

Do firms benefit from quality-related training activities?

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Presenter: Jasmeer Virdee
Co-authors: Antonina Popova & Valentina Rollo

Research question and key findings

Research question

What is the impact of attending quality-related training activities / investing in quality control services, on firms' certification status, exporter status and performance outcomes?

Key findings

1. Treatment helps firms acquire and retain internationally recognised quality certifications (IRQCs)
2. Treatment helps firms acquire and retain their exporter status
3. Larger firms are more likely to see positive outcome 1
4. Treatment improved firms' sales and increased their size, however, had no effect on productivity, capacity utilization or export values

A refresh on the role of standards in trade

A refresh on the role of standards in trade

Standards are essential to international trade and value chains

Plenty of literature points to benefits of holding quality certificates:

Terlaak & King, 2006:

- Certified facilities in value chains grow faster than non-certified facilities
- Effect is bigger in advertising intensive industries

Otsuki, 2011:

- ISO certification increased the share of exports in sales by 45%

Goedhuys & Sleuwagen 2016:

- Certified firms are more likely to export, and to export on a larger scale
 - Increased productivity
 - Reduced transaction costs
 - Stronger effect in counties with weak institutions



A refresh on the role of standards in trade

- But, getting certified is no easy job:
 1. Select standard;
 2. Implement required changes;
 3. Prove compliance; and;
 4. Pay for the certificate.
- Quality trainings and quality management services can help
 - Global ISO certification market valued at \$12 billion
 - Global market for all types of certifications is likely to be much higher
- But, how effective are such services?
 - No empirical evidence showing that quality-related trainings effectively increase firms' probability to become certified or to start exporting



The data and our model specification

The data



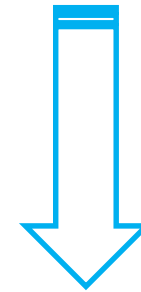
Source: World Bank Enterprise Surveys

Panel data: 2006 & 2010

Countries: 14

Size of dataset: 19,646 obs.

- 10,430 obs. in 2006 surveys
- 9,216 obs. in 2010 surveys
- ✓ 6,226 obs. in 2006 & 2010 surveys



3,113 firms

Defining treatment

*“Over the last three years, did this establishment use any services or programs **to improve quality control** or **training to obtain quality certification**?”*

(World Bank Enterprise Surveys, 2010)

Treatment = Participation in quality-related business trainings between 2007
and 2009

$$\begin{cases} Treat_i = 1 & \text{if the firm participated} \\ Treat_i = 0 & \text{if the firm did not participate} \end{cases}$$

DiD OLS regression model

Testing the effect of being treated on several outcome variables:

$$Y_{it} = \alpha + \beta_1 Treat_i + \beta_2 Time_t + \boxed{\beta_3 (Treat_i * Time_t)_{it}} + \beta_4 X_{it} + \gamma_j + \gamma_s + \varepsilon_{it}$$

Where:

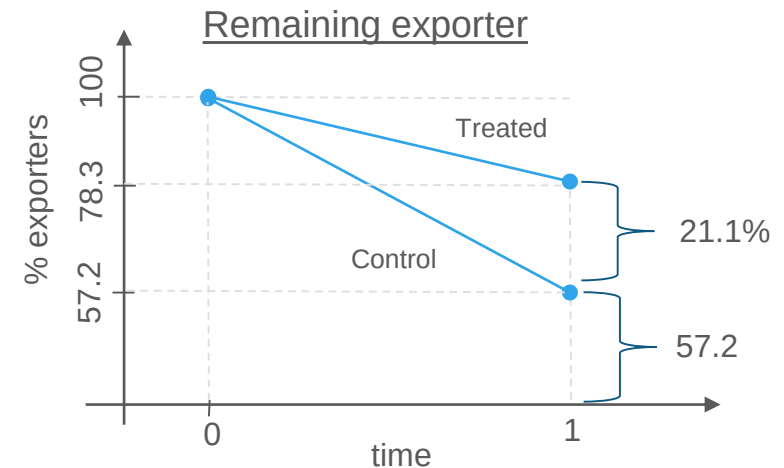
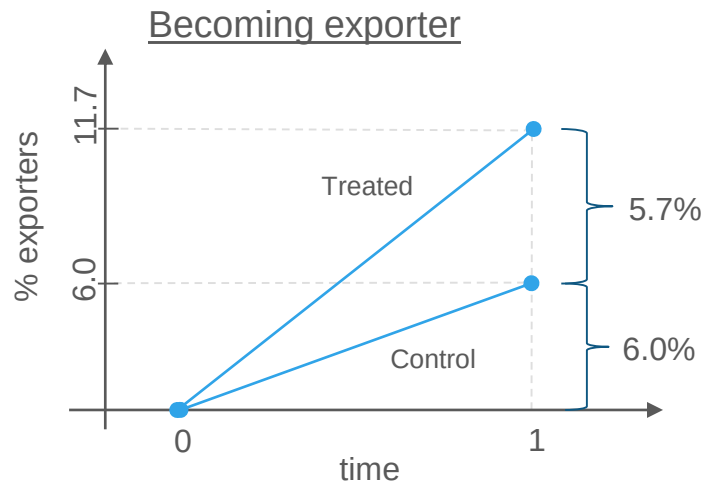
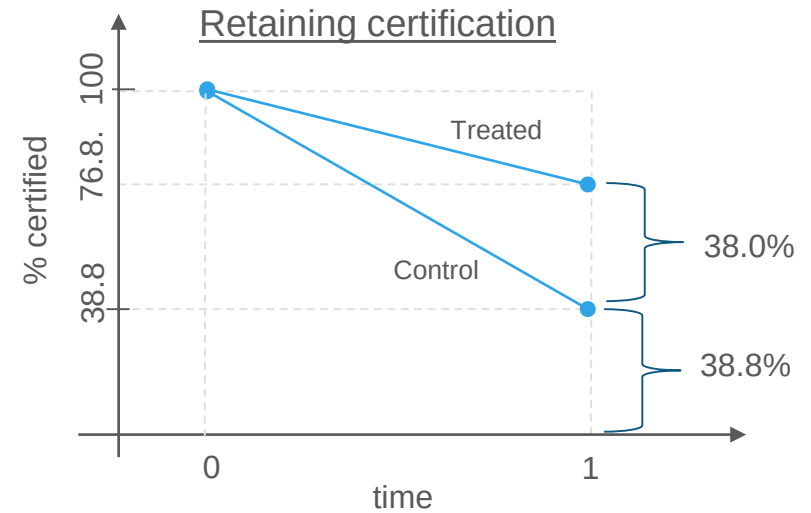
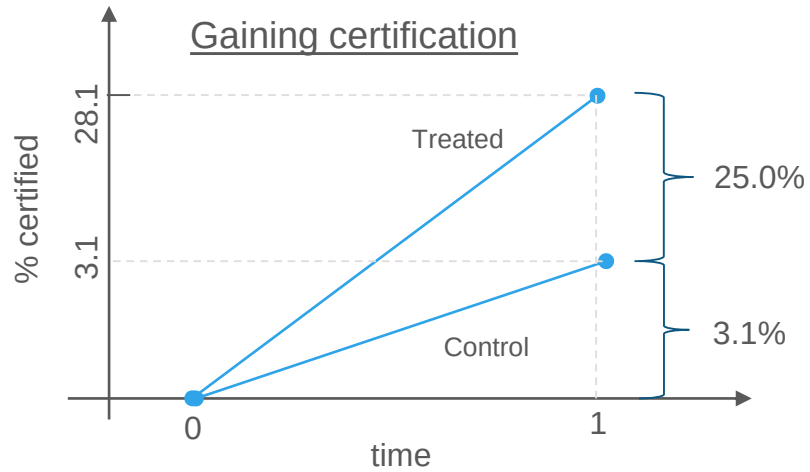
- Y_{it} Binary outcome variable which states whether a firm holds an IRQC or is an exporter
- $Treat_i$ Treatment dummy which controls for **time-invariant** differences between the treated and non-treated groups
- $Time_t$ Time dummy which gives the time evolution of the **control group**
- $Treat_i * Time_t$ The **average effect of treatment on the treated group**
- X_{it} A vector of firm level controls set to 2006 values
- γ_j, γ_s Country and sector fixed effects

The Results

Regression results

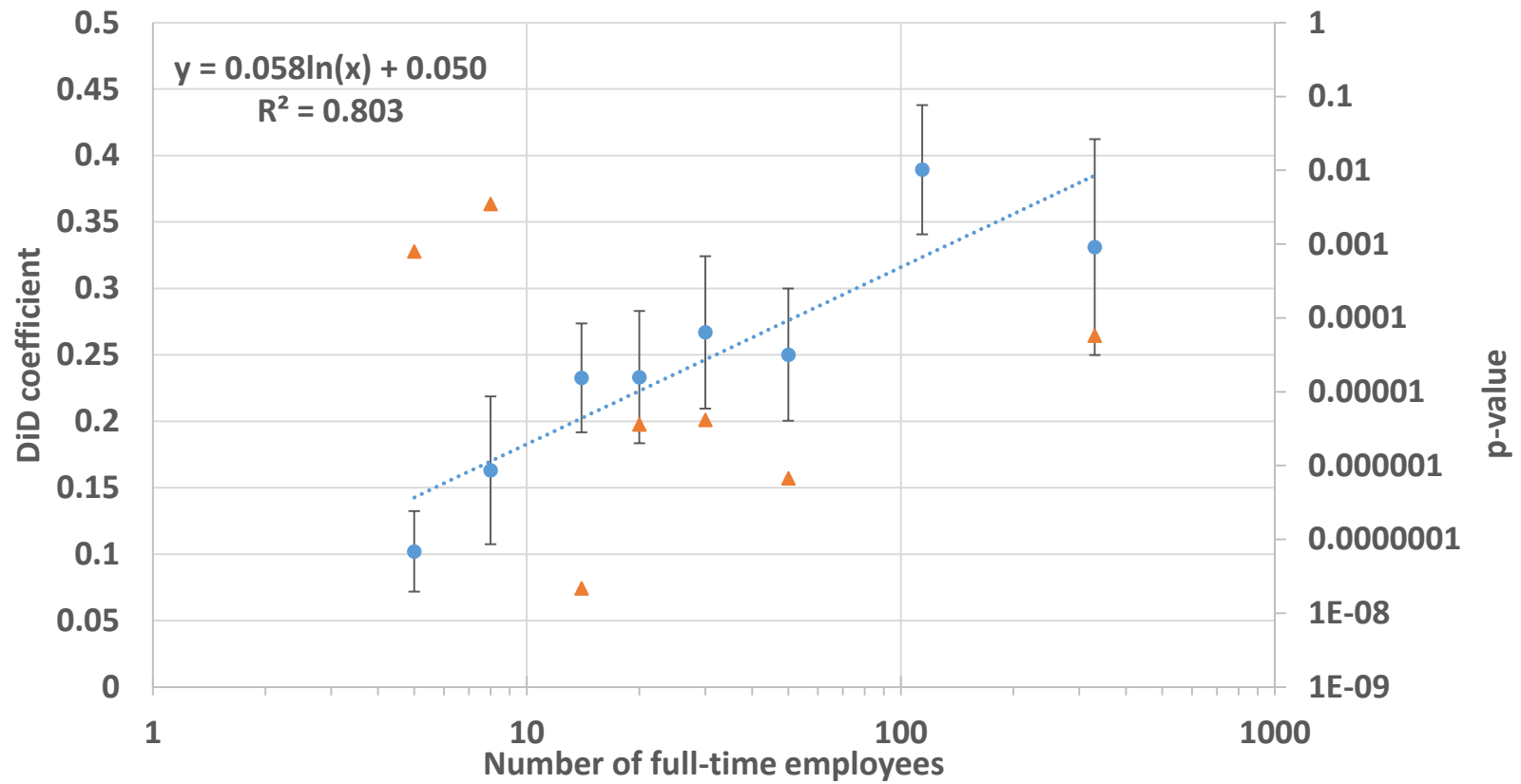
VARIABLES	Certification status (Gain certification)	Certification status (Retain certification)	Export status (Become exporter)	Export status (Remain exporter)
	Model 1	Model 2	Model 3	Model 4
Treat	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Time	0.031*** (0.009)	-0.612*** (0.066)	0.060*** (0.008)	-0.428*** (0.039)
Treat*Time	0.250*** (0.019)	0.380*** (0.060)	0.057*** (0.018)	0.211*** (0.034)
Ln(Firm size) (2006)	-0.000 (0.004)	0.023 (0.021)	0.017*** (0.006)	0.004 (0.010)
Ln(sales) (2006)	0.006 (0.004)	-0.003 (0.011)	-0.001 (0.004)	0.008 (0.006)
Manager's Experience (2006)	-0.001** (0.000)	0.000 (0.001)	-0.000 (0.000)	-0.001 (0.001)
Locality (2006)	0.011 (0.007)	0.009 (0.025)	-0.009 (0.010)	-0.049* (0.027)
Firm age (2006)	-0.000 (0.000)	-0.001 (0.000)	-0.000* (0.000)	-0.000 (0.000)
Exporter status (2006)	0.037*** (0.013)	0.059*** (0.021)	-	-
Certification status (2006)	-	-	0.027** (0.013)	0.026 (0.021)
Sector effects	Yes	Yes	Yes	Yes
Country effects	Yes	Yes	Yes	Yes
Constant	0.000 (0.000)	1.000 (0.000)	0.000 (0.000)	1.000 (0.000)
Observations	3,788	940	3,728	1,022
R2	0.2133	0.3017	0.1927	0.3253

Regression results - Graphically



The effectiveness of treatment as a function of firm size

As firm size increases, the probability that treatment results in the acquisition of an IRQC rises from about 15% to 40%



Performance results

DiD OLS regression model

Testing the effect of being treated on several outcome variables:

$$Y_{it} = \alpha + \beta_1 Treat_i + \beta_2 Time_t + \boxed{\beta_3 (Treat_i * Time_t)_{it}} + \beta_4 X_{it} + \gamma_j + \gamma_s + \varepsilon_{it}$$

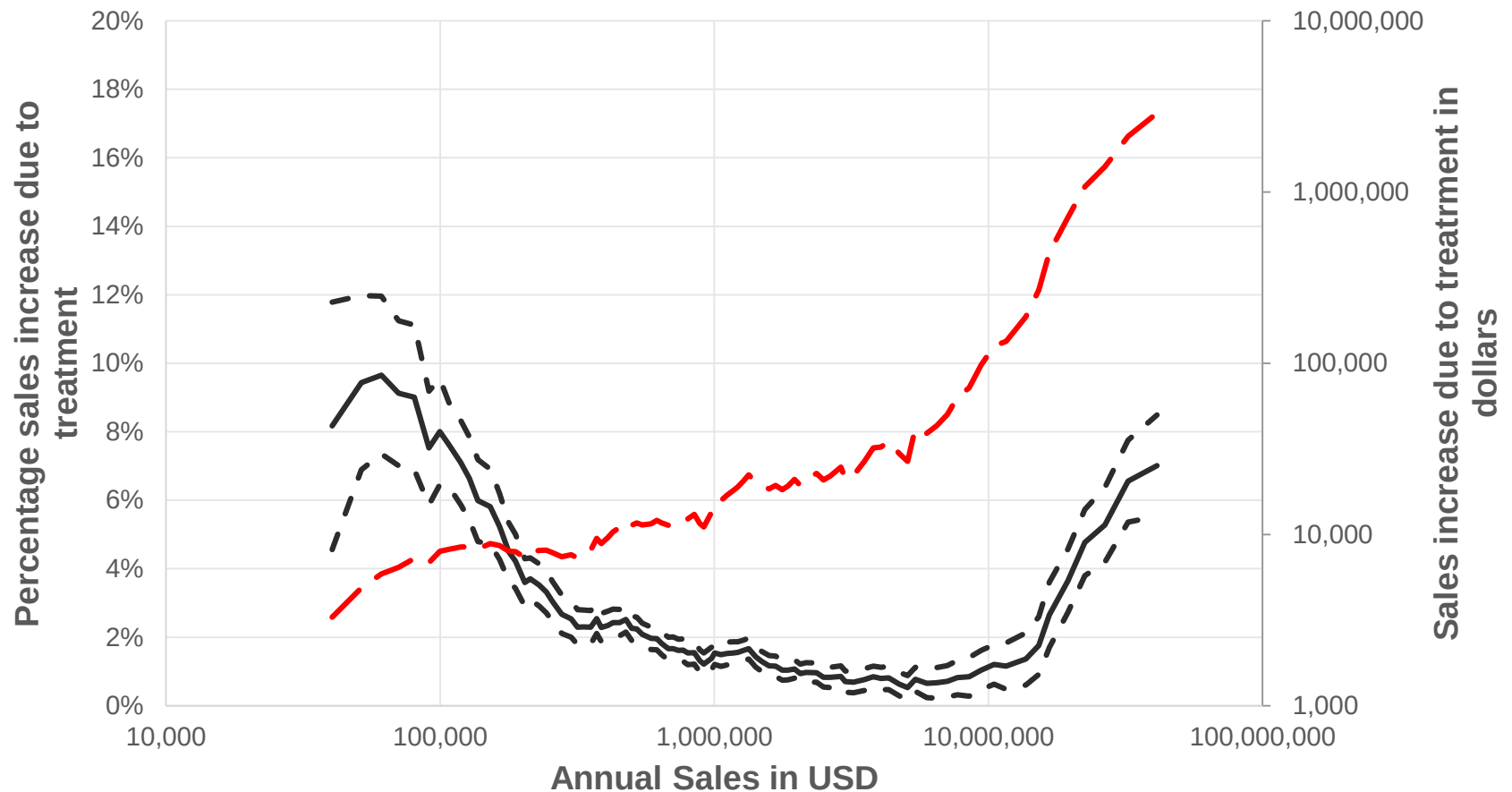
Where:

- Y_{it} The natural logarithm of annual sales in thousands / the natural logarithm of the number of full-time employees
- $Treat_i$ Treatment dummy which controls for time-invariant differences between the treated and non-treated groups
- $Time_t$ Time dummy which gives the time evolution of the control group
- $Treat_i * Time_t$ The average effect of treatment on the treated group
- X_{it} A vector of firm level controls set to 2006 values
- γ_j, γ_s Country and sector fixed effects

Regression results – Performance variables

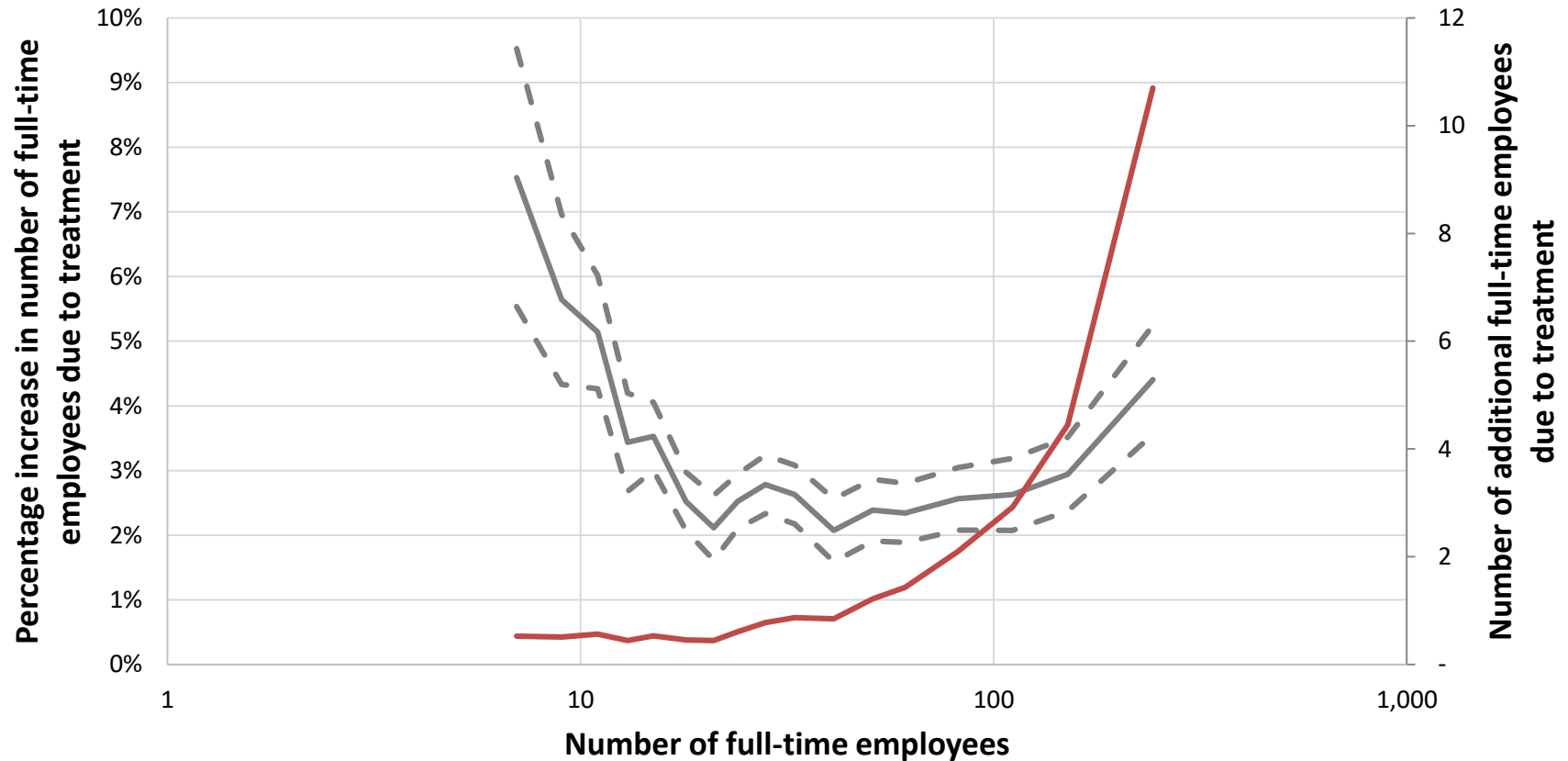
VARIABLES	Sales (ln) (No filtering)	Employment (ln) (No filtering)	Sales (ln) (Gained certification)	Sales (ln) (Retain certification)
	Model 1	Model 2	Model 3	Model 4
Treat	0.032	0.035**	0.035	0.109
Time	0.420***	0.063	0.392***	0.712**
Treat*Time	0.197***	0.138***	0.257**	-0.149
Ln(Firm size) (2006)	0.229***	0.857***	0.223***	0.229***
Ln(sales) (2006)	0.783***	0.051***	0.791***	0.758***
Manager's Experience (2006)	-0.001	-0.000	-0.001	-0.001
Locality (2006)	0.017	0.024	-0.007	0.160
Firm age (2006)	-0.000	-0.000	-0.001	0.001
Exporter status (2006)	-0.022	-0.032	-0.024	-0.007
Certification status (2006)	0.116**	0.029	-	-
Sector effects	Yes	Yes	Yes	Yes
Country effects	Yes	Yes	Yes	Yes
Constant	0.705***	0.204***	0.711***	0.867***
Observations	4,860	5,146	3826	1,032
RMSE	0.864	0.875	0.844	0.841

Total annual sales



The values in this plot were calculated by executing quantile regressions between percentiles of 0.05 and 0.95, in steps of 0.01. The solid line is the value of the DiD coefficient, transformed into a percentage sales increase. The dashed lines are the one standard deviation errors.

Full time employees



The values in this plot were calculated by executing quantile regressions between percentiles of 0.1 and 0.90, in steps of 0.05. The solid grey line is the value of the DiD coefficient, transformed into a percentage employment increase. The dashed grey lines are the one standard deviation errors. The solid red line is the value of the number of additional full-time employees due to treatment.

Robustness checks

PSM robustness checks

Idea of matching

- Matching groups of treatment and control group observations, **based on a combination of their observable characteristics**, allows one to calculate the counterfactual change in the treatment group if there were no treatment

Propensity Score Matching

- PSM **collapses a vector of pre-treatment characteristics, X , into a single variable** (i.e. the propensity score), and uses this as the matching estimator.
- By combining covariates into a single score, it can balance treatment and non-treatment groups without losing a large number of observations.

Propensity Score

$$T_{it} = \begin{cases} 1 & \text{if } \beta X_{it-1} + \gamma_j + \gamma_s + \varepsilon_{it} > 0 \\ 0 & \text{otherwise} \end{cases}$$

Where:

- T_{it} is a binary variable that defines whether firm i received a quality-related training at time t
- X_{it} is a vector of controls
- γ_j and γ_s are included as fixed effects

PSM robustness checks

Average effect of the treatment on the treated (ATT):

$$\widehat{ATT}(S) = \sum_{i \in T \cap S_P} \frac{1}{N^T} \left[(Y(1)_{it} - Y(0)_{it-1}) - \sum_{j \in C \cap S_P} \omega_{ij} (Y(0)_{jt} - Y(0)_{jt-1}) \right]$$

Where:

- $Y(1)_i$ is the treatment outcome for treated firms, i
- $Y(0)_j$ is the non-treatment outcome for unit j (comparison group)
- t is time
- T, C denotes the set of control units
- N^T is the number of treated firms
- S_P denotes the region of common support (e.g. the matching radius)
- ω_{ij} is the weight used in the matching method (e.g. Kernel matching)

Matching methods:

- *Nearest Neighbour Estimation* uses only those control group observations that are closest to treated units
- *Kernel Matching* uses all control group observations, but weights each observation according to its distance from the treated unit. We use an epanechnikov weighting function.

PSM - Results

- For the first two specifications, PSM provides complementary evidence
- For the last two, the errors are large, meaning that it neither confirms nor denies our regression based results

	Average Treatment effect on Treated (ATT)			
Outcome	Nearest Neighbour (1)	Nearest Neighbour (2)	Kernel (epanechnikov)	Bandwidth (epanechnikov)
Gaining an IRQC (t-stat)	0.24±0.02 (11.3)	0.23±0.02 (11.4)	0.25±0.02 (13.6)	0.4
Retaining an IRQC (t-stat)	0.40±0.07 (6.1)	0.41±0.06 (6.8)	0.39±0.05 (7.3)	0.06
Becoming an exporter (t-stat)	0.024±0.021 (1.1)	0.026±0.0.018 (1.45)	0.036±0.015 (2.3)	0.025
Remaining an exporter (t-stat)	0.060±0.064 (0.9)	0.071±0.057 (1.25)	0.079±0.054 (1.5)	0.025



Conclusions

Recap of main findings

Programmes to improve quality control or quality-related trainings help firms to:

- acquire IRQC (8.1 times more likely)
- retain their IRQC (2.1 times more likely)
- transition from non-exporter to exporter status (2.0 times more likely)
- retain their exporter status (37% more likely)
- larger firms are better able to translate treatment into positive outcomes
- increase sales, especially for smaller firms
- increase employment



Implications for managers

- Firm managers who choose to invest in quality management are more likely to see sales rise, as well as the size of their company expand
- No indication on whether that investment was 'worth it'
- No evidence that treatment increased capacity utilization or productivity
 - This may indicate that treatment mostly helped firms attract new customers or secure larger orders from existing ones.
- Presumably, the acquisition or retention of an IRQC is the main mechanism behind the increase in sales, not the training *per se*.

Implications for policymakers

- Investments in quality control and quality-related trainings **lead to a variety of beneficial outcomes** for these firms.
- However, treatment was much less effective for smaller firms. Why?
 - Lower absorptive capacities?
 - Limited financial resources?
 - Lower quality treatments?
 - Cheaper treatments selected?
- Policymakers may want to direct resources towards these firms with tailored quality management programmes and implementation support



Description of variables - 1

Name	Description	Mean	Std. dev
Outcome variables			
Certification status	A binary variable equal to (1) if the firm had an internationally-recognized quality certificate, and (0) if it did not.	0.22	0.42
Export status	A binary variable equal to (1) if the firm is an exporter, and (0) if it is not. A firm is considered an exporter in our sample if 1% or more of its sales come from direct export.	0.22	0.41
Independent variables			
Treat	A treatment dummy which controls for time-invariant differences between the treated and non-treated firms. The question asked was, “Over the last three years, did this establishment use any services or programs to improve quality control or training to obtain quality certification?”	0.44	0.50
Time	A time dummy which controls for time-variant differences between 2006 and 2010.	0.50	0.50
Treat*Time	An interaction between the treatment and time dummies, which isolates the effect of being treated over time on an outcome variable. Put differently, the resulting coefficient can be interpreted as the average effect of being treated for the treated group.	-	-
Fixed effects			
Sector	A two-step categorical variable indicating the sector the firm was operating in, in 2006: (1) is equal to manufacturing and (2) to services.	-	-
Country	A variable indicating which country the firm is operating in: (0) Argentina, (1) Bolivia, (3) Chile, (4) Colombia, (5) Ecuador, (6) El Salvador, (7) Guatemala, (8) Honduras, (9) Mexico, (10) Nicaragua, (11) Panama, (12) Paraguay, (13) Peru, (14) Uruguay.	-	-

Description of variables - 2

Name	Description	Mean	Std. dev
<i>Firm-level controls</i>			
Firm size (2006)	The natural logarithm of the number of full-time employees in 2006.	3.46	1.39
Sales (2006)	The natural logarithm of annual sales for 2006 in thousands. Sales were converted from local currency to USD using the real annual exchange rate.	7.02	2.10
Firm age (2006)	A continuous variable, defined simply by the age of the firm in 2006.	26.1	20.6
Manager's experience	A continuous variable, defined simply by the number of years of management experience the top manager has.	20.6	10.6
Size of locality	A binary variable indicating if the firm is situated in the capital city or a city of 1 million people or more (1), or a smaller locality (0).	0.76	0.43
Certification status (2006)	A binary variable equal to (1) if the establishment had an internationally-recognized quality certificate in 2006, and (0) if it did not.	0.20	0.40
Exporter status (2006)	A binary variable equal to (1) if the establishment is an exporter in 2006, and (0) if it was not. A firm is considered an exporter in our sample if it 1% or more of its sales come from direct export.	0.22	0.42