# An evaluation of export promotion programmes with repeated multiple treatments

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# Outline



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# Export promotion programs (EPPs)

EPPs are a usual tool of enterprise policy worldwide, additional to custom and exchange-rate policies

**Economic theory**: selling abroad involves sunk costs and only the "better" firms (efficient or productive) are able to overcome these entry barriers and export successfully (Bernard and Jensen, 1999; Melitz, 2003)

**Policy Rationale**: compensate a number of possible deficiencies of firms in terms of information, know-how, business linkages or finance. **Very important for SMEs**

They stimulate participation in / receipt of / set up of:

- international fairs
- trade missions with B2B meetings
- specialized consultancies
- temporary sale outlets
- subsidies, ...

It makes sense that firms willing to enter a new market may need **more than one type of support**, or also **repeated support**

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# Previous literature on the analysis of EPPs

Unlike other enterprise policies (e.g. R&D or investment subsidies), empirical analyses on EPPs are rather uncommon. Most of the existing literature comprise:

- Spence (2003, UK): overseas trade missions, **if repeated, contribute to the generation of incremental exports** by enhancing the relationship between business partners
- In a series or work on Latin American countries Martincus & Carballo (MC) analyse the impact of export assistance provided by agencies and make the distinction between two outcomes: size of trade flows (*intensive margin*); new markets or new products (*extensive margin*). Their findings suggest that EPPs:
  - are overall **beneficial for smaller firms** (MC, 2010/Chile; Martincus et al, 2010/Argentina)
  - are overall more **effective on the extensive** than on the intensive margin (MC, 2008/Peru and 2010/Uruguay; Martincus et al, 2010b/Argentina)
  - **bundled services** combining counselling, trade agenda, and trade missions and fairs **are more effective** than isolated assistance actions (MC, 2010/Colombia)
- According to more "descriptive" contributions, export assistance is beneficial with regard to the formation of marketing competencies and export strategies (Francis & Collins-Dodd, 2004/ Canada; Wilkinson and Brouthers, 2006/ US), but **not all kind of supports have the same effects** (Alvarez, 2004/ Chile).

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# Aim and Novelty of this work

We build on the approach of Martincus & Carballo (2010/ Colombia).

- We are interested not only in estimating the **causal effects of alternative export supports** (fairs, B2B, consultancies, subsidies)

Since the provision of different supports occurs not only simultaneously (as in MC, 2010/ Colombia) and it is common that firms take sequences of (potentially different) supports in time, we have to address the issue of **dynamic confounding**.

Under the assumption of **sequential ignorability** we should be able to disentangle what has really affected their outcome at a particular time point.

- We are interested in the **timing of causal effects**, not only simultaneous ones but also after 1, 2, ... years

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# Outcomes of interest

We reconstruct firm-level export flows based on custom declarations (from the SDOE dataset, held by the Italian Chambers of Commerce).

Our outcomes variables are:

- the value of non European firm exports
- the number of non European market served
- the number of products exported in non European markets

We limit the analysis to non European export since the program under scrutiny are mostly aimed at promoting export towards non-EU countries.

The focus will be on variations and not on levels. This differences-in-difference approach enables us to get rid of firm fixed effects.

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# Data

We analyse export promotion programs for SMEs implemented in Tuscany (Italy) in the period 2006-2012. They consist of:

- Free specific supports (fairs, B2B, consultancies) offered by the local export promotion public agency (Toscana Promozione)
- Direct provision of subsidies by the regional Government through a program that offer export grants to firms for a series of goals, including those above mentioned

A main characteristic of this programs is that **firms were allowed to take multiple supports, also repeatedly over time**. In fact the repeated intake of multiple treatments occurred rather frequently.

Beneficiaries of these supports are 1648 small and medium-size manufacturing firms. Firms's data are derived from the ASIA datasets (held by ISTAT).

In addition, we are also included a set of never-treated firms. This set is selected by means of matched sampling techniques (Rosenbaum and Rubin, 1985) based on pre-2006 covariates, so that we obtain a never-treated twin for each firm that will receive support in the future.

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# Descriptive statistics (I)

Table: Firms' characteristics **before treatments**.

| | Treated firms | Non treated firms | Matched non treated firms |
|---|---|---|---|
| n. of employees (mean) | 21 | 4.1 | 17.5 |
| age (mean) | 19.5 | 15.3 | 19.6 |
| corporations (quote) | 74.8% | 17.2% | 74.6% |
| No exporters (quote) | 12.6% | 83.11% | 12.9% |
| Only EU exporters (quote) | 4.6% | 3.77% | 4.6% |
| Occasional Extra-EU exporters (quote) | 14.6% | 6.87% | 14.7% |
| Habitual Extra-EU exporters (quote) | 68.1% | 6.24% | 67.8% |
| N. of EU markets served (mean) | 5 | 0.2 | 4.4 |
| N. of Extra-EU markets served (mean) | 7 | 0.4 | 5.6 |
| N. of products exported in EU markets (mean) | 6 | 0.3 | 5.2 |
| N. of products exported in Extra-EU markets (mean) | 9.7 | 0.5 | 8.1 |
| Value of EU export (mean, x1000 euro) | 1097 | 47 | 825 |
| Value of Extra-EU export (mean, x1000 euro) | 1015 | 38 | 727 |

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# Descriptive statistics (II)

The 4 supports can be repeated in time and can be assigned simultaneously: 16 possible combinations of supports at each time (1 null + 15 active treatments).

| Fair | B2B | Consultancy | Subsidy | Freq. | % active tr. |
|---|---|---|---|---|---|
| No | No | No | No | 8693 | |
| Yes | No | No | No | 476 | 16.74% |
| No | Yes | No | No | 517 | 18.19% |
| No | No | Yes | No | 1038 | 36.51% |
| No | No | No | Yes | 511 | 17.97% |
| Yes | Yes | No | No | 50 | 1.76% |
| Yes | No | Yes | No | 62 | 2.18% |
| Yes | No | No | Yes | 29 | 1.02% |
| No | Yes | Yes | No | 68 | 2.39% |
| No | Yes | No | Yes | 39 | 1.37% |
| No | No | Yes | Yes | 20 | 0.70% |
| Yes | Yes | Yes | No | 19 | 0.67% |
| Yes | Yes | No | Yes | 7 | 0.25% |
| Yes | No | Yes | Yes | 3 | 0.11% |
| No | Yes | Yes | Yes | 4 | 0.14% |
| Yes | Yes | Yes | Yes | 0 | 0.00% |

We have 1648 firms that receive al least one support in the period 2006-2012: **688 are treated more than one time**, **960 are treated only one time**.

| N. repetitions | 0 | 1 | 2 | 3 | 4+ |
|---|---|---|---|---|---|
| Fair | 1323 | 232 | 50 | 24 | 16 |
| B2B | 1252 | 295 | 77 | 17 | 4 |
| Consultancy | 836 | 648 | 119 | 26 | 16 |
| Subsidy | 1254 | 286 | 91 | 14 | - |
| Fair & B2B | 1577 | 62 | 5 | 0 | 1 |
| Fair & Consultancy | 1573 | 63 | 6 | 3 | 0 |
| B2B & Consultancy | 1565 | 73 | 4 | 2 | 1 |
| Fair & Subsidy | 1616 | 20 | 8 | 1 | - |
| B2B & Subsidy | 1603 | 34 | 8 | 0 | - |
| Consultancy & Subsidy | 1619 | 25 | 1 | 0 | - |

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# Marginal structural models (I)

In a **longitudinal setting with sequential treatments**, unit $i$ is followed for a $T$ times and it can receive some treatment $A(t)$, e.g. $a_1$, $a_2$, ..., $a_m$, at multiple times $t = 1, ..., T$

At each time $t$ this unit is associated with $m$ potential outcomes $Y_i(A_t = a_1)$, ..., $Y_i(A_t = a_m)$.

Let $\bar{A}_i(t-1)$ and $\bar{\mathbf{L}}_i(t-1)$ be, respectively, the unit's treatment history and the unit's covariates history up to moment $t$.

We **need to control for dynamic confounders**, i.e., variables that are affected by past treatment and that affect future treatment assignment in the sequence.

Using the potential outcomes framework in longitudinal settings, some assumptions are usually made:

- **Stable unit-treatment value assumption** (no interference): the potential outcomes values for each unit are only functions of its own treatment history up to that point in time.
- **Sequential ignorability assumption** (unconfoundedness): the $m$ potential outcomes in $t$ are independent of the current treatment assignment mechanism, conditional on the unit's past history of treatments and covariates, the latter including past observed outcomes:

$$Y_i\left[A_i(t) = a_1\right], ..., Y_i\left[A_i(t) = a_m\right] \perp A_i(t) | \bar{A}_i(t-1), \bar{\mathbf{L}}_i(t-1).$$

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# Marginal structural models (II)

Under the previous assumptions, treatment effects can be consistently estimated with a **marginal structural model** (Robins et al. 2000).

Marginal structural models do not require to model the relation of the outcome to the confounders, instead they require to specify the relation of the confounders to the selection/assignment process (to obtain a propensity score).

Estimation occurs in two stages:

1. Being a **propensity-score-based methodology**, a MSM requires to model the treatment receipt as a function of the past histories of treatment, outcome and covariates, which is synthesized by the weights.
2. Relying on **inverse-probability-of-treatment weighting** (IPTW) in order to adjust for time- dependent observed confounders, treatment effect estimation is carried out by means of a **weighted regression**.

The **longitudinal propensity score** at each time $t$ is

$$Pr\left[A(t) = a(t) | \bar{A}(t-1) = \bar{a}(t-1), \bar{\mathbf{L}}(t-1) = \bar{\mathbf{l}}(t-1)\right]$$

and can be estimated with a generalised linear model suitable for multinomial variables.

# Inverse probability of treatment weights

IPTW are the inverse of the probability of having one's own treatment history, conditional on past time-varying covariates $\bar{\mathbf{L}}_i(t-1)$, which include baseline covariates $\mathbf{V}_i$ and past outcomes, and previous treatments $\bar{A}_i(t-1)$.

$$w_i(t) = \prod_{k=0}^{t} \frac{1}{Pr\left[A_i(k) = a_i(k) | \bar{A}_i(k-1) = \bar{a}_i(k-1), \bar{\mathbf{L}}_i(k-1) = \bar{\mathbf{l}}_i(k-1), \mathbf{V}_i = \mathbf{v}_i\right]}$$

A stabilized version of the weights is preferable due to its small variance and narrower confidence intervals (Hernan et al, 2000; Robins et al. 2000).

$$sw_i(t) = \prod_{k=0}^{t} \frac{Pr\left[A_i(k) = a_i(k) | \bar{A}_i(k-1) = \bar{a}_i(k-1), \mathbf{V}_i = \mathbf{v}_i\right]}{Pr\left[A_i(k) = a_i(k) | \bar{A}_i(k-1) = \bar{a}_i(k-1), \bar{\mathbf{L}}_i(k-1) = \bar{\mathbf{l}}_i(k-1), \mathbf{V}_i = \mathbf{v}_i\right]}$$

MSMs may be sensitive to model misspecification of the treatment assignment mechanism, resulting in poorly balanced PSs and, thus, in extreme weights.

Common support and covariate balance issues should be accurately checked for.

In addition, we need to check the distribution of the weights, both overall and year by year, and (if needed) trim the observations whose weight are too large.

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# Construction of the weights

Since, at each point in time, we have multiple alternative treatments which can be combined with each other, we estimate our propensity scores with a multinomial model, assuming each possible combination of treatment as a treatment per se (Lechner, 2001).

Variables included in the multinomial model:

- **Treatment history** (2 previous years)
- **Baseline covariates** (pre-treatment year)
  - Sector of activity (Food, Fashion, Jewellery, Machinery, Furniture, Other manif., Retail)
  - Non European export history (No experience, Occasional, Habitual, Only EU exporter)
  - Artisan or Industrial firm
  - Legal form
  - Age
- **Time-varying covariates** (2 previous years + pre-treatment year)
  - Number of employees
  - Annual revenue (in class)
  - Value of European exports, Number of products exported in Europe and Number of European market served in the previous year
  - Value of non European exports, Number of products exported outside Europe and Number of non European market served in the previous year

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# Distribution of the weights

After checking for common support and covariate balance, we exclude a few firms with histories that are too unlikely and obtain the weights below:

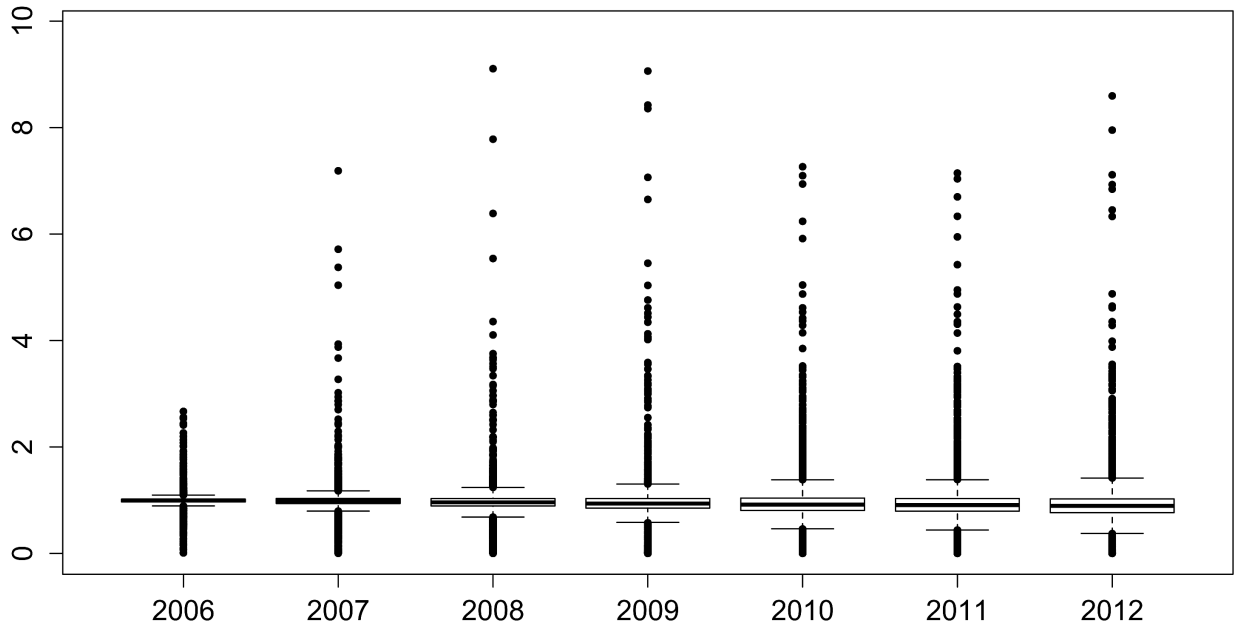


Figure: Box-plots of the inverse probability-of-treatment weights for the years 2006-2012

Now we need to specify models linking outcomes to treatments (treatment histories) and estimate them by means of weighted regressions

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# Model Specification

The 3 outcomes ($Y^{Market}$, $Y^{Product}$, $Y^{Sales}$) are expressed as first differences in order to discard individual fixed effects: $\Delta Y_t = Y_t - Y_{t-1}$

We specify for each outcome the following marginal structural model (with $h = 0, 1$)

$$\Delta Y_{i,t+h} = \beta_0 + \beta_1 Y_{i,0}^{Market} + \beta_2 Y_{i,0}^{Product} + \beta_3 Y_{i,0}^{Sales} + \beta_4 D_{i,0} + \beta_5 A_{i,t}^{F} + \beta_6 A_{i,t}^{B} +$$
$$+\beta_7 A_{i,t}^{C} + \beta_8 A_{i,t}^{S} + \beta_9 (D_{i,0} A_{i,t}^{F}) + \beta_{10} (D_{i,0} A_{i,t}^{B}) + \beta_{11} (D_{i,0} A_{i,t}^{C}) + \beta_{12} (D_{i,0} A_{i,t}^{S}) + \varepsilon_i$$

- baseline levels of the outcome variables ($Y_0^{Market}$, $Y_0^{Product}$, $Y_0^{Sales}$)
- indicators for each type of treatment ($A^F$ for participation in a trade fair, $A^B$ for B2B meeting, $A^C$ for specialised consultancy, $A^S$ for export subsidy)
- dummy for firm with no previous export experience ($D_0$)

Since the dataset has a longitudinal structure with each firm repeated for each time of observation, the model is estimated via **WLS** procedure with **cluster-robust standard errors** to account for the clustered structure of the data.

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# Estimated average treatment effects

Table: Average treatment effects on the number of non-European markets served and on the number of products sold in non-European markets. Year of treatment (t+0), one year later (t+1).

| | Markets | | | | | | Products | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $t+0$ | | | $t+1$ | | | $t+0$ | | | $t+1$ | | |
| Treatment | $ATE^M$ | $p$-value | | $ATE^M$ | $p$-value[a] | | $ATE^P$ | $p$-value | | $ATE^P$ | $p$-value | |
| HABITUAL EXPORTERS ($D_0 = 0$) | | | | | | | | | | | | |
| Fair | **0.293** | 0.014 | * | -0.258 | 0.114 | | 0.373 | 0.117 | | 0.007 | 0.980 | |
| B2B | -0.047 | 0.701 | | **0.346** | 0.008 | ** | -0.092 | 0.651 | | **0.734** | 0.000 | *** |
| Consultancy | **0.188** | 0.039 | * | 0.005 | 0.957 | | 0.197 | 0.179 | | -0.075 | 0.682 | |
| Subsidy | **0.994** | 0.000 | *** | **-0.337** | 0.033 | * | **1.027** | 0.000 | *** | 0.015 | 0.961 | |
| FIRST-TIME EXPORTERS ($D_0 = 1$) | | | | | | | | | | | | |
| Fair | 0.185 | 0.237 | | 0.561 | 0.182 | | 0.116 | 0.756 | | -0.477 | 0.239 | |
| B2B | 0.019 | 0.845 | | 0.001 | 0.995 | | 0.135 | 0.446 | | -0.080 | 0.737 | |
| Consultancy | 0.135 | 0.057 | | 0.123 | 0.142 | | 0.136 | 0.165 | | 0.042 | 0.736 | |
| Subsidy | **0.383** | 0.047 | * | 0.025 | 0.796 | | **1.033** | 0.020 | * | -0.196 | 0.416 | |

Significance codes: *** 0.1% ** 1% * 5%

No statistically significant effect on foreign sales, therefore the *ATEs* related to this outcome are not reported in the table

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# Findings

For a **first-time exporter**, the receipt of a subsidy helps much more than the participation in trade fairs, B2B meetings or the receipt of specialised consultancy.

This is because the subsidy provides inexperienced firms with money they can invest in implementing a complex attempt of entry into foreign markets, an entry that can be impracticable relying on the other services and supports alone.

On the contrary, **firms already experienced** in foreign markets that have higher know-how to exploit trade opportunities can take advantage also of fairs, business-to-business meetings or specialised consultancies.

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# Final remarks

Export promotion programmes have **positive effects on the extensive rather than on the intensive margin**: Increase in markets and in the array of products exported suggests a diversification of markets and / or exported products, but not necessarily implying a significant growth in aggregate export flows.

They can be useful to let small and medium-sized firms attempt first exploratory approaches to new markets or try the introduction of new products into new or existing foreign markets.

Therefore, we can conclude that these programmes, rather than fostering the volume of foreign sales, are **more suitable to accompany firms that try to implement some diversification of markets and products sold abroad**.

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