European Commission

Quasi-experimental methods: Propensity Score Matching and Difference in Differences

http://crie.jrc.ec.europa.eu

Centre for Research on Impact Evaluation

DG EMPL - DG JRC

Joint Research Centre

Internships - Job Abroad example

Intervention: Internships or short-term job contract abroad (IJA)

- The intervention offers unemployed people the opportunity to do an internship abroad or to work with a short-term contract in another EU country.
- Voluntary participation $\Rightarrow$ participants may self-select into treatment
- Intervention takes place between t_1 and t_2, where t is time.

Objective of the evaluation:

- Did the intervention have an effect on the employability of participants at t_3 ($t_1 < t_2 < t_3$)

Internships-Job Abroad example

- What we observe:
  - Y_i, =1 if employed at t_3, =0 otherwise
  - D_i, =1 if treated, =0 otherwise
  - X_i, individual characteristics/controls (e.g age, gender, education)

Internships-Job Abroad example

- Assumptions:
  - Age is observed
  - Age of the individual is the only factor determining selection into the intervention
- Is there self-selection?
  Are participants and non-participants comparable?

European Commission

Internships-Job Abroad example

Descriptive statistics for age and t-test for differences in means

	$D=1$	$D=0$	Diff
Mean	34.4	43.4	9.04***
St.d.	(9.05)	(10.4)	(1.07)
N	128	272	

Conclusion:

- Participation to intervention is not random.
- Young people are more likely to participate maybe because they are less affected by family ties.

Presentation Outline

Matching

Exact matching

- **Idea**:
  - Match participants to non-participants with the same observed characteristics (e.g Day 1 example).
  - The difference in the outcome variable between the two should only be due to the treatment status.

- **Problem**:
  - As the number of characteristics determining selection increases it is more and more difficult to find comparable individuals
    $\Rightarrow$ Curse of dimensionality

Matching

Solution by Rosenbaum and Rubin (1983)

- Matching on a single index *(propensity score)*, reflecting the probability of participation, could achieve consistent estimates of the treatment effect in the same way as matching on all covariates

Conditions

- This single index summarises all the relevant information contained in the covariates X
- Matching on this index is equivalent to matching on the X, i.e. for a given value of the index the distribution of X should be the same for participants and non-participants (This is called the propensity score theorem)

Propensity Score Matching (PSM)

- **Definition:**
  PROPENSITY SCORE: Probability of participating in the intervention, conditional on the characteristics X_i

- **Matching**: Find participants and non-participants with equal/similar propensity score

- **Average treatment effect on the treated (ATT)**:
  Average of the difference between the outcomes of participants and matched control individuals

Conditions

1) CIA:

$\Rightarrow$ There are no systematic differences between participants and non-participants in terms of unobserved characteristics that may influe

$\Leftrightarrow$ All the variables that affect simultaneously D and Y are observed

2) Common support:

$\Rightarrow$ In both groups there are individuals with similar propensity scores

$\Leftrightarrow$ Matching is feasible

3) Propensity Score balances the covariates

$\Rightarrow$ Similar propensity scores are based on similar observed X

Presentation Outline

Propensity Score Matching step by step

In order to check the assumptions, it is advisable to frame the implementation of the propensity score matching in the following steps:

1. Estimation of the propensity score
2. Check the assumptions: common support
3. Match participants with non-participants
4. Check the assumptions: covariates' balance
5. Compute the average treatment effect
6. Compute the standard error of the treatment effect

Step 1 - Estimation of the Propensity Score

- Use a binary model to estimate γ_0 and γ_1

$$P(D_i = 1|X_i) = G(\gamma_0 + \gamma_1 X_i)$$

- G(.) can be a logit or probit link
- Compute the predicted values

$$\widehat{P}(D_i = 1|X_i) = G(\widehat{\gamma}_0 + \widehat{\gamma}_1 X_i) = \widehat{PS_i}$$

European Commission

Step 1 - Estimation of the Propensity Score

Internships-Job Abroad example:

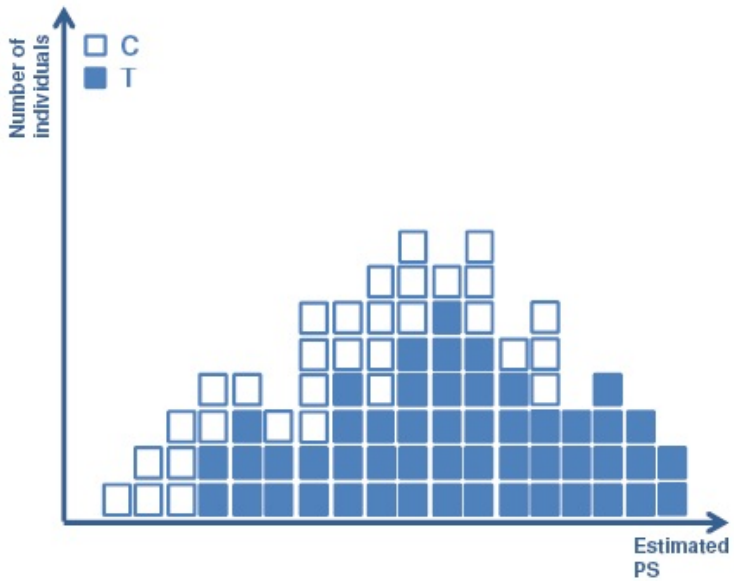
```
Logistic regression                                     Number of obs   =        400
                                                        LR chi2(1)      =      65.61
                                                        Prob > chi2     =     0.0000
Log likelihood = -217.94219                             Pseudo R2       =     0.1308

------------------------------------------------------------------------------
           d |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |  -.0901068   .0124142    -7.26   0.000    -.1144382   -.0657754
       _cons |   2.745099   .4785879     5.74   0.000     1.807084    3.683114
------------------------------------------------------------------------------
```

European Commission

Step 2 - Check the assumptions: common support

Example: Hypothetical situation

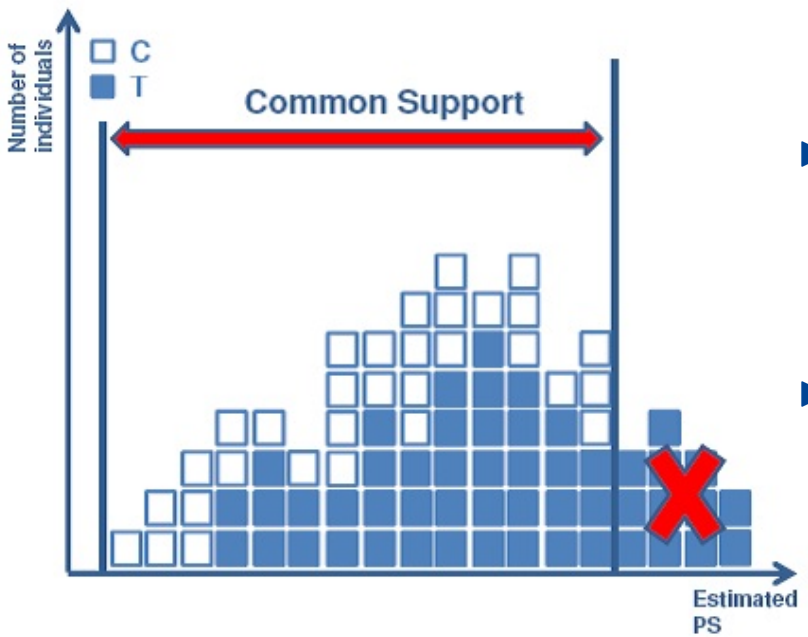


- Compare only similar individuals, that is with similar propensity score
- Drop treated units that have no units with similar PS in the control group

European Commission

Step 2 - Check the assumptions: common support

Example: Hypothetical situation



- Compare only similar individuals, that is with similar propensity score
- Drop treated units that have no units with similar PS in the control group

Attention: If too many observations are dropped a bias may occur and the remaining treated may not be representative of the treated population. The characteristics of those dropped should be investigated.

European Commission

Step 2 - Check the assumptions: common support

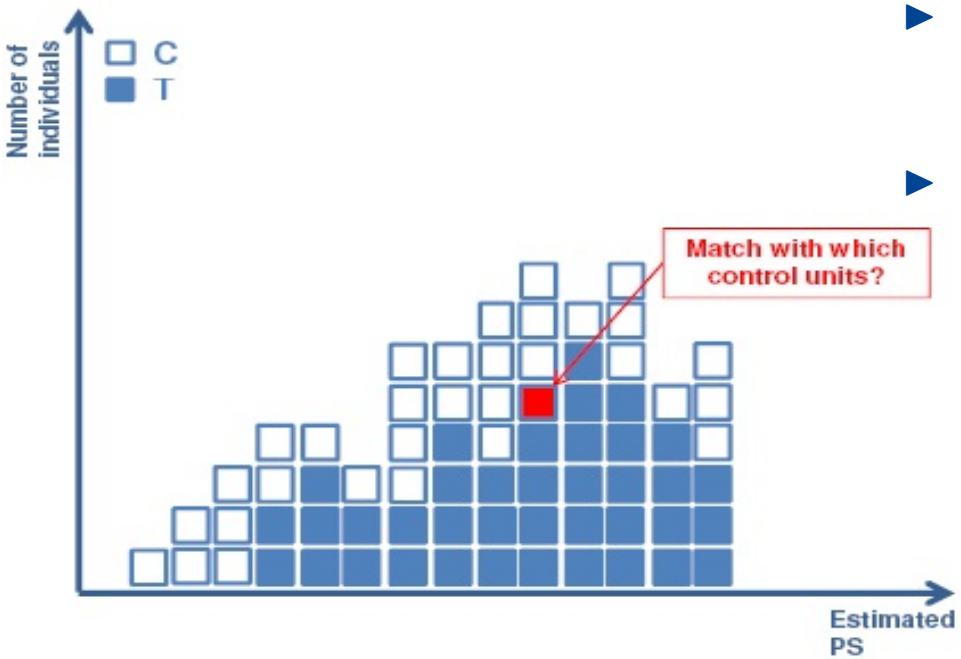
Internships-Job Abroad example

2 treated observations dropped from the analysis (out of 400)

European Commission

Step 3 - Matching

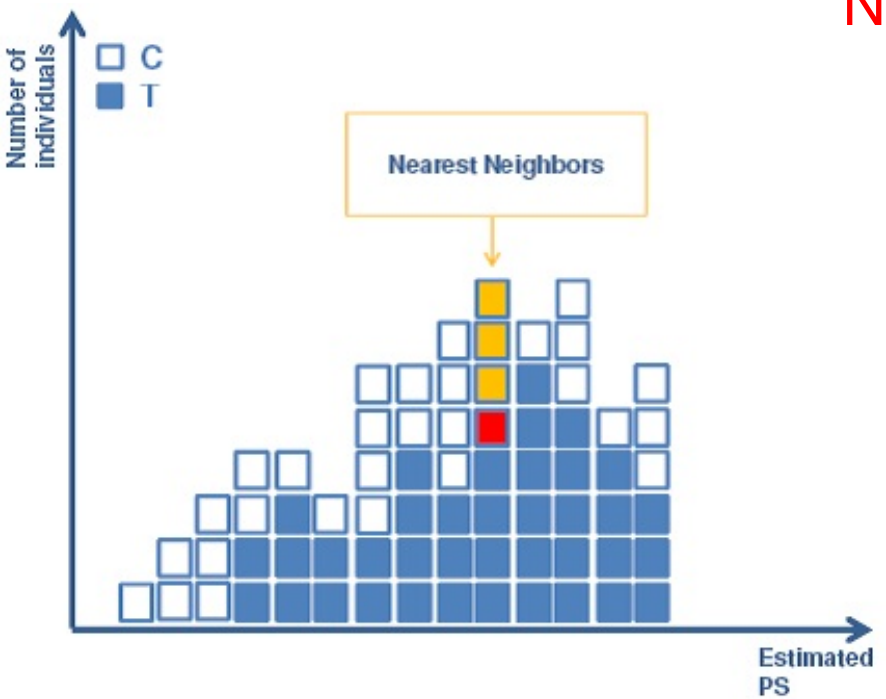
Example: Hypothetical situation



- Matching is done individually
- Which control units to choose?
  - Number of control units
  - Weight attributed to each control
  - With or without replacement

Step 3 - Matching

Example: Hypothetical situation

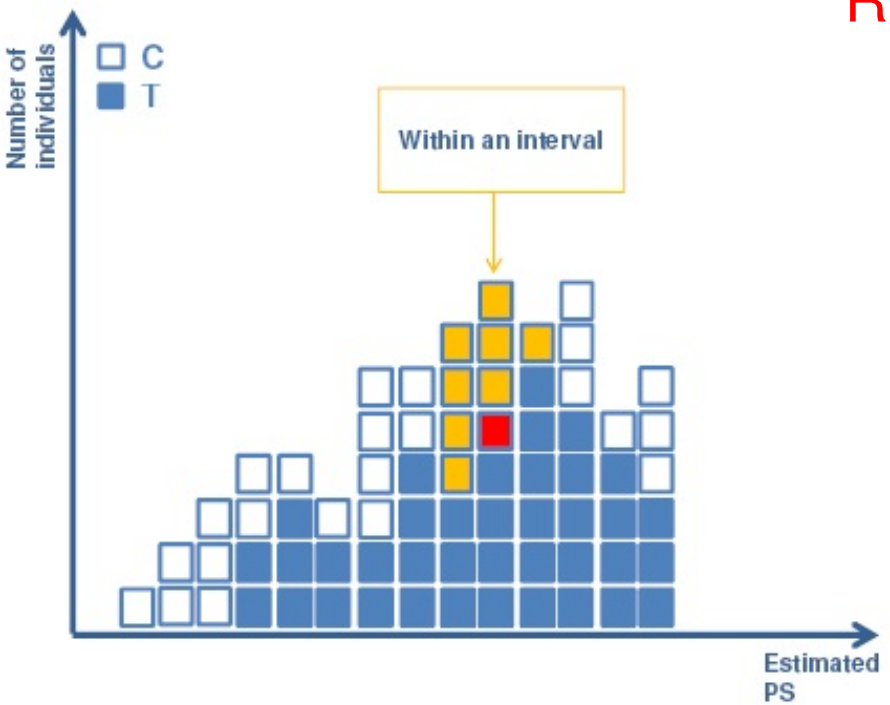


Nearest Neighbors Matching

- Choose the nearest neighbors control units
- Options:
  - Number of neighbors
  - Limit the distance from treated
  - With or without replacement

Step 3 - Matching

Example: Hypothetical situation



Radius Matching

- Choose the control units within a maximum interval/range
- Options:
  - Maximum distance from treated
  - With or without replacement

Step 3 - Matching

- Is there a matching algorithm better than the others? Not clear...
- In big samples, the difference between them should not be relevant.
- Try several algorithms and options for robustness

European Commission

Step 4 - Check covariates' balance

- Assess this property of PS, for instance, by checking if the distribution of all covariates is the same for participants and matched non-participants
- If covariate balance is not satisfactory it may indicate a fundamental lack of comparability between the two groups $\Rightarrow$ alternative evaluation approaches should be considered.

Step 4 - Check covariates' balance

Internships-Job Abroad example

Mean of age and t-test for difference in means:

	$D = 1$	$D = 0$	Diff
Before matching	34.41	43.46	9.04***
After matching	34.69	34.7	0

$\Downarrow$

No difference in age between treated and matched control

$\Rightarrow$ The PS successfully balances the covariates

Step 5 - Compute the average treatment effect

- Treatment effect for treated i:

$$\widehat{TT}_i = Y_i D_i - \sum_{j \in C_i} w_{i,j} Y_j (1 - D_j)$$

- Average treatment effect on the treated:

$$\widehat{ATT} = \widehat{\text{ave}} \left(\widehat{TT}_i \middle| D_i = 1 \right)$$

- The choice of the matching algorithm affects:
  - The number of units matched from the control group
  - The weights attributed to each of them

European Commission

Internships-Job Abroad example

Estimated ATT from several matching algorithms and options:

Algorithm	Options	ATT	s.e.
Nearest Neighbors	2 controls	0.167**	(0.078)
	4 controls	0.218***	(0.059)
	2 + maximum distance	0.174**	(0.084)
Radius	0.02 radius	0.243***	(0.067)
	0.04 radius	0.247***	(0.054)
Kernel	weighting function 1	0.249***	(0.064)
	weighting function 2	0.252***	(0.057)

Note: ** and *** indicate significance at 5% and 10% levels, respectively. Bootstraped standard errors.

Presentation Outline

Pros and Cons

Pros

- More focus on the selection process and on the underlying assumptions
- Imposition of the common support ensures comparability
- Versatility:
  - Allows to estimate **heterogeneous** effects (by sub-group)
  - Allows to put more emphasis on specific variables, on which exact matching can be done (e.g. region, gender)
  - Allows the estimation of **multiple treatments**: different treatment levels or types of participation can be compared

Pros and Cons

Cons

- "Data-hungry" method, more efficient methods under CIA exist
- Requires strong robustness and sensitivity analysis
- CIA is a Strong assumption:
  - Impossible to verify, so bias stemming from unobservables can never be ruled out
  - Matching is only as good as the characteristics used for matching

Internships-Job Abroad example

- Assumptions:
  - Age is observed
  - Age and $motiv_i$ of the individual are the factors determining selection
  - Motivation is not observed
- CIA is not a valid assumption $\Rightarrow$ Use other evaluation method.
- How severe is the implication of not observing motivation?

Propensity Score Matching versus Regression

Regression: $Y_i = \alpha + \rho T_i + \beta f(X_i) + \upsilon_i$

- Both methods have the same identifying assumption: selection on observables
- Regression provides estimates of the effect of *T and X* on *Y*
- Propensity Score matching has the following **advantages**
  - Imposes the common support: compares the comparable (while using regression we extrapolate in no common support areas)
  - Semi-parametric: parametrises only the participation decision (while regression is fully parametric)

Presentation Outline

DiD, an old and new technique

- It was pionereed by John Snow (1855), while studying the cholera epidemics in London
- Snow wanted to establish that cholera was transmitted by contaminated water
- He then compared changes in death rates from cholera in districts served by 2 water companies: Southwark and Lambeth
- In 1849 both of them obtained the water supply from the dirty Thames...but in 1852 Lambeth moved the supply upriver (free of sewage)
- Death rates in the districts supplied by Lambeth fell sharply! (Angrist and Pischke 2009, Mostly harmless econometrics)

Why you DiD?

- Remember that a limitation of the PSM is related to matching on observables
- If unobserved characteristics are important, we can identify a causal effect using instrumental variables
- ...but instrumental variables are generally hard to find
- Difference-in-difference exploits the time or cohort dimension, and allows accounting for unobservable but fixed characteristics

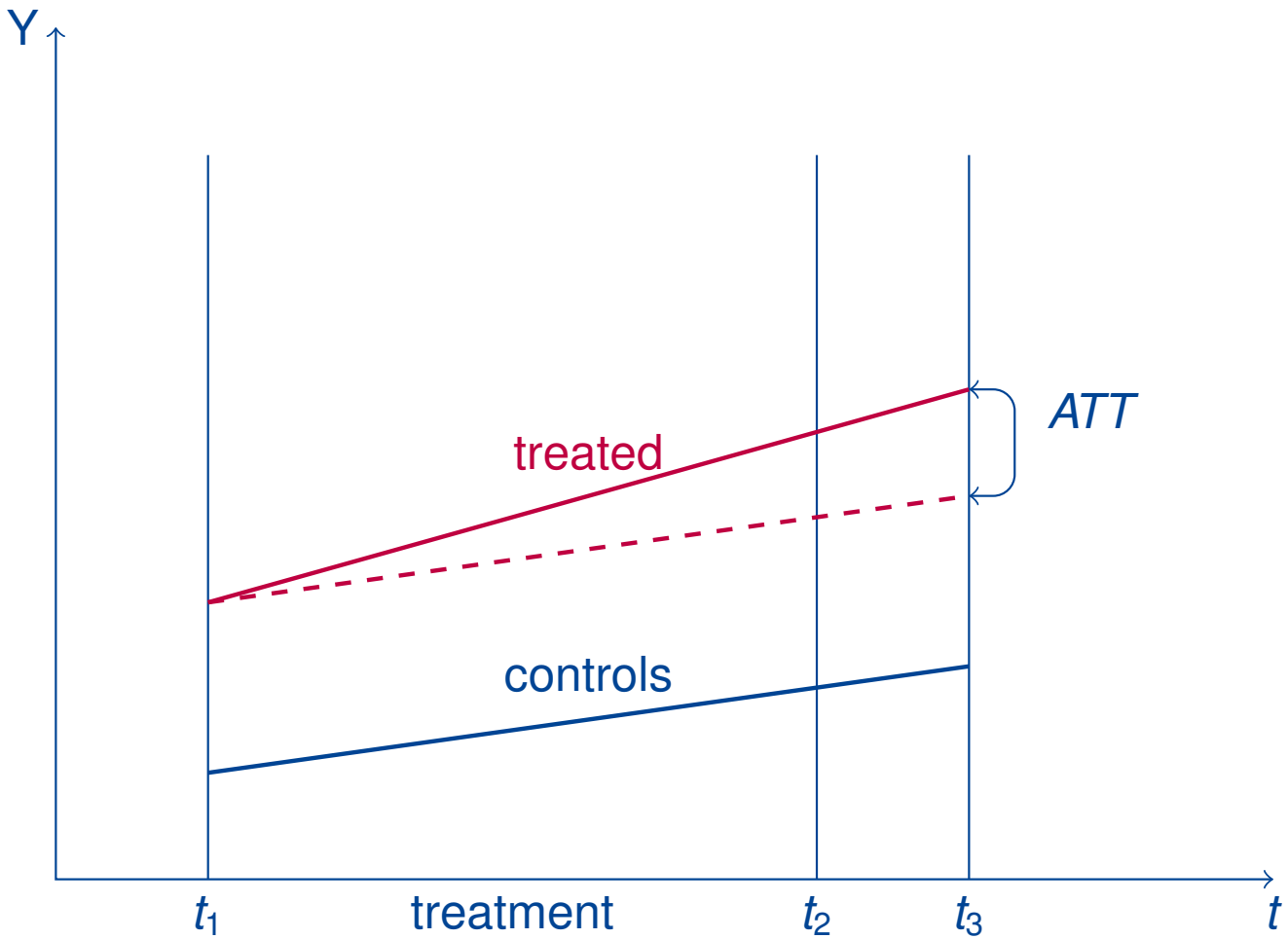
Presentation Outline

Time of intervention

- Recall $t_1 < t_2 < t_3$
- Intervention between t_1 and t_2
- Outcome measured at some time t_3 after completion of the intervention.

When is DiD applicable?

Whenever one has access to longitudinal data or repeated cross-sections



Assumption underlying the DiD estimator

The key assumption for DiD is that the outcome in treatment and control group would follow the same time trend in the absence of the treatment (parallel worlds).

This does not mean that they need to have the same average outcome!

The Common trend assumption is difficult to verify but one could uses pre-treatment data to show that the trends are the same before treatment takes place.

Even if pre-trends are the same one still has to worry about other policies changing at the same time.

Examples

- The effect of minimum wage on employment
- The impact of an enterpreneurship education program on skills and motivation

Example 1

- Suppose you are interested in the effect of minimum wages on employment (a classic question in labour economics and still very actual).
- In a competitive labour market, increases in the minimum wage would move us up a downward-sloping labour demand curve $\rightarrow$ employment would fall!

Example 1

- Card Krueger (1994) use the change in the minimum wage in the state of New Jersey to check whether ↑ minwage causes ↓ employment
- In February 1992 NJ increased the state minimum wage from 4.25 to 5.05 dollars. Pennsylvania's minimum wage stayed at 4.25.
- They surveyed about 400 fast food stores both in NJ and in PA both before and after the minimum wage increase in NJ.

European Commission

Average employment per store before and after the New Jersey minimum wage increase

	PA	NJ	PA-NJ
FTE employment before	23.33	20.44	-2.89
	(1.35)	(0.51)	(1.44)
FTE employment after	21.17	21.03	-0.14
	(0.94)	(0.52)	(1.07)
Change in mean FTE employment	-2.16	0.59	2.76
	(1.25)	(0.54)	(1.36)

Interpretation

- How convincing is this evidence ?
- Remember: our assumption is that the employment trends would be the same in both states in absence of the treatment
- The common trend assumption could be investigated further using data from previous periods (Card and Krueger 2000, repeated their 1992 study collecting payroll data and ran a new experiment in 1996)
- Conclusion: too many swings in the data so that PA was not a good comparison group for NJ.

European Commission

Example 2

European Economic Review 54 (2010) 442–454

Contents lists available at ScienceDirect

European Economic Review

journal homepage: www.elsevier.com/locate/eer

The impact of entrepreneurship education on entrepreneurship skills and motivation ☆

Hessel Oosterbeek, Mirjam van Praag *, Auke Ijsselstein

University of Amsterdam, Roetersstraat 11, 1018 WB Amsterdam, The Netherlands

Policy type

- Intervention SMC: Junior Achievement Young Enterprise student mini-company intervention
- Active: In Europe it is effective in 40 countries and more than 2 million students have participated in the year 2005/2006.
- Rationale: more entrepreneurship $\Longrightarrow$ higher level of innovation $\Longrightarrow$ higher growth
- Question: is the intervention effective?

Objectives and targets (i)

- The objective of the intervention is to teach students to put theory into practice and to understand what entrepreneurship is about. In this way students are assumed to gain self-confidence and motivation, become proactive, creative and learn how to work in a team
- The target (outcome variable) is ESCAN test results, and its breakdown in entrepreneurial traits and skills
- The ESCAN is a validated self-assessment test based on 114 items (questions and statements) aimed at assessing entrepreneurial traits and skills. This is widely applied in the NL

Objectives and targets (ii)

- In contrast to most other interventions in which entrepreneurship training is provided, this program works with a general population of students and not with a group of individuals who self-selected into entrepreneurship.
- Sample from one vocational college in NL, which supplies the same Bachelor program in two different locations, with one location offering the SMC program (treated group) and the other not offering it (control group).

Institutional context

- In NL higher education is provided by 52 vocational colleges (VC) and 13 universities (U)
- Enrollment was 357K in VC and 205K at U in 2005/06.
- Enrollment in programs in Admin, Management, Economics and Law at VC was 115K, where the entrepreneurship education matters

Intervention design

- 360 student mini-companies were created in 2005/06, involving 3600 students out of 25K in their 2nd year, earning 10 ECTS (out of 60 per annum)
- The intervention ran for an entire academic year on a part-time basis and was mandatory
- Sample from the AVANS Hogeschool in Breda, Den Bosch and Tilburg, in South NL, with student enrollment 18K, with market share of 5%.
- Breda offered SMC as compulsory in 2005/06 while Den Bosch was planned to start only in 2007/08.

Policy question

- Is SMC effective in increasing the entrepreneurial skills of participants?

CIE issues

- Possibility of self-selection of students that are more interested in becoming entrepreneurs

Target population

- Population: 2nd year NL Bachelor students in Admin, Management, Economics and Law, Academic Year 2005/06

Variables

- Dependent variable Y: before-after difference in score of ESCAN test or one of its components
- Treatment variable D: indicator of Breda

Covariates

X_i

- gender
- nationality
- age
- secondary education
- parental education
- parental entrepreneurial activity

Data

September 2005 survey (before)

- 219 students in the treated and 343 in the control group received the first survey
- 189 (86%) students in the treated and 220 (60%) in the control group returned valid answers

July-September 2006 survey (after)

- 189 students in the treated and 220 in the control group received the second survey
- 104 students in the treated and 146 in the control group returned valid answers

European Commission

Pre-treatment differences 1

Table 2
Pre-treatment differences between the treatment and control group.

	Final sample		Full pre-attrition sample	
	Treated	Control	Treated	Control
Outcome variables (1–10)				
Entrepreneur traits	6.03	6.06	6.13	6.06
Need for achievement	7.29	7.18	7.33	7.19
Need for autonomy	5.64	5.91	5.69	5.81
Need for power	5.95	6.14	6.03	6.16
Social orientation	6.38	6.13	6.58	6.31
Self efficacy	5.29	5.41	5.54	5.35
Endurance	6.41	6.37	6.44	6.38
Risk-taking propensity	5.25	5.31	5.27	5.28
Entrepreneur skills	5.91	6.01	6.00	6.04
Market awareness	6.16	6.44	6.29	6.43
Creativity	6.08	6.29	6.23	6.34
Flexibility	5.50	5.31	5.47	5.34
Entrepreneur intentions (0–6)	3.52	3.12	3.55	3.31

European Commission

Pre-treatment differences 2

Student background characteristics				
% Female students	0.45	0.45	0.38	0.42
% Studs (partly) non Dutch	0.04	0.04	0.05	0.05
Age				
% Under 19	0.28	0.20	0.30	0.21
% 19 years old	0.28	0.27	0.26	0.26
% 20 years old	0.24	0.19	0.24	0.19
% 21 years old	0.13	0.19	0.11	0.19
% Over 21	0.07	0.15	0.09	0.15
Secondary school level				
% Vocational (<4 years)	0.24	0.32	0.23	0.28
% General (5 years)	0.63	0.53	0.63	0.59
% General (6 years)	0.11	0.13	0.12	0.11
% Other	0.02	0.02	0.02	0.02
Father's education level (1–5)	3.04	2.91	3.05	2.92
Mother's education level (1–5)	2.69	2.47	2.59	2.50
% Parent ever entrepreneur	0.34	0.33	0.39	0.33
Program				
Business studies and accountancy	0.33	0.26	0.36	0.25
Management and law	0.33	0.42	0.39	0.47
Personnel studies	0.14	0.11	0.10	0.10
Small business and retail	0.20	0.21	0.15	0.18
Number of observations	104	146	189	220

The first two columns report mean values for the sample that is used in the analysis at baseline. The last two columns show the same statistics for the entire, including that are absent post-treatment due to attrition. If both numbers are underlined they are significantly different at the 5% level.

Presentation Outline

Regression of interest

$$\Delta Y_i = \alpha + \rho D_i + \beta X_i + \epsilon_i$$

where $\Delta Y_i = Y_{i2006} - Y_{i2005}$

European Commission

Results: all

Table 5
Treatment effects

	Treatment			Control			DD no controls	DD with controls
	1	2	3(=2-1)	4	5	6(=5-4)	7(=3-6)	8
Outcome variables (1–10)	*t*=0	*t*=1	Diff	*t*=0	*t*=1	Diff		
Entrepreneur traits	6.03	6.04	0.017 (.060)	6.06	6.20	0.142 (.043)***	−0.125 (.074)*	−0.115 (.077)
Need for achievement	7.29	7.30	0.012 (.087)	7.18	7.34	0.158 (.061)***	−0.146 (.106)	−0.150 (.108)
Need for autonomy	5.64	5.98	0.341 (.115)***	5.91	6.01	0.102 (.095)	0.239 (.149)	0.204 (.149)
Need for power	5.95	5.67	−0.276 (.161)	6.14	6.19	0.048 (.133)	−0.324 (.209)	−0.299 (.205)
Social orientation	6.38	6.38	0.002 (.132)	6.13	6.27	0.138 (.104)	−0.136 (.168)	−0.154 (.178)
Self efficacy	5.29	5.46	0.170 (.129)	5.41	5.76	0.355 (.095)***	−0.185 (.160)	−0.124 (.163)
Endurance	6.41	6.40	−0.005 (.095)	6.37	6.64	0.276 (.063)***	−0.281 (.114)**	−0.292 (.121)**
Risk-taking propensity	5.25	5.12	−0.126 (.098)	5.31	5.22	−0.083 (.073)	−0.043 (.122)	0.009 (.123)
Entrepreneur skills	5.91	5.80	−0.112 (.067)*	6.01	6.09	0.077 (.056)	−0.188 (.088)**	−0.151 (.092)*
Market awareness	6.16	6.12	−0.034 (.098)	6.44	6.46	0.017 (.088)	−0.051 (.132)	−0.008 (.137)
Creativity	6.08	5.80	−0.280 (.129)**	6.29	6.37	0.080 (.096)	−0.360 (.161)**	−0.326 (.158)**
Flexibility	5.50	5.48	−0.021 (.091)	5.31	5.44	0.133 (.069)*	−0.154 (.114)	−0.120(.118)
Entrepreneur intentions(0–6)	3.52	3.14	−0.375 (.125)***	3.12	3.29	0.178 (.107)*	−0.553 (.165)***	−0.543 (.174)***
N	104	104	104	146	146	146	250	250

European Commission

Results: male

Table 5
Treatment effects

	Treatment			Control			DD no controls	DD with controls
	1	2	3(=2-1)	4	5	6(=5-4)	7(=3-6)	8
Outcome variables (1–10)	*t*=0	*t*=1	Diff	*t*=0	*t*=1	Diff		
Treatment effects – male								
Entrepreneur traits	5.98	6.02	0.038 (.092)	6.09	6.31	0.222 (.063)***	−0.184 (.111)*	−0.130 (.124)
Need for achievement	7.18	7.30	0.135 (.119)	7.19	7.37	0.170 (.088)*	−0.035 (.148)	−0.018 (.154)
Need for autonomy	5.46	5.80	0.347 (.165)**	5.83	6.03	0.194 (.140)	0.154 (.216)	0.104 (.229)
Need for power	6.20	5.93	−0.291 (.244)	6.32	6.54	0.228 (.178)	−0.519 (.302)*	−0.360 (.314)
Social orientation	6.30	6.29	−0.018 (.186)	6.38	6.46	0.099 (.151)	−0.116 (.240)	−0.072 (.260)
Self efficacy	5.37	5.48	0.088 (.196)	5.47	6.00	0.533 (.141)***	−0.445 (.242)*	−0.303 (.266)
Endurance	6.23	6.28	0.082 (.135)	6.28	6.60	0.319 (.092)***	−0.237 (.163)	−0.230 (.173)
Risk taking propensity	5.12	5.07	−0.079 (.127)	5.15	5.17	0.013 (.096)	−0.092 (.159)	−0.033 (.172)
Entrepreneur skills	5.92	5.87	−0.040 (.093)*	6.08	6.21	0.124 (.082)	−0.164 (.124)	−0.121 (.138)
Market awareness	6.20	6.19	−0.000 (.118)	6.61	6.66	0.053 (.129)	−0.053 (.175)	−0.030 (.207)
Creativity	6.08	5.96	−0.130 (.182)**	6.34	6.50	0.153 (.136)	−0.283 (.227)	−0.282 (.236)
Flexibility	5.46	5.47	0.011 (.136)	5.31	5.47	0.166 (.095)*	−0.155 (.166)	−0.049(.176)
Entrepreneur intentions (0–6)	3.88	3.62	−0.281 (.177)	3.48	3.70	0.228 (.127)*	−0.509 (.218)***	−0.422 (.228)*
N	57	57	57	79	79	79	136	136

European Commission

Results: female

Table 5
Treatment effects

	Treatment			Control			DD no controls	DD with controls
Outcome variables (1–10)	1 t=0	2 t=1	3(=2-1) Diff	4 t=0	5 t=1	6(=5-4) Diff	7(=3-6)	8
Treatment effects – female								
Entrepreneur traits	6.08	6.07	−0.016 (.075)	6.03	6.08	0.051 (.059)	−0.067 (.095)	−0.065 (.099)
Need for achievement	7.42	7.30	−0.133 (.127)	7.18	7.31	0.146 (.087)*	−0.279 (.154)	−0.296 (.173)
Need for autonomy	5.84	6.20	0.335 (.161)**	6.00	5.99	−0.002 (.131)	0.336 (.207)	0.301 (.200)
Need for power	5.64	5.34	−0.272 (.205)	5.91	5.76	−0.163 (.205)	−0.109 (.290)	−0.118 (.285)
Social orientation	6.47	6.48	0.009 (.192)	5.83	6.03	0.195 (.146)	−0.187 (.241)	−0.114 (.262)
Self efficacy	5.20	5.48	0.239 (.160)	5.33	5.48	0.143 (.121)	0.096 (.201)	−0.150 (.217)
Endurance	6.63	6.57	−0.091 (.133)	6.48	6.69	0.251 (.083)***	−0.342 (.157)**	−0.429 (.168)***
Risk-taking propensity	5.39	5.17	−0.200 (.158)	5.50	5.30	−0.217 (.112)*	−0.017 (.193)	0.048 (.204)
Entrepreneur skills	5.91	5.71	−0.201 (.099)*	5.93	5.94	0.026 (.076)	−0.228 (.125)**	−0.144 (.133)
Market awareness	6.11	6.04	−0.076 (.166)	6.23	6.21	−0.023 (.122)	−0.053 (.206)	−0.014 (.221)
Creativity	6.08	5.60	−0.461 (.181)***	6.23	6.22	−0.017 (.137)	−0.444 (.227)**	−0.249 (.225)
Flexibility	5.54	5.49	−0.067 (.119)	5.32	5.41	0.118 (.102)	−0.186 (.156)	−0.169(.170)
Entrepreneur intentions (0–6)	3.08	2.54	−0.543 (.172)***	2.68	2.80	0.092 (.183)	−0.636 (.251)***	−0.891 (.261)***
N	46	46	46	65	65	65	111	111

Note: All effect estimates in the various rows of columns 7–10 come from separate regressions. Robust standard errors in parentheses. */**/*** indicates signific

Explanation

- Both men and women have significantly lower Entrepreneurial intentions after being exposed to the program
- Especially women who have experienced that running their own business is hard to combine with other uses of their time.

Presentation Outline

European Commission

Appendix: DiD IV Results, all

Outcome variables (1–10)	DD-IV no controls 9	DD-IV with controls 10
Entrepreneur traits	−0.092 (.096)	−0.077 (.096)
Need for achievement	−0.074 (.126)	−0.078 (.127)
Need for autonomy	0.173 (.197)	0.188 (.197)
Need for power	−0.097 (.262)	−0.079 (.259)
Social orientation	−0.171 (.223)	−0.158 (.226)
Self efficacy	−0.213 (.202)	−0.112 (.207)
Endurance	−0.239 (.144)*	−0.255 (.151)
Risk-taking propensity	−0.026 (.157)	−0.040 (.155)
Entrepreneur skills	−0.057 (.114)	−0.007 (.115)
Market awareness	0.117 (.167)	0.161 (.171)
Creativity	−0.263 (.196)	−0.162 (.200)
Flexibility	−0.026 (.158)	−0.021 (.158)
Entrepreneur intentions(0–6)	−0.465 (.215)**	−0.449 (.228)*
N	250	250

European Commission

Appendix: DiD IV Results, male

Outcome variables (1–10)	DD-IV no controls 9	DD-IV with controls 10
Treatment effects – male		
Entrepreneur traits	−0.018 (.149)	0.044 (.163)
Need for achievement	0.011 (.200)	−0.015 (.201)
Need for autonomy	0.227 (.301)	0.165 (.321)
Need for power	0.099 (.398)	0.320 (.426)
Social orientation	−0.083 (.325)	0.103 (.341)
Self efficacy	−0.291 (.316)	−0.079 (.340)
Endurance	−0.201 (.224)	−0.252 (.251)
Risk taking propensity	−0.113 (.209)	0.062 (.230)
Entrepreneur skills	0.019 (.171)	0.144 (.172)
Market awareness	0.128 (.243)	0.217 (.288)
Creativity	−0.123 (.272)	0.045 (.308)
Flexibility	−0.051 (.245)	0.171 (.245)
Entrepreneur intentions (0–6)	−0.425 (.303)	−0.326 (.319)
N	136	136

European Commission

Appendix: DiD IV Results, female

Outcome variables (1–10)	DD-IV no controls 9	DD-IV with controls 10
Treatment effects – female		
Entrepreneur traits	−0.195 (.122)	−0.172 (.121)
Need for achievement	−0.172 (.154)	−0.190 (.181)
Need for autonomy	0.103 (.257)	0.155 (.238)
Need for power	−0.353 (.346)	−0.309 (.348)
Social orientation	−0.315 (.313)	−0.275 (.337)
Self efficacy	−0.176 (.245)	−0.055 (.273)
Endurance	−0.266 (.177)	−0.366 (.188)
Risk-taking propensity	−0.188 (.240)	−0.167 (.229)
Entrepreneur skills	−0.165 (.154)	−0.110 (.163)
Market awareness	0.097 (.239)	0.063 (.242)
Creativity	−0.440 (.285)	−0.275 (.290)
Flexibility	−0.150 (.202)	−0.116 (.211)
Entrepreneur intentions (0–6)	−0.572 (.305)*	−0.970 (.330)***
N	111	111

Presentation Outline

European Commission

References

- Caliendo, M. and Kopeinig, S. (2008), Some practical guidance for the implementation of propensity score matching, *Journal of Economic Surveys*, vol. 22, No. 1, pp. 31-72
- Bryson, A., Dorsett, R. and Purdon, S. (2002), The use of propensity score matching in the evaluation of active labour market policies, Working paper number 4, Department for Work and Pensions
- Morgan, S. and Harding, D. (2006), Matching estimators of causal effects: Prospects and pitfalls in theory and practice, *Sociological Methods and Research*, vol. 35, No.1, pp. 3-60
- Rosembaum, P. and Rubin, D. (1983), The central role of the propensity score in observational studies for causal effects, *Biometrika*, vol. 79(1), pp. 41-50
- Hessel Oosterbeek, Mirjam van Praag, Auke Ijsselstein, (2010) The impact of entrepreneurship education on entrepreneurship skills and motivation, European Economic Review, Volume 54, Issue 3, April 2010, Pages 442-454