

Evaluation of the Development Tax Benefit Scheme

Summary

The Development Tax Benefit is a tax credit available as part of the corporate income tax system. According to the General Block Exemption Regulation, an impact assessment of a given aid scheme shall be carried out if the average annual budget expenditure on the aid scheme exceeds EUR 150 million. The present paper aims at delivering the econometric impact assessment outlined in evaluation plan of Development Tax Benefit scheme (hereinafter: DTB) (SA.39292 (2014/N)) approved on 16.01.2015 (C(2015) 61 final).

Given the specific features of DTB, limitations in breadth and quality of data available, the applied methodology departs slightly from the approved evaluation plan. However, the differences are reckoned not to be distortive in terms of results and are discussed in detail in a transparent manner.

All in all, the development tax benefit, as an additional subsidy (additional in the sense that in this exercise beneficiaries receiving DTB are compared to beneficiaries receiving neither DTB nor other (substitute) state aid), is estimated to have significant impact on the amount of the assets, on the employment, on the total wage bill and both on the net and gross value added. As the effects of the DTB on growth in assets and employment – both explicit criteria of the scheme - are higher than the effects of other subsidies, DTB may be regarded as appropriate, however, the scheme may still not be self-financing in the long run.

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1. Main features of the Development Tax Benefit scheme

The Development Tax Benefit (hereinafter referred to as “DTB”) is a tax credit available in corporate income tax. Enterprises that undertake an investment of a certain amount can reduce their corporate income tax. It was introduced in 2003 as a scheme primarily intended to address the issues of comparatively low level of employment, capital stock and investments in certain activities. The scheme is open to companies of any sector or size, capable of implementing the investments above the thresholds or willing to expand their level of employment, while also meeting other criteria.

DTB is regulated by Act LXXXI of 1996 on Corporate Tax and Dividend Tax and the set of rules evaluated in this exercise is regulated by Government Decree No. 165/2014 entering into force on 18th of July, 2014. The regulation of the incentive is based on Articles 14 and 17 of the General Block Exemption Regulation (*Commission Regulation (EU) No 651/2014 of 17 June 2014*; hereinafter referred to as GBER).

Due to the decisions of the Hungarian legislators there have been a number of minor changes in the system of conditions of the scheme during the examined period (i.e. since 18 July 2014.). Each of these changes are highlighted below, however they have no impact on the scheme’s compatibility under the GBER, nor on the evaluation plan or its implementation.

The taxpayers may apply for DTB for certain types of investments according to the regulation. These categories are the following:

- (a) projects exceeding at least HUF 3 billion at present value,
- (b) projects commissioned and operated in the administrative territory of a beneficiary municipality, defined in the Government Decree and exceeding at least HUF 1 billion at present value,
- (c) projects exceeding at least HUF 100 million at present value and satisfying one of the following conditions:
 - a. the project aims to put in place the food hygiene requirements specified by law for already commissioned plants manufacturing food of animal origin,
 - b. the project is an independent environmental investment project,
 - c. the project is an investment concerning basic research, applied research and experimental development,
 - d. the project is an investment exclusively for motion picture and video production,
 - e. the investment is implemented in a free enterprise zone,
 - f. the investment begins in the first three years after the admission to trading on a regulated market of the shares issued to increase its subscribed capital,
- (d) investment projects for job creation,
- (e) projects exceeding at least HUF 500 million at present value and realized by a small or medium-sized enterprise (from 24 July 2019 the threshold has been HUF 300 million for small enterprises and HUF 400 million for medium-sized enterprises),
- (f) from 24 September 2017: investment projects for the purpose of product diversification or creating new process innovation, realized by a large company in any supported municipality of the Central-Hungary region and reach at least HUF 6 billion at current prices,
- (g) from 24 September 2017: investment projects for the purpose of product diversification or creating new process innovation, realized by a large company in any supported municipality

of the Central Hungary region and aimed at creating new jobs, at least HUF 3 billion at current prices.

Given the investment thresholds eligible for support, the scheme might favour larger companies with stronger financial backgrounds, but it is alleviated by lower thresholds for SMEs, the absence of thresholds in terms of net job creation and the fact, that the DTB is available in the most developed region only for SMEs.

The most basic condition for claiming the tax benefit is that prior to the commencement of the project, the taxpayer has to submit an application to the Ministry of Finance supplying all data and information prescribed in the Government Decree. Except for notified individual aid (when the taxpayer may use the tax benefit according to a Government resolution, adopted upon the authorization of the European Commission) **as a general rule, the enterprise may use the tax benefit automatically if its application is in conformity with all requirements** and also the prescribed additional conditions are met during the implementation of the investment.

These additional conditions are partly general and partly depending on the type of investment. For example, the mandatory maintenance period (3 years for SMEs and 5 years for LEs) and certain environmental regulations are general requirements, while mandatory headcount increasing or maintaining conditions are only required for certain types of projects. The mandatory headcount conditions are prescribed for a four year long period as follows:

- for investment type (a) it was 150 people till the end of 2016, 50 people in period 2017-2019 and only the maintenance of the number of employees is required from 1 January 2020;
- for investment type (b) it was 75 people till the end of 2016, 25 people in period 2017-2019 and only the maintenance of the number of employees is required from 1 January 2020;
- for investment type (e) it was 25 or 10 people depending on the firm's size till the end of 2016, 10 or 5 people in period 2017-2019 and there is not any requirement for the number of employees from 1 January 2020;
- for investment types (f) and (g) it was 50 people (or 25 people in case of projects commissioned and operated in the administrative territory of a beneficiary municipality, defined in the Government Decree) till the end of 2019, and only the maintenance of the number of employees is required from 1 January 2020;

An important rule, that all of these employment related conditions could be also satisfied by a proportional increase in wages according to the Act.

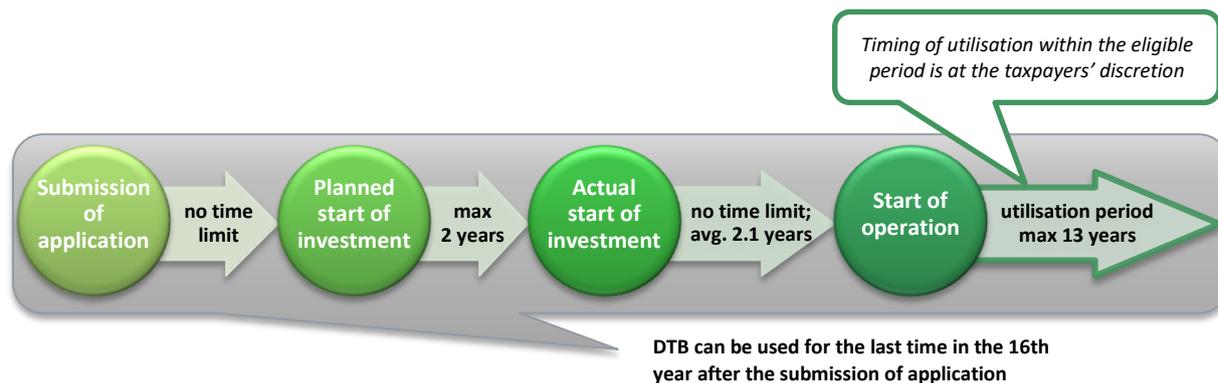
The Act on Corporate Tax and Dividend Tax clearly states that any taxpayer who is unable to comply with any of the conditions set out in the regulation shall not be entitled to claim the tax benefit and any tax benefit already claimed shall be treated unlawful, with the exception if non-compliance is the result of unavoidable reasons beyond the taxpayer's control.

The eligible costs of the investment (on which the amount of tax benefit is based) and the aid intensity are defined on the basis of the GBER and the regional aid map. An important difference between job creation projects and all the other types of supportable investments is, that while for the former ones the eligible cost is the personnel expenditure in newly created jobs, while otherwise it is based mainly on the newly purchased assets in all the other cases.

Applying for the tax benefit does not preclude the taxpayer from claiming state aid from other sources for the project, but of course the amount of the tax benefit must be taken into account when considering the maximum amount of aid according to EU law.

There is a generous timeframe in which the company can utilise the tax benefit it has become entitled to. According to the rules in force at the beginning of the examined period, the taxpayer can utilize the DTB from the tax year following the year when the investment project has been completed - or in the same tax year upon the taxpayer's decision - and in the following nine tax years, at the latest until the fourteenth tax year following the tax year application was submitted.

Figure 1 - Timeframe of DTB



Source: authors' own

The utilisation schedule is at the discretion of the enterprise, but **the amount used up shall not be more than 80% of the annual corporate income tax liability in any given year.**

From the 1 January 2017 the above mentioned 9-year rule was raised to 12 years and the 14-year rule was raised to 16 years, in relation to the decrease of corporate tax rate from 19% to 9% in 2017.

We also note that the system has been in force since 2003 in some form, in compliance with the prevailing compatibility conditions of the time, under an essentially similar set of rules.

2. Necessity and feasibility of the evaluation

According to the General Block Exemption Regulation, an impact assessment of a given aid scheme shall be carried out if the average annual budget expenditure on the aid scheme exceeds EUR 150 million. In the case of the Hungarian Development Tax Benefit, the evaluation was deemed necessary because the expected total amount of the maximum supports to which the enterprises became eligible according to the applications submitted during the reference period exceeded this limit, and the Commission considered this amount in 2014 to be the worst case budget expenditure for the period.

Due to the logic of the system of DTB described above, we believe that this approach leads to significant overestimation of even the worst case in terms of budgetary expenditure. This position of Hungary had been communicated to the Commission in the run-up to the submission of the evaluation plan, giving detailed reasons and supportive background-statistics and an estimation, which was partly included also in the evaluation plan.

In 2014, estimating the budgetary impact of the applications to be submitted in the 2014-2020 period was possible only by relying on historical data of the predecessor schemes. By now, we have had more

factual data on the examined period, thus we consider it worthwhile to report them as part of the evaluation and to repeat and update our estimation on the worst case budget expenditure scenario.

Given all the above, the peculiarities of DTB cause several methodological difficulties for implementing the expected evaluation, mainly due to the timing characteristics of the scheme. In addition to the budgetary estimation, these features are also described in more detail in the next section.

2.1. Difficulties of assessments and forecasts in light of the regulation of DTB

The application for the development tax benefit contains an amount of state aid available conditionally at a relatively far, uncertain time in the future. Many of the taxpayers that file the application for DTB at no extra cost are likely to take it into consideration as an option with no obligations at the time of submission.

The most basic condition for the eligibility to the tax benefit is that the application must be submitted before the start of the investment, i.e. at the planning stage.

Subsequently, the following factors cause uncertainty regarding the usage of the aid both in terms of timing and value:

- Will the investment be implemented? – According to the survey data detailed in the following subsection, a measurable part of the investments is never realised.
- If the project is realised, will the other conditions for claiming the tax credit be met?
- How much will the investment cost be? If the actual cost is lower than was planned, the amount of the aid will also be lower.
- If the enterprise uses state aid for the investment from other sources too, it will diminish the sum of DTB to which they become eligible as the combined value has to be under the maximum amount of state aid (on the basis of actual costs).
- At the end of the day, will the corporate income tax liability be enough to claim the tax benefit? (if the company is not profitable enough, it might not be able to use up all the available aid amount)
- How many years after the completion of the project will the tax credit have been fully used up (if ever)?

Most of the listed questions can only be answered just many years after the submission of the application. The applications submitted in the period 2014-2020 would only be possible to be accurately assessed in totality at the end of the full usage period: in 2036. Even if we consider only the projects included in the applications submitted in 2014, all the information would be available only in 2028.

One can say that these uncertainties are mostly theoretical because the processes are likely to be faster in practice, but very often they are not. In the next subsection we present the available data on this issue.

2.2. Lessons from a survey

From the methodological point of view, this evaluation is based on the difference-in-differences method which will be presented in detail later. For this method to work, a firm can be selected to the treated group only if it has already completed the aided investment, because this ensures that the

impact of the investment, if any, can already be seen in its economic indicators. Since we had to know which projects had been finished and had no other source of information, we asked the taxpayers concerned to complete a questionnaire. The questionnaire also asked for information on the current status of the related development tax benefit, obtaining this way a more rounded view than tax declarations alone could have provided.

The electronic questionnaire was compiled by the Ministry of Finance and the National Tax and Customs Administration (hereinafter referred to as the NTCA) made it available to taxpayers on the form filling interface businesses regularly use. Taxpayers concerned were requested to complete the questionnaire in a specific letter sent by the NTCA on 6 January, 2020. The questionnaire was available until 28 February. The completion was not mandatory in the absence of a legal authorization. In view of this, the questionnaire was kept to be brief in order not to discourage taxpayers from responding.

The questionnaire covered the following questions:

- data identifying the company,
- data identifying its legal predecessor (if applicable), if the application had been submitted by the legal predecessor,
- date of the application,
- type of the investment according to the regulation on DTB,
- completion date of the investment project (if applicable),
- current status of the related development tax benefit (e.g. use of tax credit has begun / for some reason use of tax credit is not possible anymore / etc. – see *Table 1* for all the options).

According to the application register of the Ministry of Finance, 669 companies have taken the opportunity to apply for the development tax benefit since the introduction of the system in 2003. Out of them, 407 companies (about 61%) completed the questionnaire. Since its introduction in 2003, of course, it has happened many times that a company has submitted several applications for DTB in connection with different projects. Some of these taxpayers have completed the questionnaire only for some of their projects.

When looking at projects instead of taxpayers and limit our interest to the currently available scheme (i.e. 18/7/2014-31/12/2019), then out of the 392 project applications submitted under the current regulation 285 (about 73%) were stated in the survey. The share of reported projects is similar also in terms of the maximum amount of support to which the enterprises became eligible. The 392 submitted applications covered potentially HUF 832 billion of maximum aid value, while the total amount of aids reported in the survey was HUF 604.5 billion (73%).

According to the survey data, only 38.2% of the investments had been completed out of the 285 project applications. This corresponds to 26.8% of the maximum support amount (HUF 604.5 billion) to which the enterprises became eligible. For most of these projects, taxpayers had not lost their entitlement to the tax benefit until filling the questionnaire, but only 11.7% of the maximum support amount of reported investments had started to use up by the end of 2018, and the actually used sub amount is only a fraction of this (less than 17%).

Table 1: Survey data on the current status of supported investment projects and the related DTB

Applications submitted in period 18 July 2014 - 31 December 2019	Number of projects		Available tax credit	
	No.	% of total	billions of HUF	% of total
applications reported in the survey	285	100%	604.5	100%
- finished investments	109	38%	162.2	27%
- usage of tax credit has begun	59	21%	71.0	12%
- usage of tax credit has not begun, but the taxpayer has the right to use it up in the future	43	15%	78.7	13%
- usage of tax credit has not begun and it is not possible anymore, because the taxpayer has got the maximum amount of state aid from another source	1	0%	2.1	0%
- usage of tax credit has not begun and it is not possible anymore, because the taxpayer failed to meet eligibility criteria	6	2%	10.3	2%
- unfinished investments (→ usage of tax credit has not begun!)	173	61%	440.5	73%
- the taxpayer has the right to use the tax credit up in the future	142	50%	355.8	59%
- usage of tax credit is not possible anymore, because the taxpayer has got the maximum amount of state aid from another source or failed to meet eligibility criteria	3	1%	6.1	1%
- usage of tax credit is not possible, because the taxpayer does not plan to realise the investment anymore	18	6%	43.7	7%
- taxpayer has not reported the exact status of the project in the survey	10	4%	34.8	6%
- taxpayer has not reported in the survey whether the investment is finished or not	3	1%	1.8	0%

Source: authors' calculation based on NTCA survey

As additional information to the survey, we see from the tax returns that the tax benefit actually used out of the total submitted applications within the current period is only HUF 12 billion (1.4%) linked to 62 investment projects.

Table 2: Actual usage of the tax benefit in period 2014-2018

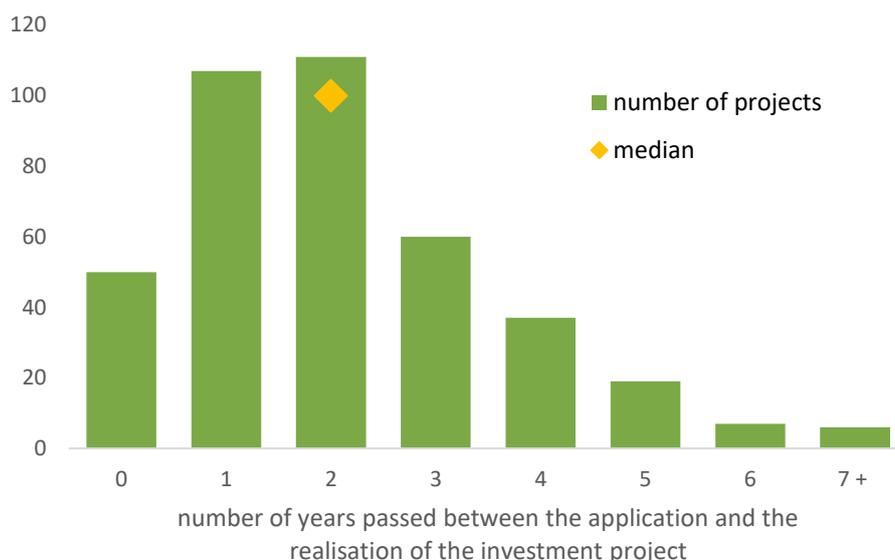
	Number of projects	Available tax credit (billions of HUF)
submitted applications in the examined period		
18 July 2014 - 31 December 2019	392	832.0
Actual usage of the tax credit in period 2014-2018		
2014	0	0.0
2015	4	0.0
2016	12	4.0
2017	29	2.4
2018	54	5.6
Total	62	12.0

Source: MoF application register and CIT return data

The low utilization rate is mainly due to the time required to implement the projects and to the limit resulting from the amount of corporate income tax. First, the average length of the implementation of a project was 2.1 years and 32.5% of the projects took at least 3 years, and also, the rate of Hungarian corporate income tax decreased to 9% from 2017, which together with the varying levels of profitability, the 80% limit in any given year and other tax benefits constrained the actual value of DTB companies could claim in the period.

Figure 2: Frequency of projects by the number of years they have taken

Data of 397 investments which were reported as finished projects in the survey



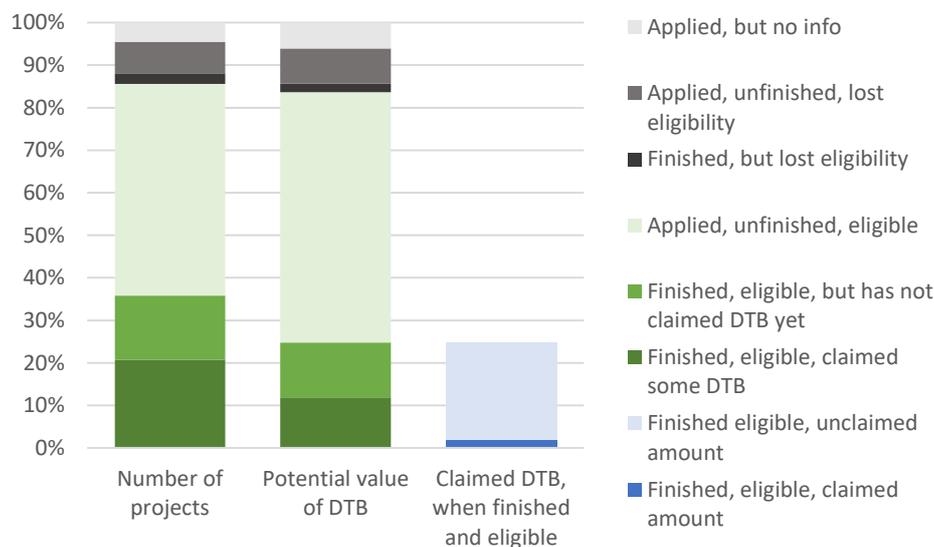
Source: authors' calculation based on NTCA survey

2.3. Expected budget of the scheme (worst case scenario)

Given that the survey covers 73% of the aid applications submitted during the examined period, it provides a good indication on the status of the whole set. The survey data reveal that 5.5 years after the launch of the scheme, 11.7% of the benefits included in the applications have started to be used, but 10.3% of them clearly will not be used ever for different legal reasons.

That is an open question whether those taxpayers who already have begun to use the tax benefit will be able to take the maximum amount of their aid or not. (In fact, due to the multi-year eligibility conditions such as the obligatory maintenance period, there may even be a repayment obligation.) However, the uncertainties of the use of the remaining 78% are very diverse and high.

Figure 3: Current status of the supported investment projects and the related DTB reported in the survey



Source: authors' calculation based on NTCA survey and CIT return data

The most pessimistic (but unrealistic) assumption for the budgetary effect of the scheme is that all the aid will be fully used at the maximum amount in the future. However, we can also state the following:

- 10.3% of the total amount of the maximum supports to which the enterprises became eligible will not be used ever for different legal reasons (i.e. taxpayers get the maximum amount of state aid from another source, fail to meet eligibility criteria or do not realise the investments),
- the path of budget expenditures follows a Gaussian curve, and its period is factually 2015-2036.

Table 3: Expected budget of the scheme (worst case scenario)

	Number of projects	Available tax credit (billion HUF)
submitted applications: 18 July 2014 - 31 December 2020*	467	991.7
projects ever finished and not failed to meet any criteria	421	889.4
average yearly budget (2015 - 2036)		40.4

* forecast based on actual application data for the period 2014-2019

Source: authors' calculation based on MoF database, NTCA survey

It must be highlighted that in contrast with the HUF 40.4 billion worst case yearly budget of the scheme, within the first 5.5 year long period only HUF 12 billion of DTB was used by the beneficiaries of the system (as it shown in Table 2). Thus, in average, the actual yearly budget of the scheme was only 5.4% of the estimated amount of the worst case scenario.

3. Methodology and limitations compared to the approved evaluation plan

Given the specialities of DTB, the difficulties of the evaluation described in the previous sections and the fact that not all data sources became available as planned, the methodology drafted in the evaluation plan had to be modified at a few points. In this section we present these differences and the finalized methodology.

3.1. Data sources

The evaluation hinges on matching three separate anonymized firm-level databases. They were linked together by the Hungarian National Tax and Customs Administration based on §131 (14) g) and i) of Act CL of 2017, which provides the legal authorisation to the Tax Authority to provide taxpayer-level information for administration and evaluation of state aid. The data sources used cover all firms in a uniform fashion.

The main sets of data which were needed for the analysis are the accrual based financial data of the firms, total amount of their direct state aid and indirect state aid (i.e. tax incentives) and the data of the requested development tax benefit.

Table 4: Data sources planned and actually used

necessary data	source planned	source used	reason of difference
profit and loss account and balance sheet data	corporate income tax returns (period 2007-2020)	corporate income tax returns (period 2011-2018)	For the reason of difference in period, see subsection 3.3.
total amount of direct state aids (in cash)	OTR: firm-level database on non-corporate-tax supports including EU and domestic schemes (period 2014-2020)	corporate income tax returns <i>estimation</i> (period 2012-2018)	OTR is a register and control system for state aid which has started live operation in 2016. It contains incomplete data for the period before 2016. The data from tax returns are a bit noisy but consistent. For the reason of difference in period, see subsection 3.3.
total amount of corporate income tax incentives	corporate income tax returns (period 2014-2020)	corporate income tax returns (period 2012-2018)	The latest closed financial year for which data was available at the time of drafting the evaluation was 2018. Data for 2019 will not be available before autumn 2020.
total amount of social security tax incentives	OTR: firm-level database on non-corporate-tax supports including EU- and domestic schemes (period 2014-2020)	corporate income tax returns <i>estimation</i> (period 2012-2018)	See above in row of <i>total amount of direct state aid</i> .

necessary data	source planned	source used	reason of difference
current status of the supported investment project and the related DTB	corporate income tax returns (period 2014-2020)	survey data on the current status of the supported investment project and the related DTB (2020 January)	CIT returns contain reliable information only for those beneficiaries who have already started the use of DTB. Limiting the evaluation to these would have diminished the sample size to a level too small for econometric analysis.
date of the application for DTB	application register of DTB (period 2014-2020)	application register of DTB (period 2003-2016)	For the reason of difference in period, see subsection 3.3.
completion date of the supported investment project	corporate income tax returns (period 2014-2020)	survey data on the current status of the supported investment project and the related DTB (2020 January)	CIT returns contain reliable information only for those beneficiaries who have already started the usage of DTB. Limiting the evaluation to these would have diminished sample size too low for econometric analysis.
the maximum amount support to which the enterprise became eligible under DTB	application register of DTB (period 2014-2020)	application register of DTB (period 2003-2016)	For the reason of difference in period, see subsection 3.3.
the amount of DTB which has been actually used	corporate income tax returns (period 2014-2020)	corporate income tax returns (period 2014-2018)	The latest closed financial year for which data was available at the time of drafting the evaluation was 2018. Data for 2019 will not be available before autumn 2020.

Source: authors' own

3.2. Overall methodology, research questions

The evaluation is based on the difference-in-differences method (hereinafter referred to as “DID method”), comparing the recipients of development tax benefit (as treated group) to a control group. In this framework a pre-treatment and an after-treatment period were defined and the changes of certain economic indicators (dependent variables) of companies were observed between these periods. The average difference between these changes of the treated and control groups were measured by linear regression and this average difference was attributed to the effect of the treatment, i.e. the tax benefit.

The key of this method is the creation of an appropriate control group, which is sufficiently similar in basic characteristics to the treated group. Another important part of the design is the proper definition of the pre-treatment and after-treatment periods. Difficulties emerged in connection with these subtasks which and their solutions are explained in detail in the following sections.

The evaluation covers the following questions:

- **direct impact and effectiveness of the scheme** in dimensions of investment, job creation, value added and productivity,
- **appropriateness** of the scheme, i.e. whether the scheme has been more effective than other forms of state aid,
- **heterogeneity** of direct impact,
- **proportionality** of the scheme, i.e. whether the fiscal balance of the scheme is positive in the long run,
- **robustness** of the results for direct impact.

Table 5: Variables used for the evaluation

variable	source	content
dependent variables (changes of indicators between the base and the current period ¹)		
relative change in total assets	CIT return	tangible + intangible assets
relative change in employment	CIT return	statistic number of domestic employees
change in ratio of total wages to total assets	CIT return	total gross wages / total assets in the base period
change in ratio of gross value added (GVA) to total assets in the base period	CIT return	'gross value added / total assets in the base period, where GVA is defined as follows: + turnover + own performance capitalised - original cost of goods sold - value of intermediated services * - raw materials and consumables - contracted services - other service activities + land lease paid * * only for manufacturing industry
change in ratio of net value added (NVA) to total assets in the base period	CIT return	NVA = gross value added - depreciation & amortisation
change in labour productivity	CIT return	gross value added / number of employees
explanatory variables		
treatment dummy	survey data	dummy variable
development tax benefit (DTB) as a ratio of total assets	application register	the maximum amount support to which the enterprise became eligible under DTB / total assets
development tax benefit (DTB) as a ratio of total state aids including DTB	application register	the maximum amount support to which the enterprise became eligible under DTB / total state aids incl. DTB
total state aids excluding DTB (full period)	CIT return	+ sum of total amount of aids without repay obligation for developments and other costs + sum of CIT allowances' effect on liability, excluding DTB + sum of estimated SSC allowances
total state aids including DTB (full period)	CIT return & application register	total state aids excluding DTB + DTB

variable	source	content
estimated financing cost (full period)	CIT return	sum of interest paid / average total liabilities
turnover (base period)	CIT return	average revenue net of VAT
total assets (base period)	CIT return	average tangible + intangible assets
employment (base period)	CIT return	average statistic number of domestic employees
total wages (base period)	CIT return	average total gross wages
investment (base period)	CIT return	average change in net assets
gross value added (base period)	CIT return	see the content of <i>relative change in gross value added</i>
further variables used for selecting control group		
estimated financing cost (base period)	CIT return	sum of interest paid / average total liabilities
the ratio of turnover to total assets (base period)	CIT return	turnover / total assets
the ratio of total state aids excl. DTB to total assets (base period)	CIT return	total state aids excl. DTB / total assets
the ratio of total state aids incl. DTB to total assets (base period)	CIT return & application register	total state aids incl. DTB / total assets
economic activity (base period)	CIT return	2-digit level NACE rev. 2. code

* base period: 2012-2013; current period: 2017-2018; full period 2012-2018
for each period the values are defined as the average of yearly values

Source: authors' own

We note that there was a problem related to dependent variables which had to be handled. The results can be biased if the relative change is extremely high in some cases of the observations. Therefore in the case of dependent variables *relative change in total assets* and *relative change in employment* the range of values was trimmed into the interval [0.1; 10].

3.3. Examined period and treated group selection

According to the evaluation plan and the expectations of the Commission (declared in the *Commission Staff Working Document on Common methodology for State aid evaluation, Brussels, 28.5.2014 SWD(2014) 179 final*; hereinafter referred to as “common methodology”) the examined period must be set in accordance with the approved duration of the scheme: 18/7/2014-31/12/2020. However due to limitations of available data and the particular timing characteristics of the DTB, the expected econometric impact assessment method (DID method) could only be applied to a modified period.

For applying the difference-in-differences method, we need to define a treatment, a pre-treatment and an after-treatment period. Due to the timing characteristics of the DTB, this is not a trivial task. For the after-treatment period it is to be assumed as a natural requirement that the potential effect of the supported investment on the firm’s economic indicators can already appear within this period. This condition and the definition of the treatment indicator set the options for defining the proper treatment-period.

In the evaluation plan of DTB we outlined several different options for defining the treatment indicator:

- (1) using a dummy variable if the enterprise applied for development tax benefit;
- (2) using a dummy variable if the supported investment had been finished;
- (3) using a variable of the maximum amount support to which the enterprise became eligible;

- (4) using a variable of the actual support which the enterprise claimed in the reference period;
- (5) using a variable of the actual support which the enterprise claimed in the reference period and an estimation (based on profitability patterns) of the future support it could claim until its eligibility expires.

Considering the above mentioned condition if all enterprises which have applied for the DTB are handled as treated, then we would underestimate the aid's effects, because most of the effects (e.g. new jobs, additional value added, etc.) appear only after the investment was put into operation. This leads to the rejection of option (1). Option (2) seemed more appropriate base for dummy variable of treatment, but given that a company may lose its right for the DTB even after the completion of the investment (e.g. if fails to meet eligibility criteria), the definition of treated entities had to be specified as follows.

A company is treated

- **if its investment has been finished and**
- **it has not lost its right for the DTB (according to its survey data).**

Among the three continuous variable options considered options (4) and (5) were rejected. Option (4) had to be refused as there were too few companies who have already begun to use the tax credit.¹ Option (5) was rejected because the estimation error for future support was too large. Regarding that the data of maximum amount of support to which the enterprise became eligible is available for all companies option (3) was chosen as an alternative indicator of the treatment.

Definitions of treatment indicators are the following:

- (a) a dummy variable which is equal to one if the company is treated according to the definition (0 otherwise),**
- (b) a continuous variable which is equal to the maximum amount support to which the enterprise became eligible, provided the company is treated according to the definition (0 otherwise).**

Considering that an investment's effect on growth indicators of the investor company (if exists) gradually builds up and firms' accounting data are available only until 2018, we have defined the after-treatment period as a two-year long period: 2017-2018. This choice determined all the other periods as follows.:

Definitions of examined periods:

- **pre-treatment period (base period): 2012-2013,**
- **treatment period: 2014-2016,**
- **after-treatment period (current period): 2017-2018.**

In our view, fixing the periods this way meets the expectation declared in the common methodology, but also implies some restrictive conditions for the treated group:

- A company can be handled as treated only if its investment has been finished till the end of 2016.

¹ As it was mentioned in section 2.3 – due to the timing rules of the system – the path of the total amount of yearly utilised DTB is expected to follow a Gaussian curve in a 22 year long period. Thus low utilisation rate is a natural consequence of the characteristics of the system in the short run (i.e. within the first 4-year-long period between 2014 and 2018).

- A company can only be included only if it had already existed in 2012 and its accounting data were available for all years since then.

If these narrowing conditions had been carried out on the range of companies which have applied for the tax credit under the current scheme, i.e. after 18/7/2014, according to the survey data there would have been only 10 companies fulfilling the criteria with an investment project finished until the end of 2016. Among these companies two firms were established later than 2012 and another one has lost eligibility. As such a small number of observations would have rendered the evaluation impossible, we extended the range of examined companies to those who submitted their applications in the period prior to 18/7/2014, but finished the investments in the 2014-2016 period. Considering that the system of DTB had also been in force under the previous EU regulation (*Commission Regulation (EC) No 800/2008 of 6 August 2008*) and the basic criteria of the DTB have not changed since then, we believe that this extension is an acceptable solution for increasing the number of observations in the treated group and that it does not cause undue distortions in the results of the evaluation.

Final definition of treated companies:

- **the supported investment was finished in the period 2014-2016** (according to survey data), **regardless of when its application had been submitted,**
- **the companies are still eligible for the DTB** (according to survey data),
- **the companies already existed in 2012 and its accounting data are available for all years since then** (according to the tax return data).

It has to be noted, that the first two criteria are project-level requirements and thus firms having multiple projects needed special handling. This issue was handled as follows:

- If a firm had two projects, but it reported only one of them in the survey, then this firm was dropped from the treated group, because in connection with the other one, there was no reliable information to check the mentioned conditions.
- If a firm had two projects, both of them were perfectly reported in the survey, but one of them did not meet the criteria, then the firm was included in the treated group, but only the project meeting the criteria was examined. If the other project was excluded because the investment was finished outside the period 2014-2016 (but the aid was available), then the DTB linked to excluded project was added to the amount of total other state aids.
- If a firm had two projects, both of them were perfectly reported in the survey and met the criteria, then the *maximum amount support to which the enterprise became eligible under DTB* was calculated as a sum of the maximum amounts of support to which the firm was eligible in connection with both projects.

Based on the survey we identified 69 companies which completed 91 investments within the period of 2014-2016 and which has retained their rights for the DTB in connection with these projects. The evaluation includes nearly 70 percent of these observations: 47 firms with 60 projects. 6 firms had to be excluded because they had been established later than 2012 and 16 firms because of poor data quality (e.g. the firm missed to give all the necessary data in its tax return or the investment was realised by a legal predecessor of the firm, etc.).

According to the application register data the total value of the 60 projects of these 47 companies included in the evaluation was HUF 166.7 billion and the maximum amount support to which these companies became eligible is HUF 51.7 billion.

3.4. Control group selection

The key to the DID method is the creation of an appropriate control group which is sufficiently similar in basic characteristics to the treated group. For the selection of the control group, we had the opportunity to take into account the full range of corporate taxpayers as a starting database, relying on the data from corporate tax returns. According to the evaluation plan, matching along some dimensions was used to ensure that the treated group and the control group are similar.

According to the plan the control group should have consisted of companies:

- (1) of the same economic activity (as defined in ISIC Rev. 4/ NACE Rev. 2 A38 code),
- (2) same firm size category,
- (3) level of employment stagnant or increasing,
- (4) the level of other support received (i.e. apart from the development tax benefit) is comparable,
- (5) carried out investments in the evaluation period (alternatively, the stock of non-current assets are stagnant or increasing),
- (6) estimated financing costs are comparable (based on the liabilities in the balance sheet and the financing expenditures in the profit-and-loss account).

During the implementation numerous steps were needed to narrow down the range of observations and execute the matching. The CIT return database contains all the indicators needed for these steps.

As a first step, we cleaned the database and dropped the following corporate taxpayers:

- those that have ever applied for DTB,
- that have been established later than 2012,
- if the time series of the tax return data is interrupted (e.g. due to a legal transformation),
- if the taxpayer has switched to IFRS from Hungarian accounting standards within the examined period, because in this case its current accounting data (IFRS) are not comparable with accounting data in the base period (HAS),
- if any of variables needed for the indicators were missing in a tax return,
- if any of variables needed for the indicators were unreliable based on an internal consistency test of the tax return.

The additional consistency test mentioned above was necessary because some of the data we used (e.g. number of employees) are not an integral part of the tax return, but are only included for statistical purposes as extra information. The electronic tax return program in Hungary does not include a consistency check for such variables.

In the second step we ensured that control companies were operating in the same economic sector as the treated companies.

In line with condition (1) in the plan, we narrowed down the range of observations to the range of those taxpayers which were operating in the same economic sector as one of the members of treated group. We used NACE Rev. 2 codes on a two-digit level.

In the third step we ensured conditions (3) and (5) in the plan with a slight modification. As the whole examined period was relatively long, in some cases even the treated companies failed to meet the

original strict criteria. First, increasing or maintaining the level of employment were not requirements for all recipients of DTB. Second, due to amortisation and the fact that firms also had assets independent of their supported investment projects, the stock of assets may have been decreasing over the entire period.

In view of these cases, entities were dropped out from the potential range of control group:

- if both the decrease in the stock of assets and the decrease in employment were more than 20 percent over the entire period.

At the end of this step **we had 29,623 potential control observations.**

Step four was about ensuring conditions (2), (4) and (6) and matching procedure.

The initial idea for the method of matching procedure was the *propensity score matching*, with the requirement of perfect matching on 2-digit level economic sector codes (NACE Rev. 2.). We have planned to select an observation to the control group, if its treatment probability (propensity score) falls within a fixed-radius ball of the treatment probability of a treated observation according to the propensity scores.

We used the following indicators as explanatory variables:

- total assets (base period),
- turnover (base period),
- employment (base period),
- estimated financing cost (base period),
- total state aids excluding DTB (base period),
- the ratio of turnover (base period) to total assets (base period)
- the ratio of total state aid excluding DTB (base period) to total assets (base period).

Variables (a)-(e) ensure the similarity between the treated and control groups in terms of firm size, financing costs and level of other support received. We introduced the two relative variables ((f) and (g)), because we also wanted to ensure similarity in the internal relation of some financial indicators of the firms.

Unfortunately, the low number of observations did not allow the application of this method, because for some of the economic activity classes the convergence was not achieved in the maximum likelihood estimation.

Table 6: Distribution of the number of observations by economic activity

Economic sector (2-digit level NACE Rev. 2 classification)	No. of treated observations	No. of potential Control observations
10 Manufacture of food products	3	1,011
11 Manufacture of beverages	1	442
14 Manufacture of wearing apparel	1	283
15 Manufacture of leather and related products	1	75
20 Manufacture of chemicals and chemical products	2	195
21 Manufacture of basic pharmaceutical products and pharmaceutical preparations	1	36

Economic sector (2-digit level NACE Rev. 2 classification)	No. of treated observations	No. of potential Control observations
22 Manufacture of rubber and plastic products	4	603
23 Manufacture of other non-metallic mineral products	3	419
24 Manufacture of basic metals	2	102
25 Manufacture of fabricated metal products, except machinery and equipment	2	1,944
26 Manufacture of computer, electronic and optical products	4	351
28 Manufacture of machinery and equipment n.e.c.	3	777
29 Manufacture of motor vehicles, trailers and semi-trailers	3	144
31 Manufacture of furniture	1	422
38 Waste collection, treatment and disposal activities; materials recovery	1	311
41 Construction of buildings	1	2,007
45 Wholesale and retail trade and repair of motor vehicles and motorcycles	1	3,123
46 Wholesale trade, except of motor vehicles and motorcycles	4	7,232
56 Food and beverage service activities	1	2,349
58 Publishing activities	1	459
61 Telecommunications	1	222
68 Real estate activities	2	3,968
70 Activities of head offices; management consultancy activities	1	1,662
72 Scientific research and development	1	340
80 Security and investigation activities	1	379
82 Office administrative, office support and other business support activities	1	767
Total	47	29,623

Source: authors' own

As an alternative approach we applied the *Mahalanobis matching method*. In the matching procedure, the perfect matching requirement on the economic sector was maintained and the set of variables was neither modified.

After checking the results for the first (closest) ten pairs of treated observations, we decided that controls should be narrowed to the first 3 pairs. However in some economic sectors quality issues emerged even with the first three best pairs:

In some cases we got excessive differences between the values of a certain indicator of the treated and control observations. In our view, such differences are not problematic if they appear only in absolute terms, but the treated and its control observation are similar in terms of the relative internal relations of their indicators. For instance, when both the values of turnover and total assets of firm A are the double of these values of firm B, but the turnover to assets ratio is similar in the two firms.

However, we found it critical, if all the pairs were in a significantly different size category compared to the treated, e.g. if the treated firm had 100 employees, but each of its pairs employed less than 5 workers.

There are two limitations of the Mahalanobis matching method behind the described problem. Firstly, the method weights the variables equally, and secondly, it handles the differences between the values symmetrically. Continuing the above mentioned example, suppose that there is a treated firm (A) with 100 employees and two potential pairs of it, B and C, which are similar to A in terms of all of the other indicators. Firm B has 200 employees, while firm C has only 1 employee. Mahalanobis matching method will pick firm C, due to the difference is smaller in this case, while firm B would be arguably much better for us.

To solve the outlined problem, **we finalized the matching algorithm as follows:**

- we run the Mahalanobis matching algorithm on the above listed variables (a)-(g) and kept the first (closest) 10 potential control observations for each treated firm,
- for each potential control observation we generated a new variable (*employment distance*) measuring the relative distance of it from the treated observation in terms of employees in the following way:

$$\text{emp ratio} = \frac{\text{potential control firm's employment in the base period}}{\text{employment of the treated firm in the base period}}$$

$$\text{employment distance} = \begin{cases} \text{emp ratio} & \text{if emp ratio} < 1 \\ \frac{1}{\text{emp ratio}} & \text{anyway} \end{cases}$$

- for each treated firm the 10 potential pairs of it were re-ranked by the new variable,
- **for each treated firm the first (closest) 3 pairs were included to the control group,** according to the new ranks.

When examining the appropriateness of the scheme we aim to evaluate whether this scheme had been more effective than other forms of state aid. For this examination, **the treated observation and the control observations are needed to be similar in terms of the total state aid received including DTB**, not just in terms of the level of other support (*total state aid excluding DTB*). Therefore, for evaluating the appropriateness we run the above detailed matching algorithm by modifying the variables listed in points (e) and (g) accordingly:

- (a) total assets (base period),
- (b) turnover (base period),
- (c) employment (base period),
- (d) estimated financing cost (base period),
- (e) total state aid **including (!) DTB** (base period),
- (f) the ratio of turnover (base period) to total assets (base period)
- (g) the ratio of total state aid **including (!) DTB** (base period) to total assets (base period).

3.5. Direct impacts, heterogeneity and effectiveness

The direct impacts of the development tax benefit were measured under the assumption of the additionality of the DTB. The matching method helped us to reach this goal, because in the case of perfect matching the only difference between the members of the pairs would be the existence of the DTB. In that case it would have been enough to use only one explanatory variable in the regressions (the treatment or the amount of DTB). But the perfect matching is an extreme situation, and our pairs were not at all perfect. For this reason control variables were used in the regressions (turnover, number of employees, total assets, level of investment, total wages, gross value added for the base period; cost of capital and total state aids excluding DTB for the full examined period). These control variables work technically like a normal explanatory variable. The main difference is attitude of analyser; on the whole we do not deal with them too much, we mostly ignore the estimated parameter itself. However, if some of the parameters were significant, it was worthwhile to use them in regression, because the matching was not perfect. If all the parameters were insignificant, the matching was good enough to begin with.

The direct impacts of the DTB were computed on the following variables (dependent variables):

- relative change in assets
- relative change in employment
- change in ratio of total wages to total assets
- change in labour productivity
- change in ratio of GVA to total assets
- change in ratio of NVA to total assets

The direct impact can be defined in two different ways; as the effect of just the treatment, or as the impact of the amount of the DTB. Both effects were calculated, so there are 12 regression equations about the direct impact.

In summary, each equation is structured as follows:

$$y = \alpha_0 + \alpha_1 x_1 + \alpha_2 x_2 + \alpha_3 x_3 + \dots + \alpha_8 x_8 + \tau z + u \quad (1)$$

where y is one of the above listed six possible dependent variables, z is one of the two possible explanatory variables (*treatment dummy* variable – which is equal to 1 for treated observations – or *development tax benefit (DTB) as a ratio of total assets*) and x_1, \dots, x_8 are control variables which are listed in the first paragraph of this section and unchanged in all the twelve equations. As it was explained above, we were interested only in the coefficient of the explanatory variable (τ).

The **heterogeneity** of the direct impact was also investigated. The strongest heterogeneity was found according to the type of the investment as it had been expected in the evaluation plan. The project types listed in the first section were divided to three subsets in order to retain sufficient number of treated observations for all:

- **large projects** (bigger investments with no specific goals, but with headcount increasing requirements listed under points (a), (b), (e) in the 1st section²),

² There were no such investments in the sample which were mentioned under point (f) in the 1st section.

- **special purpose projects** (listed in point (c) in the 1st section),
- **job creation projects** (point (d) in the 1st section³).

The analysis of the direct impacts was repeated for all three types and these outcomes are presented in the next section.

Regarding that the scheme intends to raise the level of employment, capital stock and investments in certain activities, **direct impacts and direct impacts in case of special purpose projects show whether the aid is effective or not.**

3.6. Appropriateness of the scheme

In the first step of the analysis our aim was to show the additional effect of the development tax benefit. To reach this goal our matching process created pairs with similar amount of other subsidies (total state aids excluding DTB). In this case the estimated parameters of the treatment or amount of DTB present the additional influence on the dependent variable. So these results can answer the question whether there is any relationship between the variables, but nothing more.

For measuring the appropriateness of the scheme there was no opportunity to look at alternative scenarios, thus we focused on overall effectiveness of DTB compared to that of the support system's in general. In order to do this we repeated the method which was used in case of direct impact with three slight but important modifications. Firstly, we modified the matching process. This time pairs made with similar amount of all subsidies (*total state aids including DTB*), thus the re-estimated coefficients of the treatment showed the additional effects of the total mix of subsidies including DTB. Secondly, the regression equations were also modified in two points. In line with the modified matching method the total state aid related control variable in the equations was also changed: *total state aids excluding DTB* was replaced by *total state aids including DTB*. In order to measure the effects also in terms of the amount of DTB the *ratio of DTB to total state aid (incl. DTB)* was used as explanatory variable instead of the *ratio of DTB to total assets*. If the coefficients are positive, that would mean a support mix with DTB yielding larger results than one without DTB, thus the scheme would be regarded as an appropriate. In summary, the equations measuring the appropriateness are structured as follows:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \dots + \beta_8 \widehat{x}_8 + \tau \widehat{z} + w \quad (2)$$

where the two differences compared to the equations used for measuring direct impacts are marked by hats on the involved variables. The dependent variable (y) and seven of the control variables (x_1, \dots, x_7) are the same as in case of the equations for direct impacts (1). The 8th control variable is changed to *total state aids including DTB*, and although there is also two possible explanatory variables, the continuous one is also changed to *development tax benefit (DTB) as a ratio of total state aid (incl. DTB)*. As earlier, we are interested only in the coefficient of the explanatory variable (τ).

³ There were no such investments in the sample which were mentioned under point (g) in the 1st section.

3.7. Proportionality of the scheme

We also analysed the proportionality of the development tax benefit in terms of return on fiscal cost. We concentrated on those budget lines which could be affected by this scheme and have the largest weight: the value added tax, the local business tax and the taxes on employment (including the taxes paid by both the employers' and employees' side). Corporate income tax is not included, because the analysed scheme is just about decreasing this tax, thus the fiscal cost of DTB cannot be distinguished properly from the effect of it. In addition, the corporate income tax revenue is a relatively modest source of the budget. The budgetary consequences are presented in the Results section of the evaluation.

3.8. Robustness of the results

As mentioned previously, we paid a special attention to the number of employees as a matching variable. We even modified our methodology to create pairs with similar labour force; in cases where the Mahalanobis method did not reach this goal. The problem is that there is a strong reason to believe that Hungarian firms' reaction to treatment can be quite sensitive to size, even if their other characteristics are similar. So we decided to identify the 'bad matching pairs' in our dataset (referring to the number of employees)⁴, and we left them out, creating a new, restricted dataset. Our robustness checks consisted of rerunning the model using this restricted dataset. If the regression parameters and the significance levels do not change significantly, we can regard our estimations as robust to this factor. Results are presented in detail in the Results section.

3.9. Excluded elements of the evaluation plan

Deadweight loss was planned to be analysed through a comparison of the investment activity of the treated group in the 2014-2020 period to an estimated hypothetical investment activity based on their own investment behaviour the past (e.g. 2007-2013). The incidental difference between the hypothetical investment activity of the treated group and that of the control group could have been used as an estimate of the deadweight loss. Due to lack of data it was not possible to realize this analysis. However, the lack of this investigation is deemed less of an issue, because the relatively low direct impact can already give an indication to this question.

4. Results

4.1. Direct impact and appropriateness

Table 7 shows the **direct impact** estimated on the whole dataset resulting from the implementation of steps written in sections 3.3 and 3.4. This dataset contains 47 treated firms and 141 control observations (3 pairs of each treated firm) and covers 60 investment projects supported by DTB. As mentioned above, direct impacts are measured under the assumption of the additionality of the DTB (all the other subsidies are controlled for), while in the case of **appropriateness** we controlled on the sum of DTB and other subsidies.

⁴ Our criterion for bad matching: if the ratio of the two headcounts is larger than 10 or smaller than 0.1.

Table 7: Estimated parameters of the models (all observations)

Dependent variable of the model	DIRECT IMPACTS		APPROPRIATENESS	
	explanatory variable		explanatory variable	
	Treatment dummy	Amount of DTB ¹	Treatment dummy	Amount of DTB ²
relative change in total assets	0.827 ***	0.302 ***	0.838 ***	1.452 ***
relative change in employment	0.723 ***	0.048	0.719 ***	1.368 ***
change in ratio of total wages to total assets	0.515 **	0.440 ***	0.573 **	1.313 ***
change in ratio of GVA to total assets	1.397 **	1.412 ***	1.194 *	3.099 ***
change in ratio of NVA to total assets	1.089 **	1.109 ***	0.882	2.390 ***
change in labour productivity	2281	140	1376	3608

* at 90% significance level; ** at 95% significance level; *** at 99% significance level

1. as a ratio of total assets

2. as a ratio of total state aids including DTB

Source: authors' own calculation

In the first two columns of Table 7 the effects of the treatment itself and the amount of DTB are presented on several different dependent variables. The effect of the treatment showed in the first column. For example in the case of the relative change in assets, the parameter (0.827) means that the treated firms increased the value of their assets by 82.7 percentage points more than the non-treated firms. In the second column, the parameter (0.302) means that one unit increase in the amount of DTB (as a ratio of total assets) causes 30.2 percentage points more increase in the assets. Similar interpretation is valid for all the other parameters for direct impacts.

In the case of assets the denominators of dependent and explanatory variables are the same, thus by simplification, we get an alternative version of the interpretation of this specific coefficient. It means that HUF 1 extra tax benefit results 0.302 forint increase in the assets. As a consequence, 69.8 percent of the support is used for replacement of assets instead of net increase.

If we regard DTB as an additional subsidy, it **has a significant effect on the amount of the assets, on the employment, on the total wage bill and on the value added**. The effect on the amount of total assets is expected, because it was an explicit criterion of the tax benefit. Increasing the number of employees and/or the wages are also mandatory requirements in case of many supported projects. However, the treatment did not increase the productivity. Nevertheless, the amount of the tax benefit did affect the NVA/assets and the GVA/assets ratios. The significance of the positive effect on net value added means that **the additional value added generated by DTB exceeded the cost of the investment**.

We have to note that the parameters can be overestimated because of potential selection bias. This bias can be caused by that firms are more likely to apply for DTB if they realize the investment independently from the scheme.

Looking at estimated parameters of the second part of the table (appropriateness), we see that most of the parameters are significant. It means that for these dependent variables **the effects of the development tax benefit are higher than the effects of other subsidies**. So, from this perspective **DTB may be regarded as appropriate**, given that on average it had larger effects on the majority of the examined growth indicators (growth in assets, employment, wages and value added) than the rest of all state aid. However, it should be reiterated that as both asset and employment increase are explicit obligatory criteria of DTB, thus it was expected to have significant impact on these variables, so these results should be assessed from this perspective.

4.2. Heterogeneity and robustness

The **heterogeneity** of the results was also analysed. We divided our observations into 3 groups according to the type of the investment (for the definition of the groups see section 3.5.). Table 8 demonstrates these stratified estimates. The 1st group represents the general development projects with conditions to minimal investment and headcounts ("**large projects**"). For this group we have found significant results, except for labour productivity. Comparing the parameters of this group (first two columns in Table 8) with the overall coefficients presented in Table 7, we can see that the significance of **the parameters improved** in many cases. Thus, we can conclude that **DTB is more effective in this stratum**.

The 2nd group represents those development projects which have only a HUF 100 million minimal investment threshold as mandatory condition and serve specific goals ("**special purpose projects**"). For this group we have found (more or less) **significant results only for the growth in assets**. The lack of significant effect on employment and value added can be caused by the fact that a part of these projects aim to comply with legal requirements (e.g. environmental protection goals or food hygienic improvement) so they are not primarily aimed at expansion.

The 3rd group represents "**job creation projects**", with no minimal investment threshold or other specific requirements. For this group we have found that **not all the employment-related independent variables were significantly affected**. The significances of the coefficients of the treatment dummy variable show that taking part in the program increases only the level of employment but not the total wage bill. However, the amount of DTB impacts significantly only the wages, which means that increasing the amount of DTB causes wages to rise, but not employment. This can be explained by the fact that the amount of DTB had to be calculated on the wages paid to the new employees. The parameters suggest that expansion in employment was not linked to additional investments in assets in this stratum. However, the amount of DTB has significantly affected the growth in value added.

Table 8: Estimated parameters of the models by types of investments

Dependent variable of the model	DIRECT IMPACTS					
	Large projects (72 obs.; 18 treated)		Special purpose projects (76 obs.; 19 treated)		Job creation projects (40 obs.; 10 treated)	
	explanatory variable	explanatory variable	explanatory variable	explanatory variable	explanatory variable	explanatory variable
	Treatment dummy	Amount of DTB ¹	Treatment dummy	Amount of DTB ¹	Treatment dummy	Amount of DTB ¹
relative change in assets	1.319 ***	0.297 ***	0.960 *	1.812 **	-0.124	-0.193
relative change in employment	0.593 ***	0.047 ***	0.531 *	0.721	1.822 ***	0.201
change in ratio of total wages to total assets	1.206 **	0.428 ***	-0.014	-0.012	0.776	1.832 ***
change in ratio of GVA to total assets	3.750 **	1.402 ***	-0.018	0.154	1.074	2.831 ***
change in ratio of NVA to total assets	2.911 **	1.095 ***	-0.109	0.001	1.062	2.746 ***
change in labour productivity	620	133	4834	9508	1904	-1256

1. as a ratio of total assets

Source: authors' own calculation

The **robustness** of results was also checked. As mentioned in the section about the methodology, matching did not provide perfect pairs in some cases. So after identifying the worst matchings in our dataset, we prepared a restricted dataset by leaving them out (i.e. 6 treated observations and their pairs). After that regressions were rerun on the restricted dataset. Table 9 shows the results. The new estimations are in the 3rd and the 4th columns; in the 1st and 2nd columns we repeated the outcomes of the original models for the sake of easy comparison.

Regarding the effects of the treatment dummy, the estimated parameters and their significance are very similar in the two cases, which means that the better matching (in the restricted dataset) did not produce significantly stronger treatment effect.

For checking the robustness of the estimation, the coefficients of the amount of the development tax benefit have to be compared (2nd versus 4th column). These parameters are very close to each other for both datasets, and the significances have not changed much either. In other words, **the whole and the restricted dataset provided results very close to each other when referring to the amount of DTB as an explanatory variable**, meaning that the model used delivered robust estimations.

Table 9: Estimated parameters of the models (all observations)

Dependent variable of the model	DIRECT IMPACTS			
	Whole dataset (188 observations)		Restricted dataset (164 observations)	
	explanatory variable		explanatory variable	
	Treatment dummy	Amount of DTB ¹	Treatment dummy	Amount of DTB ¹
relative change in assets	0.827 ***	0.302 ***	0.855 ***	0.305 ***
relative change in employment	0.723 ***	0.048	0.737 ***	0.046
change in ratio of total wages to total assets	0.515 **	0.440 ***	0.358	0.425 ***
change in ratio of GVA to total assets	1.397 **	1.412 ***	1.156 *	1.394 ***
change in ratio of NVA to total assets	1.089 **	1.109 ***	0.836 *	1.089 ***
change in labour productivity	2281	140	2246	117

1. as a ratio of total assets

Source: authors' own calculation

4.3. Proportionality

Regarding the proportionality of the scheme, we use the results presented in Table 7 for 1 unit increase in the amount of DTB to calculate average rough estimate of additional fiscal revenue brought about by the supported projects. We focus on 3 sources of taxes in particular: VAT, local business tax and taxes related to employment.

As a first step, we calculate the additional GVA brought about by the additional assets created with the support. In Table 7 (4th row, 2nd column) it can be seen that 1 unit increase in the amount of DTB causes 1.412 units additional increase in the GVA in average. This is the total impact of DTB on GVA. From this total impact one must identify the amount linked to the additional assets created. This was computed as the product of two parameters: the impact of the amount of DTB on the assets (0.302 according to Table 7) and the effect of the assets on change in ratio of GVA to total assets (1.306). The latter parameter was estimated by an additional regression using the *relative change in total assets* as explanatory variable and the same control variables as in all the regression equations in the model. The resulting coefficient was 99% significant. So the effect we were looking for is $0.302 \times 1.306 = 0.395$.⁵

Regarding that exports do not generate VAT revenue, we also calculated the ratio of domestic sales for the treated firms by simply dividing their total domestic sales revenue by their total sales revenue.⁶ This ratio reached only 27.69% of the total output. Multiplying these numbers and the standard VAT

⁵ The rest is the direct effect ($1.392 - 0.519 = 0.873$), which is ignored in this analysis. It supposed to be unrealistic, that DTB affects directly the GVA.

⁶ The data we used are reported in the corporate tax dataset as a part of profit and loss accounts.

rate we obtain $0.395 \times 0.2769 \times 0.27^7 = 0.030$. It means that increasing the amount of DTB by 1 HUF the VAT revenue of the budget will increase by 0.03 HUF on average.

For estimating the effect on the local business tax the first step was the same to the calculation of VAT estimate: finding the impact of DTB on GVA by additional assets (0.395). As the base of the local business tax is also different from the GVA, so we estimated a correction factor of 1.3023, which means that the base of the local business tax is about 30% larger than the GVA for the companies concerned. For this estimation, data reported in CIT returns were used again. The base of local business tax is equal to the net sales revenue decreased by material costs, purchase value of goods sold, cost of intermediated services, value of subcontracted work, and direct cost of R&D activity.⁸ We generated this variable for all the treated firms and divided its total by the total GVA of the firms involved. The final step was multiplying these two numbers and the statutory rate of the local business tax (2%). We got $0.395 \times 1.3023 \times 0.02 = 0.010$, which means that increasing the amount of DTB by 1 HUF the revenue from the local business tax will increase by 0.01 HUF on average.

According to our estimations (Table 7 3rd row, 2nd column) 1 unit increase in the amount of DTB causes 0.440 units additional increase in the total wage bill on average. The situation is similar to the previous; this is the total effect, but only the additional effect linked to increased assets should be used for the calculation. This was computed as the product of the impact of the amount of DTB on the assets (0.302) and the effect of the assets on the total wages (0.445). The effect of the assets on change in ratio of total wages to total assets was estimated by an additional regression using the relative change in total assets as explanatory variable and the same control variables as in all the regression equations in the model. The resulting coefficient was 99% significant. So the effect we were looking for is $0.302 \times 0.445 = 0.135$.

For the calculation of the employers' social contribution taxes we computed the average rate as a percentage of the total wage (21.3%) for the treated firms, by simply dividing their total social contribution taxes by the total gross wages they paid.⁹ Multiplying these two numbers we obtain $0.135 \times 0.213 = 0.029$. It means that increasing the amount of DTB by 1 HUF the revenue from social contribution taxes will increase by 0.029 HUF in average. For estimating the effect on the wage taxes paid by the employees we used the same parameter (0.135) and the standard tax rate (0.335). The product of these numbers is $0.135 \times 0.335 = 0.045$, which means that increasing the amount of DTB by 1 HUF the revenue employees' wage tax will increase by 0.045 HUF in average.

The total estimated additional revenue brought about by additional capacities created with one unit of DTB support is $0.030 + 0.010 + 0.029 + 0.045 = 0.114$. In other words, **spending 1 additional HUF on this scheme increases the revenues from all taxes by 0.114 HUF annually**. It means that **from a fiscal**

⁷ This can be seen as an overestimation, given the standard rate is higher than the average rate. However, as an average could not be calculated for the supported enterprises specifically and several policy changes caused the average VAT rate to change over the examined period, we decided to use this simplifying assumption. It does not have dramatic effect on the calculation.

⁸ Net sales revenue, material costs, purchase value of goods sold, cost of intermediated services and value of subcontracted work are reported in profit and loss accounts. The direct cost of R&D activity is reported among the corporate income tax base adjustment items, due to the fact that entities may double-deduct these costs from the CIT base.

⁹ We used the wages and social contribution taxes reported in corporate income tax dataset (as a part of profit and loss accounts) for this calculation.

perspective, DTB would be budget neutral if the additional assets created would be in operation for almost 9 years as a minimum ($1/0.114=8.8$).

The average lifespan of the non-current assets based on our data can be estimated to be 7.6 years¹⁰ excluding extreme outliers - some firms provided extreme values (100 years or above). As this value relates to all assets, we reckon it to be an upper-bound estimate for the lifespan of productive equipment. If one considers other relevant factors – like non-constant productivity curve of assets –, all this suggests that fiscal neutrality of the DTB is not realistic, **the scheme as a whole is not self-financing in the long run.**

It has to be also highlighted that the coefficients used for this estimation represent the average effect and thus, are subject to measurement error.

5. Conclusions

Due to the characteristics of the development tax benefit **there is a notable discrepancy between the schedule of DTB and the schedule of the evaluation obligation.** Regarding that actual duration of the scheme is 22 years and the amount of yearly utilised tax benefits follows a Gaussian curve, it was not possible to do this study on the basis of the currently available 4-year usage data due to the critically low sample size. To handle this problem and get as large a sample as possible, a company is considered as treated in the study if the utilisation period its DTB has already started and the company still has its right for the utilisation. Even if this definition allows more firms to be considered as treated entities, the final size of the sample is still modest, therefore the representativeness is harmed and **the generalizability of the results is limited.**

The development tax benefit, as an additional subsidy (i.e. comparing the case when a company receives DTB with the case when it does not receive neither DTB nor other (substitute) state aid), **has a significant impact on the amount of the assets, on the employment, on the total wage bill and both on the net and gross value added.** The significance of the positive effect on net value added means that the additional value added generated by DTB exceeds the cost of the investment.

As the effects of the DTB on the majority of the examined growth indicators (growth in assets, employment, wages and value added) are higher than the effects of other subsidies, the **DTB may be regarded as appropriate.** However, it should be reiterated that as both asset and employment increase are explicit obligatory criteria of DTB, it was expected to have significant impact on these variables, so these results should be seen from this perspective.

Looking at **heterogeneity** of results, both estimated impacts and their statistical significance are stronger for large projects – with conditions to minimal investment and headcounts – so DTB seems to be more effective in this stratum. Special purpose projects – which have only a HUF 100 million minimal investment threshold as mandatory condition and eligible for DTB due to their specific goals – provided significant results only for the growth in assets, but not for employment and value added,

¹⁰ In the evaluation plan the average lifespan of non-current assets was planned to be estimated on the basis of the original cost of assets which data is available for the different asset classes in CIT returns. This idea was rejected regarding that the data on original cost of assets covers also the value of those assets which had been totally amortised. Thus, the current booked value of the assets was used in our estimation for which no breakdown by asset classes is available in the tax returns.

which may be explained by the fact that a part of these projects aimed to comply with legal requirements (e.g. environmental protection goals or food hygienic improvement) instead of capacity expansion. In the case of job creation projects – with no minimal investment threshold or other specific requirements – not all the employment-related independent variables were significantly affected, which suggest that expansion in employment was not linked to additional investments in assets in this stratum.

The **robustness** of the models was also checked via dropping out the worst matchings from our dataset. The whole and the restricted dataset provided results very close to each other when referring to the amount of DTB as an explanatory variable, meaning that the model used delivered robust estimations.

In order to calculate the **proportionality** of the scheme the additional annual fiscal revenue was estimated. It was found that spending 1 additional HUF on this scheme increases the revenue from relevant taxes by 0.114 HUF. It means that from a fiscal perspective, DTB would be budget neutral if the additional assets created would be in operation for about 9 years minimum. As the upper-bound estimate on the average lifespan of the non-current assets is 7.6 years, the scheme as a whole is not self-financing in the long run. However, this result is subject to measurement error, because the coefficients used for this estimation represent the average effect.