

# **USE OF COUNTERFACTUAL IMPACT EVALUATION IN MANAGEMENT OF PUBLIC EXPENDITURE PROGRAMMES**

**Oto Potluka – Jan Brůha**

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## **Abstract**

Area of intervention 1.1 OP HRE (Operational program Human Resources and Employment) offers excellent possibility for the Counterfactual Impact Evaluation (CIE). This method has not been extensively applied in the case of the Structural Funds assistance in the EU. Thus, the above-mentioned area of support enables opportunity for pilot testing.

The main research question is whether the CIE methods are applicable in the case of OP HRE, area of support 1.1 in the Czech Republic and what requirements have to be met.

The quality of data is crucial for CIE. Thus the OP HRE was tested for the compliance with the data requirements (sample size, randomization for approval of the assistance, homogeneity of the assistance).

The area of support 1.1 in the OP HRE met the basic requirement for CIE. There is enough assisted firms and the assistance is homogenous (i.e. there are trainings in just a few type of educational topics).

**Key words:** Counterfactual, Impact Evaluation, Structural Funds

**JEL Code:** C31, C33, D61

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## **Introduction<sup>1</sup>**

Efficiency of public expenditure programmes is one of the core discussions in the field of economy. The financial crisis stresses the importance of the effective use of public funding and the counterfactual impact evaluation as a tool for evaluation of the effectiveness. Massive subsidizing by EU funds shows the lack of methodology in the field of evaluation of such interventions in the European Union. The conducted evaluations have so-far used mainly qualitative methods, which cannot answer the important question, which kind of the support actually works.

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<sup>1</sup> The paper has not been proof-read.

The quantitative evaluation methods are the reaction to pitfalls of qualitative methods - mainly the Counterfactual Impact Evaluation (CIE) methods. The combination of both qualitative and quantitative methods can answer what is the impact, of what on whom and why.

The main research question of this paper is whether the CIE methods are applicable in the case of Operational Programme Human Resources and Employment (OP HRE), area of support 1.1 in the Czech Republic and what requirements have to be met. To answer this question, we ask question whether it is possible to do a research of impact of OP HRE on firms (especially on turnover, employment and profitability).

The paper is organized as follows. First, the CIE methods and data requirements are introduced. The description of OP HRE follows. Then, the appropriate CIE methods and their application to the OP HRE are described. The last part concludes.

## **1. OH RE, area of support 1.1**

### **1.1 CIE Methods**

Generally the ideal CIE of public expenditure programmes would be based on a comparison of treated observations (firms in this case) with situation of non-treated observation (of the same firms) at the same time. Actually it is not possible. To assess the impact of the support, a large number of cases are used.

This methodological caveat is solved by using of two groups of firms. The first one is composed of subsidised firms; the second one is a control group. Both groups have similar characteristics. With a large number of observations in each group, the means of characteristics (i.e. the average difference) is very small.

This approach enables to use those two groups as almost identical and to use them the ideal situation described above.

### **1.2 Criteria for CIE**

Applicability of CIE requires meeting two basic:

- **A large number of cases (observations).** Observations are usually at the level of individuals or organizations. Primarily, the meeting of this requirement ensures statistical significance of estimates and contribution of the reliability of results. For the discussion see White (2011).

- **Homogeneous cases.** In order to use the CIE method, it is necessary that examined cases represent the same situation.

### **1.3 Data from OP HRE for CIE**

The calls inside the OP HRE, area of support 1.1 differentiate according to their eligible applicants (firms, associations or ministries). There are three main types of calls, of which just two are suitable for the purpose of CIE.

- 1) **Grant calls** – Those are calls with firms as final beneficiaries. Data sample is necessary to adjust as there are also some associations and training agencies as final beneficiaries. Those organizations will not probably participate on data collection. The following table summarizes this type of calls.

**Tab. 1: Number of projects in grant calls OH HRE, 1.1 suitable for CIE**

<b>Nr. of a call</b>	<b>Description</b>	<b>Realized</b>	<b>Not-realized</b>	<b>Total</b>
23	There is necessary to erase those cases, when the associations and training agencies are in the role of the final beneficiary. It is possible that those beneficiaries would not cooperate on data collection or even they do not have such data.	230	461	691
35	The call is oriented to firm level. This call is suitable for CIE. There are more than 1000 assisted projects. Thus this call is a core of the CIE with the data at the firm level.	1064	738	1802
39	The call is oriented to firm level. This call is suitable for CIE.	98	249	347
60	The call is oriented to firm level. This call is suitable for CIE.	182	280	462
<b>Total</b>		<b>1663</b>	<b>1907</b>	<b>3570</b>

*Source: Monit7+, own calculations*

*Notice: The data are valid on 1th of July 2011; Number of realized projects includes: Project recommended / approved; Project with a decision; Project in realization; Realization*

*finished. Thus there are projects with different phase of realization. Other projects are classified as not-realized.*

- 2) **System projects** – Firms are in a position of target groups, not in a position of final beneficiaries. Those are primarily calls 34 “Vzdělávejte se!” and 71 “Vzdělávejte se pro růst”.

**Tab. 2: Information on system projects in OP HRE suitable for CIE**

Nr. of a call	Description
34	There have been supported approximately 3000 firms in the frame of this system project. Thus this call meets the requirements of CIE and will be used as data set for CIE. Data are available at the Ministry of Labour and Social Affairs of the CR.
71	This is a call similar to the call nr. 34. Thus this call meets the requirements of CIE and will be used as data set for CIE.

*Source: Monit7+; Information based on structured interviews with the Managing authority of OP HRE*

- 3) **Calls not applicable to CIE** – Those are the calls, which still have not been realized or system projects oriented to other fields than training of firms’ staff. Also calls with associations and training agencies are excluded. The following table describes those calls.

**Tab. 3: Description of calls not applicable to CIE**

Nr. of a Call	Description	Realized	Not-realized	Total
02	This call is primarily oriented to social dialogue. Data from this call are not appropriate for CIE.	5	9	14
33	The call was open for associations not for firms. It would be difficult to get information on supported firms. Thus this call is not appropriate for CIE.	21	45	66
46	This call is primarily oriented to healthcare sector.	3	0	3

	Data from this call are not appropriate for CIE.			
50	Proposal of this system project has been returned to re-writing to BENEFIT7 system. Thus it is not appropriate call for CIE.	0	1	1
52	The call was open for associations not for firms. It would be difficult to get information on supported firms. Thus this call is not appropriate for CIE.	59	122	181

*Source: Monit7+, own calculations*

*Notice: The data are valid on 1th of July 2011; Number of realized projects includes: Project recommended / approved; Project with a decision; Project in realization; Realization finished. Thus there are projects with different phase of realization. Other projects are classified as not-realized.*

There are suitable two sets of data for CIE according to the above-mentioned information. The first one is from grant calls. The second one is based on system projects.

## **2 Proposed solution – application of CIE**

The following text describes the methods which the authors would use for CIE in the case of OP HRE.

For discussion of CIE in OP HRE, we start with the characterization of the distribution of the application and actually obtained support (its size and type) by firms depending on their location, sector (NACE<sup>2</sup>) and other characteristics (i.e., size). This question could help us in constructing models below. From the econometric point of view, the distribution of the support size will be modelled non-parametrically (a non-parametric density function estimation based on the kernel estimator). To do that, we propose a non-parametric spatial

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<sup>2</sup> There are different approaches how to grasp statistically the industry sector of company. One of them is the introduction of dummy variables for individual sectors. An alternative method is not to use dummy variables, but to use variables describing the characteristics typical for firms in the industry (export status, size, etc.) in the regression. These properties could be derived either from the microdata, or some from the national accounts (e.g., share of exports in value added in the sector). The advantage of the second approach is that results can be more informative: it is easier to interpret the coefficients on observed characteristics than dummy variables. On the other hand, this approach exposes a greater risk than of incorrect specification than dummy variables. Alternatively, you can combine both approaches: the first stage to use dummy variables in the regression itself, and then in the second stage to explain the coefficients of dummy variables with the above-mentioned characteristics of sectors. This approach allows avoiding the wrong specification in the first instance, and - if the second phase of the model is well specified - allows a better interpretation of results. At the same time any incorrect specification of the second phase will not affect the results of the first phase. A similar approach was used in the model of travel expenses, see Murdock (2006).

model, where the number or ratio of firms supported in the region will be explained by the geographic location and firm characteristics (size, NACE, legal form). We suggest using radial basis functions (Buhmann 2003), which is a non-parametric method. The strength of suggested method is that the geographic location of firms may not be modelled using variables 0-1 (depending on the county or district where the firm is located), but it can be understood as a continuous variable (longitude and latitude location of the company). This method allows verifying whether it is possible to model geographic location e.g. depending on the distance from the nearest economic centre, from a major road or from the border (for exporting firms). Non-parametric method has the advantage that it identifies whether there is some easy-to-grasp-regularity in the location of economic activity (or its type). If so, it will be used for answering other types of research in CIE (especially the application of the method propensity score matching).

Datasets requirements:

- (I) a list or a random selection of applicants for support from the relevant calls along with a description of basic characteristics (NACE, location, type, and basic economic data, an indicator of whether or not awarded aid, if so how much). Characteristics based on the available resources (no questionnaire, here), what could limit us, but hopefully not entirely.
- (II) Random selection (probably according to the Identification number)

Then, we will proceed to questions comparing successful applicants. Here, we suggest using three independent methods. In case the results are similar, we can be sure about their robustness.

First, we apply **the regression-discontinuity approach**. We examine whether we should use the sharp or the fuzzy variant of the model. This will be decided according to the type of choosing the supported companies.

First, it is necessary to treat the situation that the evaluation of proposals was done in several rounds, which may cause the following two problems:

1. generally - different amount of points was necessary for support;
2. Various macroeconomic environment (support in the time of economic boom may have a different impact than support during the recession).

We solve the first problem by considering the deviation from the border of gaining support relatively to the round. The second problem will be solved through the inclusion of time

dummy among regressors (see below). An alternative is to use an index of economic performance for the relevant industry sector.

We begin with the local-linear model where we will control for important firm characteristics (such as sector, geographic location, the size and time when the support was obtained).

By using a local linear model with extra regression variables (business characteristics or time dummy or cycle indexes) we can address the problem of heterogeneity of support impact. A care must be made to deal with heterogeneity of the type of education. One – easier – possibility is to include the type of education among the control regressors. Second possibility (tougher on data and statistic) is to consider the multiple treatment variant (Papay, Willet and Mumane 2011). We pursue this alternative, only if it is possible to meaningfully categorize the support obtained from ESF OP HRE.

We plan to use Imbens and Lemieux (2007) to make a set of robustness tests (especially the length of the window selection for local linear model, testing whether there is indeed a regression discontinuity, the use of alternative methods - sieve estimator – instead of local linear regression, etc).

As demands for data, we need information about successful and unsuccessful applicants - scoring obtained in the process and in the evaluation round (especially how many points were needed in the round). Most data about the companies are available in public resources. Probably, the most serious problem is the data on employment, which will probably need a survey.

Then, we attempt at using **the instrumental variable estimator**. As the instrument, we plan to use the identification of evaluators. This may be a valid instrument, because the evaluator probably determines the outcome (kind/strict), but presumably does not influence the outcome. In case evaluators do not vary enough (equally strict), this method would be unusable.

We start with a linear instrumental variable model, where we explain the percentage change in the indicator (profit, sales, employment) as a function of control variables (size, location, and sector of firms) instrumenting by the evaluators. Controlling for these regressors will enable us to address some questions concerning turnover, employment and profitability. Again by adding extra regressors it is possible to address the problem of impact heterogeneity on different companies.

As an alternative, we will consider a semi-nonparametric estimator<sup>3</sup>. This would make the results robust to the functional form, but also enables keeping the modelling of results based on the characteristics of firms.

Data requirements are similar to previous methods, but we also have to know the evaluators of individual projects (their identifiers) and how many points did evaluator give to the particular project.

In the case of using this method we discuss in detail the conditions of its application. Applicability may be at risk if:

1. All the evaluators evaluated very similarly (the instrument is too weak, standard error of estimates are large and the results unreliable);
2. or if a significant part of the evaluators skewed to certain types of companies (e.g., geographically or professionally).

As a third method we plan to use **the propensity score matching**. Among variables entering the first stage (the discrete choice model), we consider the following ones: economic sector, regions, size, employment of women, disabled or minorities, economic outcomes before the support (both levels and growth rates). We use bayesian methods (O'Hara and Sillanpaa 2009) for variable selection. We need a sample of both supported and not supported companies. The propensity score matching is also the only way applicable to addressing some questions comparing treated and non-treated firms. To do it, we need a random sample of companies, which did not ask for the OP HRE support (a control group). The PSM method will be combined with the method of conditional difference in difference, which is the standard approach, allowing isolation of the effect of observed characteristics of firms to the outcome.

Here we need similar data as above, in the case of non-applicants to construct "random" sample. Similarly as above, we need to get some data through a questionnaire survey (especially about employment).

To summarize, in all three methods described above, we first use simple models and then more difficult models. First we use linear models to explain the changes of indicator (employment, profits, or sales) using the observed characteristics, and we check deflection due to self-selection, which does each method in other way. In the next step we consider more advanced methods (mostly non-parametric), which can overcome the implicit limitations of

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<sup>3</sup> See Chen 2007 or Blundell 2007 for an introduction to semi-parametric instrumental variable techniques



linear relationship and thus make the results more robust. On the other hand, these methods are very demanding on the data (their amount).

Also - as mentioned in methods - we try to use those variants of methods that allow the involvement of additional regressors. It can both increase the efficiency of statistical estimates and allow us to have a better idea of which group of companies the support works and how much.

However, the heterogeneity of the impact of support can be compared from multiple perspectives. As already have been described, it is a comparison of the average impact of the support on different groups of companies. We plan also to characterize the distribution of the impact of the support (unconditional or conditional on observed characteristics). Indeed, the average support may not provide the complete picture, since some the impact of types of support or the impact on different businesses can be considerable variable.

The characteristics of this distribution can be addressed differently in different methods. In the parametric method of instrumental variables it is - under certain circumstances – possible to use quantile regression methods (see Chernozhukov and Hansen 2005 and Torgovitsky 2010 for more details). In the PSM method it is possible to estimate the distribution directly, if PSM version with kernel matching is used. Kernel matching directly estimates the distribution function.

## **Conclusion**

The area of support 1.1 in the OP HRE met the basic requirement for CIE. There is enough assisted firms and the assistance is homogenous (i.e. there are trainings in just a few type of educational topics).

A combination of econometric methods (regression discontinuity design, instrumental variables and propensity score matching and difference-in-difference method) can be used in the OP HRE.

To answer the questions what is the impact, of what on whom and why, it is necessary to use both quantitative and qualitative methods. Both of them have some strengths and weaknesses.

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## **Contact**

Oto Potluka

Department of Management, University of Economics, Prague  
nám. W. Churchilla 4, Praha, Czech Republic

[potluka@vse.cz](mailto:potluka@vse.cz)

Jan Brůha

IREAS

Štěpánská 16, Praha, Czech Republic

[jan\\_bruha@yahoo.co.uk](mailto:jan_bruha@yahoo.co.uk)