impact on GDP per capita of an increase in EPA's budget for different values of each EPA characteristic. The dotted lines provide the 95 percent confidence band.

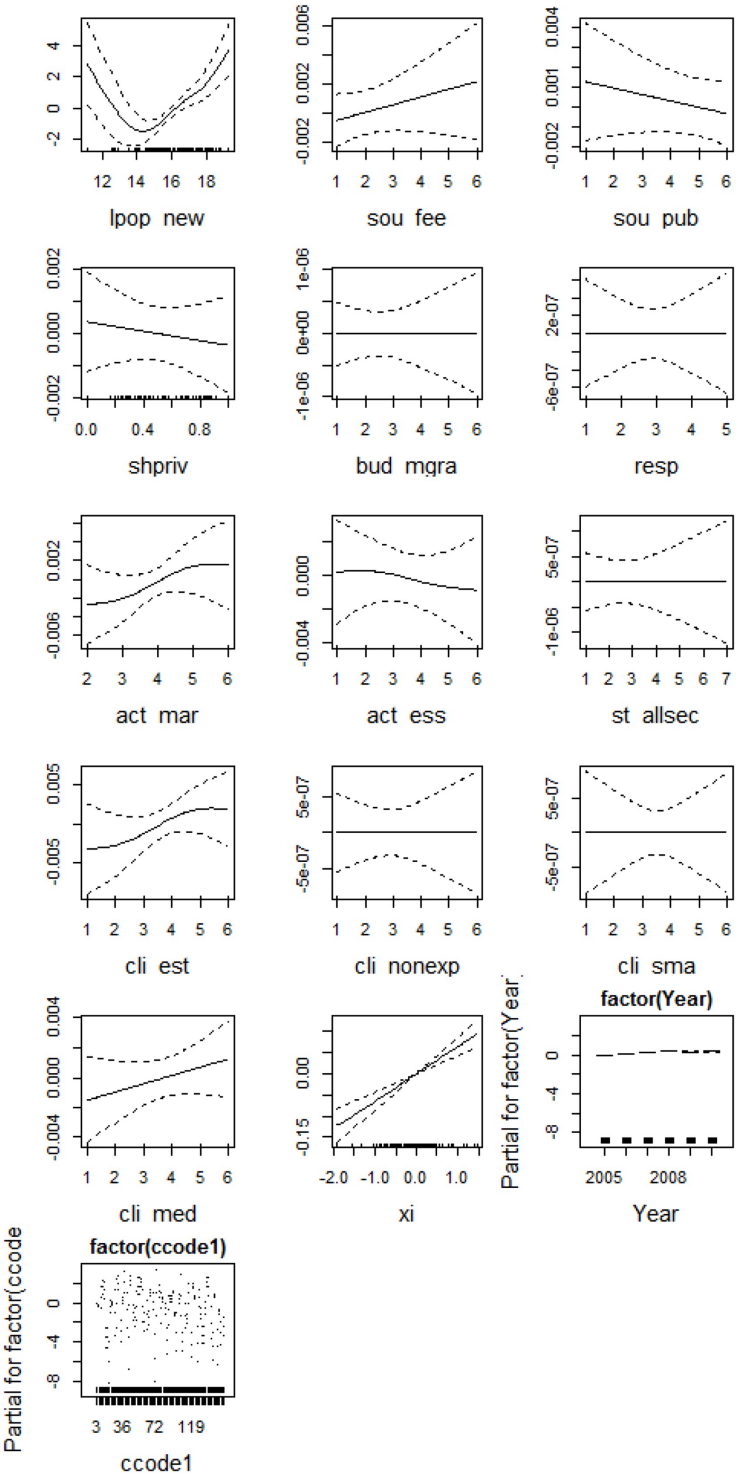
Figure S1.11. Plots of Second-Stage Regression for Exports, 2005–2010 Sample



Source: Authors' nonparametric estimation of equation (3) for exports.

Note: The full line in each plot provides the marginal impact on exports of an increase in EPA's budget for different values of each EPA characteristic. The dotted lines provide the 95 percent confidence band.

Figure S1.12. Plots of Second-Stage Regression for GDP per Capita, 2005–2010 Sample



Source: Authors' nonparametric estimation of equation (3) for GDP per capita.

Note: The full line in each plot provides the marginal impact on GDP per capita of an increase in EPA's budget for different values of each EPA characteristic. The dotted lines provide the 95 percent confidence band.

on exports and GDP per capita increases with the share spent on established exporters. The differences between the 2005–2010 results and the full sample results is that in the former the varying coefficients are statistically significant. The authors have now added a discussion on the robustness of the results to the 2005–2010 sample in section 4.