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Do Investment Incentives Affect the Performance of Domestic and Foreign Firms Differently? Evidence from Czech Manufacturing Firms

Etsub Tekola Jemberu and Adriana Knápková

ABSTRACT

This study evaluates the effectiveness of public incentives in improving firm competitiveness, with a focus on the nationality of firm ownership as a distinguishing factor. Using panel data of incentivized and non-incentivized manufacturing firms in the Czech Republic from 2005 to 2019, we investigate the impact of the Czech investment incentives scheme on domestic and foreign firms' productivity, outputs, profitability, investment, and employment level. The analysis, which is based on a combination of propensity score matching with a difference-in-difference technique estimator, reveals the presence of a substantial difference in the impact of the investment incentives between domestic and foreign firms. We find that access to the incentives has a negative effect on the output and employment of domestic beneficiary firms. In contrast, the results suggest that foreign recipient firms have a higher output and employ more physical capital and labor after receiving the incentives. Nonetheless, the results show that the incentives have no statistically significant effects on the profitability and productivity of both domestic and foreign firms. These findings are not sensitive to the matching methods employed.

Keywords: *Investment Incentives, Matching, Difference-in-difference, Firm Competitiveness, FDI, Domestic firms.*

JEL Classification: D04**,** F23, H25, L25

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1 INTRODUCTION

Public programs aimed at luring investments and directing resources into targeted economic activities and/or locations are widely used government instruments. UNCTAD (2004) defines investment incentive as "measurable economic advantage afforded to specific enterprises or categories of enterprises by, or at the discretion of, a government in order to encourage them to behave in a certain manner" (p. 101). The incentives can take a variety of forms, e.g., fiscal incentives such as tax-related supports, financial incentives like grants and loans, and other types of incentives including regulatory incentives, subsidized services, market privileges, etc., (ibid.). A variety of economic reasons may result in the provision of investment incentives. According to Johnson and Toledano (2022), however, offering such arrangements is economically justifiable only for cases of public goods provision, positive externalities generation, addressing credit market failures, and/or overcoming private firms' risk aversion. Even so, many supranational, national, and subnational governments use investment incentives to pursue various development strategies, and the Czech Republic is no exception.

As they require allocating significant public financial resources, understanding investment incentives and their influence on the real economy is important. Economic theory suggests that an increment in investment, and hence an accumulation of capital, increases production and

national welfare. Therefore, incentives are expected to stimulate new investments that contribute positively to a nation's economic growth. Job creation, alleviation of regional economic disparities, and promotion of innovations are other often-mentioned benefits. However, there are also several counterarguments against. One criticism is that investment incentives disrupt markets' normal operations and lead to inefficient resource allocation. Although provisions of investment incentives are usually linked to attracting foreign capital inflow into host countries, their effectiveness in achieving this has been questioned by both theoretical and empirical studies (see, e.g., Banga, 2003; Blomström et al., 2003). Another concern is the inefficiencies and other unfavorable effects that may arise due to incentives competition among national or local governments for attracting investments, especially FDI (Oman, 2000).

In addition to examining investment incentives' role in countries' economy-wide development strategies, several studies have empirically assessed how they impact the subsequent behavior and conditions of the final beneficiaries, the supported firms. However, the evidence provided by these studies is somewhat mixed. For example, looking at the empirical evidence from Europe, some studies find that investment incentive recipients achieve higher productivity (Kölling, 2015), are more likely to improve their financial performance (Banai et al., 2017), have a higher level of employment (Brachert et al., 2018; Kölling, 2015), and invest more in innovation and R&D (Aralica & Botrić, 2013), than non-recipients. Others, on the other hand, have shown that the impact of incentives in improving firm outcomes is limited (Burger et al., 2012; Catozzella & Vivarelli, 2016; Görg & Strobl, 2007; Moffat, 2014).

The impact of the Czech investment incentives scheme on the Czech economy has been broadly discussed in public policy documents and a few research papers. However, only a few papers have examined its impact at the firm level (e.g., Bolcha & Zemplinerova, 2012). In addition to the methodological shortcomings of these studies, they do not explore the variation of the impact across domestic and foreign firms, leaving room for further research.

Many comparative research findings have identified substantial structural, behavioral, and hence performance differences between domestic and foreign firms (Bellak, 2004). Consequently, it is plausible to expect that the impact of the investment incentives will likely differ across these two groups. While analyzing the effect of incentives on firm-level outcomes, to account for this variation, empirical studies usually treat either foreign or domestic ownership as a control variable (e.g., Görg & Strobl, 2007). However, this provides little insight into the heterogeneity of domestic and foreign firms' responses to receiving incentives.

Therefore, thisstudy examines how Czech investment incentives impact firm performance, and how these effects vary depending on the nationalities of the firms' ownership. Specifically, we evaluate the incentives' effects on various firm-level outcomes, including productivity, financial performance, investment, and employment of domestic and foreign firms separately. Hence, this study contributes to the literature on the evaluation of incentives by drawing attention to impact variations across nationalities of ownership. Furthermore, the consideration of multiple firm-level indicators provides a comprehensive view of the incentives' effect on firm performance. To address the fundamental methodological challenge of impact evaluation (i.e., missing counterfactual and selection bias), we combine and use the difference-in-difference (DID) method with propensity score matching (PSM). In addition to providing a suitable control group for the causal effect identification, the matching procedure allows us to explore which firm features are significant in determining the probability of receiving incentives.

The rest of the paper proceeds as follows. The next section provides basic information about the Czech investment incentive scheme. Then, a review of some empirical evidence regarding

the role of such programs on firm performance is presented in Section 3. A description of the methodology employed and the data used are provided in Section 4. Section 5 presents the estimation results. The discussion of the findings and concluding remarks are in Section 6.

2 THEORETICAL BACKGROUND

2.1 Institutional background: Description of investment incentives in the Czech Republic

Compared to the rest of the world, investment incentives in Czechia have a recent history. During the second half of the 1990s, the pressure from its first major economic crisis after the transition from communism, coupled with the fact that the Czech Republic was lagging behind its neighboring countries in terms of FDI inflows, forced the then-administration to look for ways of stimulating the economy (Drahokoupil, 2009). Perceiving that attracting foreign capital is the way to go about it, the government started to move towards outward-oriented policies. Accordingly, in 1998, it adopted Government Resolution No. 298, which proposed investment incentives for investors in the Czech Republic. The first investment incentive scheme was then introduced in the same year. The support started to be regulated formally when the first legislation, Act No. 72/2000, on investment incentives came into force in May 2000. Since then, the legislation has undergone multiple amendments, the most recent one being the Act No. 450/2020 Coll. amendment due to COVID-19, which made incentives easily obtainable for producers of personal protective equipment, medical services, and pharmaceuticals. This act establishes the investment incentive types, the procedures to be followed, the conditions to be met for granting them, and so forth. As stated in the evaluation plan prepared by the Ministry of Industry and Trade, the general objectives of the investment incentives are promoting economic growth and creating employment in the Czech Republic. The specific objectives include the following: eliminating economic development disparity among the regions in the country; lowering inter-region unemployment rate disparities by creating new jobs; supporting the creation of new higher-skilled jobs; promoting Czech economic development by supporting investments in advanced technologies and activities with high-added value and high export potential; and enhancing the international competitiveness of the Czech Republic in innovation, information technology, and strategic services areas (Ministry of Industry and Trade, 2014).

Currently, investment incentives are offered based on a set of requirements for both foreign and domestic firms. The scheme focuses on supporting investments in the manufacturing industry, technology centers (R&D), business support services centers, and, recently, the production of strategic products for the protection of life and health. Moreover, it aims to promote economic development in regions considered ‘underdeveloped’ or with higher unemployment levels. The incentives mainly take four forms: corporate income-tax relief for a period of up to ten years, cash grants for job creation, cash grants for the acquisition of fixed assets, and cash grants for training and retraining of new employees. These incentives are available at the entry point for new investments and post-entry for existing firms. The eligibility criteria for receiving the investment incentives vary according to the type of investment project, provided that it does or will operate in one or more of the aforementioned industries and its implementation is in the Czech Republic. However, some general conditions apply to all types of activities. One of the conditions is that the project should be environmentally friendly. Furthermore, the applicant must submit their application for the incentives before starting any activity related to the project implementation. Also, all the respective conditions should be fulfilled within three years from the issuance of the grant decision. In addition, the incentive

recipient must keep the acquired assets and the jobs created throughout the support period and at least five years after the incentive decision issuance.

The ministry primarily responsible for the provision of investment incentives is the Ministry of Industry and Trade. To qualify for an incentive, investors must submit a detailed plan for the incentive to the Business and Investment Development Agency, or CzechInvest, an agency authorized to collect, review, and process such applications. Upon receiving the application, the agency assesses the applicant's proposed investment project. It forwards its assessment and the application to the Ministry of Industry and Trade, where the ministry assesses the project plan and then sends it to other ministries, specifically the Ministry of Labour and Social Affairs, the Ministry of Finance, the Ministry of Agriculture and the Ministry of the Environment, to do the same. Once the ministries issue a binding opinion approving the granting of the incentive, the Ministry of Industry and Trade forwards the application to the Czech government for approval before issuing the decision to grant the incentive.

According to CzechInvest (2023), from the program's launch in 1998 through 2022, investment incentives have been granted to 564 FDI and 756 domestic projects. The total volume of these investment projects is EUR 34,245 million, which has created 203,115 new jobs. Moreover, it can be seen from Fig. 1 that although the program initially focused on supporting FDI, the number of domestic projects supported by the incentive program has increased significantly. This is also reflected in the increasing share of the volume of supported domestic projects and jobs created by these projects in Fig. 2.

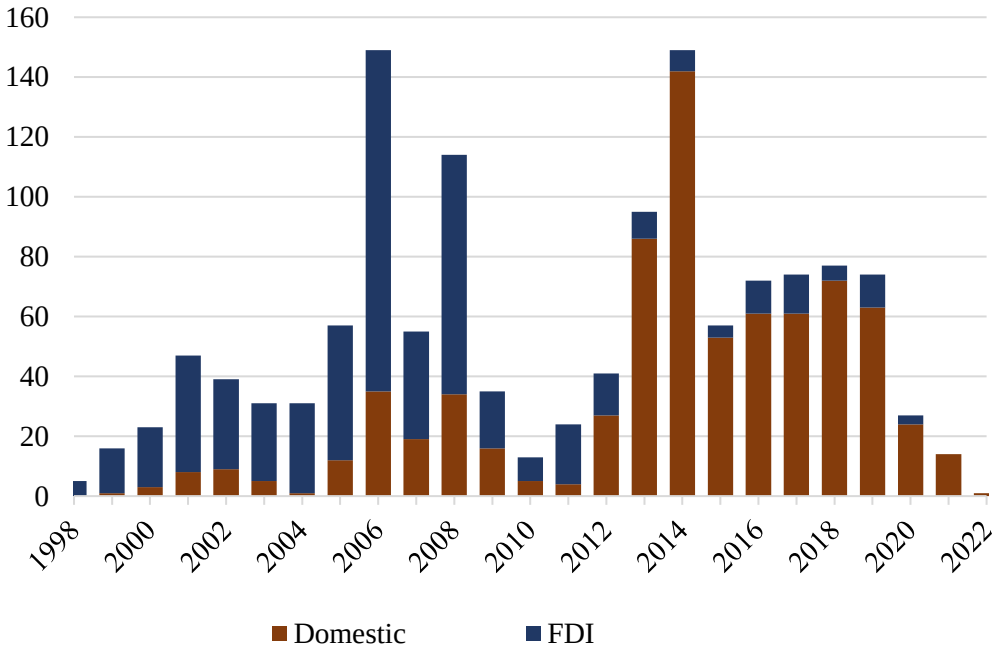

Fig. 1 – Number of projects supported. Source: CzechInvest (2023)

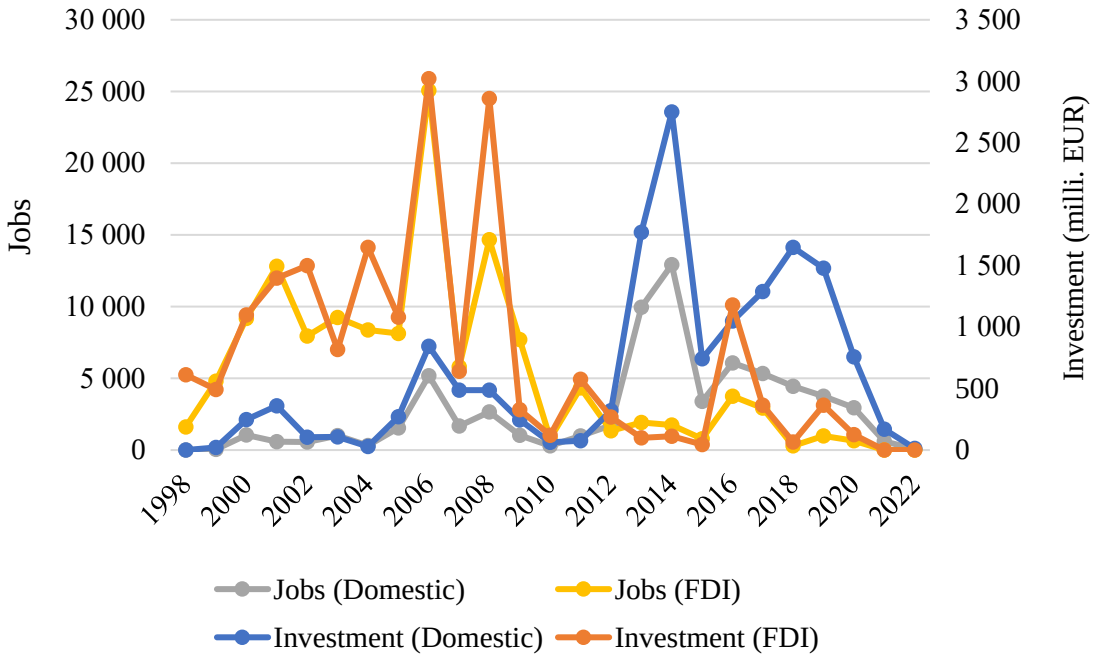

Fig. 2 – Value of supported projects and new jobs created. Source: CzechInvest (2023)

2.2 Empirical evidence on the impact of investment incentives

As the provision of investment incentives imposes significant costs on governments, a full appraisal of their impact is essential. Accordingly, considerable research has examined the effectiveness of different investment incentive programs from a range of countries. Several prior studies examined the impact of tax incentives, R&D grants, innovation subsidies, credit programs, and many other forms of incentives on various outcomes of the recipients. However, as noted by multiple literature surveys (see, e.g., Dvouletý et al., 2021; Zúñiga-Vicente et al., 2014), the results from these studies provide conflicting conclusions.

Using data from Greek food and manufacturing companies, Tzelepis and Skuras (2004) examine the effect of regional capital subsidies on various firm performance measures. The findings reveal that subsidies improve the solvency and growth of recipient firms but have no effect on their efficiency and profitability. In a subsequent paper, Skuras et al. (2006) analyzed its effect on productivity after decomposing TFP into technological, technical efficiency, and scale efficiency changes. They find that capital subsidies enhance firm productivity primarily through technical change.

Relative to other firms' performance measures, the findings on the effect of incentives on productivity indicators (i.e., labor productivity and total factor productivity (TFP)) are more mixed. For instance, Bernini and Pellegrini (2011) evaluate the impact of Italy's Law 488/92 investment subsidies using the DID matching estimator and find that the support affects output growth, employment, and fixed assets positively, while it has the opposite effect on labor productivity and TFP growth. In a later study however, after breaking down TFP into technical efficiency and technological progress change using a stochastic frontier analysis, they reported that the program improved firms' TFP in the medium-long term (3-4 years) via technological change (Bernini et al., 2017). Nevertheless, its short-term productivity effect is found to be negative. Another study on the effects of Law 488/1992 also reports higher employment, investment, and turnover in response to the incentive (Cerqua & Pellegrini, 2014). Again, its

effect on productivity, however, remains mostly insignificant. Evidence of the subsidies' positive effect on the survival probabilities of firms, particularly start-ups, has also been provided by Pellegrini and Muccigrosso (2017).

Researchers have also examined the impact of the Joint Task for the Improvement of Regional Economic Structures (GRW) program of Germany, and the Regional Selective Assistance (RSA) of the United Kingdom. Employing the DID approach with matching, Kölling (2015) finds evidence of a positive effect of GRW grants on employment, wage, value-added, and productivity in German manufacturing firms. Similarly, some evidence of the positive effect has also been provided by Brachert et al. (2018), who apply analytical methods similar to Kölling (2015) to assess the program's impact up to six years after the start of funding. This was particularly true for firm employment, short-term gross fixed capital, and medium-term turnover. However, similar to the findings on Law 488/1992, they find no significant effect on labor productivity. Along the same line, both Moffat (2014) and Criscuolo et al. (2019), who evaluate the RSA program's impact, do not find proof of improvements in firms' productivity due to the support. While the former study, which uses PSM with a system GMM estimator to obtain a negative effect on the TFP of low-tech manufacturing firms, using an instrumental variable approach, Criscuolo et al. (2019) find that the grant – while benefiting smaller firms by increasing employment and investment level – does not affect TFP growth.

Considering studies that evaluated investment incentive schemes in Central and Eastern Europe (CEE), Burger et al. (2012) studied the effectiveness of the Slovenian FDI co-financing grant program in improving various firms' outcomes. Their findings confirm that sales, employment, value-added, and exports are higher in subsidized subsidiaries than in non-subsidized ones. However, they did not find evidence that the program induces technology intensity, wage, or productivity improvement. Another study on firms' performance changes initiated by incentives is by Banai et al. (2017), who analyzed the effect of E.U. funds allocated to Hungarian SMEs between 2007 and 2013 using DID in combination with matching. The analysis shows that subsidies do improve employment, sales, value-added, tangible assets, and profit of subsidized firms. However, there is no indication that productivity (output per worker) has increased. Regarding the potential impact of tax incentives, in a study that assessed Croatia's R&D tax incentive scheme based on the PSM approach, Aralica and Botrić (2013) concluded that firms' R&D expenditure and innovation respond favorably to receiving the incentive. More recently, Dugiel et al. (2022) applied a generalized DID estimator to examine whether firms operating in Polish Special Economic Zones (SEZs) benefit from regional state aid in terms of tax credits. The results of this analysis indicate that the incentive stimulates firms' investments but has no effect on employment.

In comparison, fewer empirical studies have considered the heterogeneity in incentives impact depending on the ownership type of firms. One of these studies is that of Girma et al. (2008), which shows that foreign manufacturing plants located in Ireland create more jobs than their domestic counterparts in response to receiving public grants. In another study that focuses on Irish subsidization policy, Görg and Strobl (2007) use PSM with a DID estimator to evaluate the impact of R&D incentives on the private R&D expenditure of domestic and foreign manufacturing firms. They find evidence that grant provisions in small amounts promote domestic firms' private R&D spending, whereas large subsidies have the opposite effect. However, according to their results, regardless of the size of the grant amount, the support does not affect foreign firms' private research expenditures. Contrasting evidence on the variation of R&D subsidies impact between foreign and domestic firms can be found in recent works of Sofka et al. (2022) and Hasanov et al. (2022) who focus on examining the impact on firms located in Germany. Following the PSM estimation approach to address the selection bias

problem, both papers report that foreign firms gain greater returns from R&D subsidies in terms of R&D investment and innovation than domestic firms.

The main objective of the Czech investment incentives schemes is promoting economic growth and job creation. As a result, prior studies have concentrated mainly on the macroeconomic and regional effects of the incentives (Adámek & Rybková, 2015; Blaschke, 2022; Dinga, 2011; Mallya et al., 2004; Musil & Hedija, 2020). However, according to MIT's evaluation plan, assessing the effectiveness of the incentives in improving firm performance in terms of value-added, labor productivity, sales, employment, etc., is as important as the macroeconomic level impact evaluations (Ministry of Industry and Trade, 2014). However, despite the incentive being in existence for over two decades, microeconometric studies on its effects have been scarce. One exception is Bolcha and Zemplinerova (2012), who, after examining the impact of the incentive in promoting firm-level investment using the PSM approach, conclude that the effect, albeit positive, is low. Nevertheless, few studies have looked into the effectiveness of other incentive programs in improving the performance of firms operating in the Czech Republic. For instance, studies like Spicka (2018), Dvouletý and Blažková (2019), and Dvouletý et al. (2021) have evaluated the Czech Operational Programme Enterprise and Innovation (OPEI). Although somewhat mixed, these studies generally provide evidence of the positive contributions of the program on the firm outcomes.

To sum up, numerous studies have been dedicated to evaluating the impact of different investment incentive programs on the inputs and outputs of firms, producing mixed results. The general verdict that emerged from these empirical works is that public incentive schemes contribute to the improvement of recipient firms', *inter alia*, financial performance, growth, employment, R&D expenditure, and investment. Nonetheless, their productivity effects appear to be insignificant at best and negative at worst. These conclusions are also compatible with the evidence documented by studies focused on incentive policies in CEE, in general, and the Czech Republic, in particular. Conversely, there are few attempts to compare the causal impacts between foreign and domestic firms. To our knowledge, no studies have yet investigated the role of the Czech investment incentive scheme on a wide range of firm outcomes using a causal model.

3 RESEARCH OBJECTIVE, METHODOLOGY AND DATA

This study's key objective is to evaluate the causal effect of the Czech government's investment incentives on firms' performance. The main challenge of evaluating the impact of such public policies and interventions, which can be understood as the difference between the outcomes of the entities with and without interventions, is that it is impossible to measure the same entity's outcome in two states simultaneously. As in the case of this study, researchers can only observe the outcomes of firms that were beneficiaries and other firms that were not, and not the counterfactual or what would have happened to the beneficiary firms if they had not received the incentives.

The second challenge is the non-randomness of these incentive provisions. If the incentives had been distributed to recipients randomly without any selection process, their impact could have been easily assessed with a comparison of the outputs of the beneficiary firms and that of the non-beneficiary firms. This assumes that, in the absence of the incentive, those firms that received the incentive would have had similar outcomes to those that did not. However, like most public grants, the Czech Republic's investment incentives are not allocated randomly. Instead, firms self-select themselves into the investment-incentive application process. Then the government deliberately selects the recipients among the applicants based on certain criteria (e.g., the type of investment project, its expected contributions, the region it will be realized in,

etc.). This leads to a selection bias (Gertler et al., 2016). The beneficiary and the non-beneficiary firms' features differed even before the investment incentive. The outcomes of these two groups of firms would likely be quite different even without the incentive. Hence, a simple comparison between firms cannot accurately show the impact of the incentives.

Given these challenges, to circumvent "the fundamental problem of causal inference" (Holland, 1986, p. 947), evaluators need to find a credible way of empirically estimating the counterfactual outcomes, typically by using comparison or control groups drawn from non-participants. In this study, we combine two different methods, the propensity score matching (PSM) method with difference-in-differences (DID).

3.1 Selection of control firms: Propensity Score Matching

The general idea of PSM is constructing a statistical comparison group based on the probability of the whole sample getting the treatment, which is formally called the *propensity score, or p-score* (Rosenbaum & Rubin, 1983). The *p-score* values combine multiple observed pre-treatment characteristics of the treated and non-treated subjects into a single index. Therefore, in the case of the present study, it comes down to estimating the probability of each firm in our sample (regardless of whether it is incentivized or non-incentivized) getting the investment incentive using a set of covariates. This can be defined as

$$p_i(X_i) = Pr(T_i = 1|X_i) \quad (1)$$

where $p_i(X_i)$ is the propensity score of firm i receiving the incentive conditional on a vector of observable pre-incentive characteristics X_i, and I_i is a binary treatment indicator that equals 1 when the firm is the incentive recipient and 0 otherwise.

According to Brookhart et al. (2006), the robustness of the PSM estimates and the subsequent inference that will be made depends primarily on the selection of covariates for the model. Caliendo and Kopeinig (2008) suggest choosing variables that affect the treatment assignment and the outcome variable but are unaffected by the treatment, based on theories and findings of previous empirical studies. Hence, we identify the following firm attributes as important in this regard; firm size (logarithm of total assets), personnel cost, debt ratio, profit, asset tangibility, and age. We also include a set of dummy variables that indicate the firm operating location. These variables are measured prior to the beneficiary firms receiving the incentives to avoid the incentives affecting the covariates. The details of the variables used in the analysis are provided in Table 1.

After obtaining the propensity score of each firm, the incentivized firms are matched with non-incentivized firms with the closest propensity, which then produces the comparison group. According to the PSM literature, multiple alternative techniques exist to accomplish this procedure. This study uses the kernel matching method (Epanechnikov kernel, bandwidth 0.06). However, choosing one matching algorithm over another, especially for a small sample size like ours, involves a trade-off between bias and efficiency (Caliendo & Kopeinig, 2008). It has been suggested that one should consider more than one method to check the robustness of the matching (Gertler et al., 2016; Khandker et al., 2010). Accordingly, as a complementary analysis and robustness check, we also employ two other commonly used matching algorithms, i.e., nearest neighbor and radius matching methods.

Following the matching, it is possible to estimate the PSM average treatment effect of the incentives on the treated (ATET) firms by calculating the difference between the average outcomes of the incentivized firms and that of the matched non-incentivized firms. However, PSM relies on the Conditional Independence Assumption, which asserts that once the

differences in observable characteristics between the treated and non-treated units are controlled for, the potential outcomes of the two groups are independent of treatment status (Caliendo & Kopeinig, 2008). This is a strong assumption and is unlikely to be met. Therefore, after applying PSM to ensure that the incentivized firms have a similar probability of being selected for the program as matched non-incentivized firms, we estimate the impact using DID, which can account for time-invariant unobserved factors that may affect the incentive assignment.

3.2 Identification of the causal effect: Difference-in-differences (DID)

The DID method attempts to resolve the missing counterfactual problem using pre- and post-treatment information of treated and non-treated entities. Suppose Y_{it} is the outcome of interest of firm i at year t. Hence, we estimate the following DID model, to calculate the ATET.

$$Y_{it} = \beta_0 + \beta_1 T_i \times Post_t + Z'_{it}\gamma + yearFE + firmFE + \varepsilon_{it} \quad (2)$$

where T_i and $Post_t$ are dummy variables that indicate whether firm i is incentivized or not and whether year t is before or after the introduction of the incentive respectively. $yearFE$ and $firmFE$ are year and firm fixed effects. Z_{it} is a vector of observable features of firm i at time t that may affect the output variable of interest, and ε_{it} is the error term. The main coefficient of interest from the above model is β_1, which indicates the treatment effect. If $\beta_1 > 0$, it implies that the investment incentive improves the firms' outcomes.

Tab.1– List and descriptions of variables used for the analysis.

Variable		**Description**
Panel A		**Matching Variables**
SIZE	Firm size	Natural logarithm of total assets averaged over the pre-incentive years, 2005–2008.
lnLC	Personnel cost	Natural logarithm of real personnel cost averaged over the pre-incentive years, 2005–2008.
LEV	Financial leverage	The ratio of total liabilities to equity averaged over the pre-incentive years, 2005–2008
PM	Profit margin	The ratio of profit to sales averaged over the pre-incentive years, 2005–2008
TANG	Tangibility	The ratio of tangible fixed assets to total assets
AGE	Firm Age	Number of years since the establishment of the firm relative to 2019
Dregion	Region dummies	Dummy variables indicating the region the firm is located in the Czech Republic
Panel B		**Outcome variables (DID estimation)**
TFP	TFP	Total factor productivity estimated based on the LP approach (Levinsohn & Petrin, 2003)

lnSALES	Sales	Natural logarithm of total sales deflated by the producer price index
lnPROF	Profit	Natural logarithm of profit for the period
ROA	Return on Assets	The ratio of profit to total assets
lnTFA	Tangible fixed assets	Natural logarithm of tangible fixed assets deflated by the consumer price index
lnEMP	No. of employees	Natural logarithm of the number of employees
lnLC	Employees' compensation	Natural logarithm of expenditure on personnel expenses deflated by the consumer price index
Panel C		**Control variables for DID estimation**
AT	Assets' turnover	The ratio of total sales to total assets
DR	Debt Ratio	The ratio of total liabilities to total assets
LIQ	Liquidity	The ratio of current assets to current liabilities
TANG	Asset tangibility	The ratio of total tangible fixed assets to total assets
LC	Personnel cost	Personnel cost
AGE	Firm Age	Number of years since the establishment of the firm relative to 2019

Source: Authors' compilation.

3.3 Data and variables construction

Data source

The data for this research is drawn from a large firm-level unbalanced panel dataset on firms located in the Czech Republic. The dataset is compiled by CRIBIS and provides a wide range of information on around 2,153 domestic and foreign firms over the period 2005 to 2019. The sample for this study is restricted based on certain conditions. First, as the majority of Czech government investment incentive recipients have been manufacturing firms, our study focuses on firms that operate in this sector. Second, for a firm to be included in our sample, it must have data for at least one pre-incentive year and one post-incentive year. To have a sufficient number of firms in the sample, the period from 2009 through 2014 is selected as the treatment period, while the years between 2005-2008 and 2015-2019 are considered pre-treatment and post-treatment years, respectively. Therefore, the treatment group refers to firms that received an investment incentive between 2009-2014. The control group is comprised of firms that did not receive an incentive during the entire sample period, 2005-2019.

Between 2009 and 2014, 108 foreign and 56 domestic firms from the initial dataset received one or more investment incentives from the state. In the entire sample period, 2005-2019, 622 foreign and 739 domestic firms did not get any type of incentive. After cleaning the dataset and excluding firms that do not meet the selection criteria, the final sample consists of 321 foreign (76 incentivized and 245 non-incentivized) and 265 domestic (47 incentivized and 218 non-incentivized) firms.

Concerning the selection of outcome variables to be assessed, as the purpose of the study is to examine the effectiveness of the investment incentives scheme at a firm level, we select indicators that can reflect firm performance after receiving the incentives. The first indicator is firm productivity, which is measured as total factor productivity (TFP). Since this variable is unobservable, its estimation procedure is described in the following subsection. The output level of firms is captured with their annual total sales, which is weighted with the value of the producer price index for the corresponding 2-digit CZ-NACE sectors of the particular year. Furthermore, to assess the effect on firms' profitability, we use their gross profit and return on assets (ROA) for the observed year. The incentives' effect on firms' investment activities is proxied by tangible fixed assets. Finally, to measure the incentives' employment effect, we use the number of employees and personnel cost of firms as indicators.

Table A2 presents descriptive statistics of the outcome variables for both foreign and domestic firms, broken down by their incentive receipt status.

Productivity estimation

To estimate firms' TFP, we adopt Van Beveren's (2012) approach, which is based on a three-factor Cobb-Douglas production function. The natural logarithm of the equation can be given by:

$$y_{it} = \delta + \alpha l_{it} + \beta k_{it} + \gamma m_{it} + v_{it} + \varepsilon_{it} \quad (3)$$

in which Y_{it}, L_{it}, K_{it} and M_{it} denote the natural logarithm[1] of firm i's output, labor, capital, and materials inputs at time t, respectively. v_{it} is firm-specific productivity shock that is unobserved by researchers but known to the firm, and ε_{it} is a random error term. We measure firms' output with total sales deflated by the industry-specific producer price index and labor with personnel cost[2] deflated by the consumer price index.

Capital is proxied by tangible fixed assets, which is weighted with the average of the following CZ-NACE sectors deflators[3]: computer, electronic, and optical products (26), electrical equipment (27), machinery and equipment (28), motor vehicles, trailers and semi-trailers (29), other transport equipment (30), furniture (31), and building (41). Production-related consumption deflated by the electricity, gas, steam, and air conditioning sector (35) price index serves as a proxy used for intermediate inputs. All deflators are obtained from the Czech Statistical Office (CSO). Alternative econometric methods can be applied to estimate the above model.[4] This study uses Levinsohn and Petrin's (2003) semi-parametric estimator (henceforth LP). The method addresses the simultaneity bias that arises from firms' endogenous input decisions, i.e., a correlation between the inputs and v_{it}, by using intermediate inputs as a proxy for unobserved productivity shocks.

[1] Unless the variable under consideration only includes strictly positive values, to take the negative and zero values into account, the logaritmizations in this study are done through neglog transformation (Whittaker, 2005).

[2] The productivity litrature's standard measure of labor at firm level is the number of employees. However, we opted to use personnel cost for two main reasons. The dataset is missing a significant amount of data on the number of employees, and there is no way to distinguish between skilled and unskilled labor. Therefore, we believe labor cost is a better measure of labor input.

[3] We adopt Javorcik's (2004) approach to deflate the nominal values of capital with a slight modification.

[4] See Van Beveren (2012) for a discussion on the performance of various estimators.

4 RESULTS AND DISCUSSION

4.1 Probability of receiving investment incentives

The first stage of our analysis estimates the *p-score*: the probability of firms receiving Czech investment incentives. The *p-scores* are estimated using probit models for both groups of firms with the same specification. The dependent variable is a binary outcome indicating whether a firm received the incentive between 2009 and 2014 (*Incentives =1*) or not (*Incentives = 0*). The independent variables are firm attributes defined in Tab. 1, Panel A.

Tab. 2 presents the estimation results of the probit model in Equation 1. As shown in the table, out of the matching variables considered for the estimation, only two variables (not including the region dummies) are found to be significant in explaining the probability of firms being selected for receiving the investment incentive. This implies that the investment incentive schemes were sensitive to neither firms' profitability nor the level of their indebtedness or capital structure. We also did not find significant differences in firm age between incentivized and non-incentivized firms, implying that this attribute might not have been a key constraint in applying for and being selected for the incentive. On the other hand, the results indicate that firm size, measured by the logarithm of total assets, is significantly and positively related to the propensity of receiving incentives among both domestic and foreign firms. Moreover, the table also shows significant and negative parameters for personnel costs. This suggests that firms with lower labor costs, which indicates a lower level of employment in those firms, are more likely to apply for the incentive and be accepted. Since one of the objectives of the Czech investment incentives scheme is promoting job generation among firms, this finding stands to reason. The *pseudo-R^2*, a measure of the model's goodness of fit, is 0.219 for the domestic firms' model and 0.104 for the foreign firms' model, which is satisfactory.

Tab. 2 – Estimation results of the probit models for the probability of receiving investment incentives

Variable	Domestic firms		Foreign-owned firms	
	Coefficients	**Standard error**	**Coefficients**	**Standard error**
SIZE	0.507	0.119***	0.324	0.105***
LC	-0.339	0.081***	-0.265	0.123**
DR	-0.012	0.012	-0.001	0.003
PROF	3.782	2.720	0.405	2.027
TANG	-0.716	0.574	-0.662	0.441
AGE	-0.007	0.018	0.009	0.019
Region dummies	Yes		Yes	
Constant	-4.534	1.643***	-2.029	1.343
Pseudo- R^2	0.219		0.104	
Chi.sq.	0.000		0.013	
No. of Observations	257		314	

Source: Authors' estimations using *psmatch2* commands by Leuven and Sianesi (2003) that are available for STATA.

Note: The ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

After predicting the *p-scores*, we matched the incentivized firms with the non-incentivized ones based on the predicted scores. This is carried out according to the kernel matching method. To ensure the distribution of incentivized and non-incentivized firms are in the same domain, the matching was performed by imposing common support restrictions.

Matching quality diagnostic

As the quality of our impact estimation with DID estimators significantly depends on the quality of the matching between the treated and control firms, we conducted a series of diagnostic tests. First, to ensure the validity of the PSM 'common support' assumption, i.e., there should be an overlap of *p-score* distributions between the treated and control firms, we examined the predicted *p-score* density distributions between the two groups graphically. Fig. 3 illustrates the distribution of the estimated *p-scores* of the incentivized and non-incentivized domestic firms (Panel A) and foreign firms (Panel B). The non-incentivized firms' *p-scores* distribution is displayed below the midline, and the incentivized firms' is displayed above it. Despite the off-support treated units especially among the domestic firms' sample (the matching eliminates these units before proceeding to the estimation of the ATET using DID), a visual inspection of the figures indicates the existence of substantial overlap in the *p-score* between the two groups. This confirms that the common support condition is satisfied.

Furthermore, we assess the success of the matching procedure in balancing the distribution of covariates and the estimated *p-scores* between the treated and control groups using balancing property tests (Dehejia, 2005). The results of this exercise are reported in Tab. 3. According to these results, the matching procedure improved the balance of the matching covariates and the *p-scores*. For example, the imbalance, i.e., the mean difference, between the incentivized and non-incentivized firms in terms of the *p-scores* amounts to more than 103% and 74% in the unmatched sample for domestic and foreign firms' model, respectively. The matching process reduced these biases to levels well below ±1%, which is a more than 99% reduction in bias.

As for the covariates, from the table, one can see that the mean differences in the unmatched data between incentivized and non-incentivized firms exceed those in the matched cases. The differences in all covariates among the matched samples are small and insignificant. Relatedly, the post-matching standardized percentage biases also decreased substantially. According to Morgan (2018), an absolute percentage bias value < 10% for each covariate of the matched sample indicates the success of the matching procedure in creating a covariate balance. Hence, as none of the percentage biases reported in Tab. 3 are above 10%, our matching created a satisfactory covariates balance between the incentivized and non-incentivized firms.

Finally, we compare the overall standardized mean difference between the incentivized and non-incentivized firms of the kernel-matched sample with that of the nearest neighbor and radius matching algorithms to check the robustness of the selected method. The results are presented in Tab. 4, showing that, after matching, the pseudo-R2s largely decreased and became relatively low in all three matching technique cases. Nevertheless, the table indicates that, for foreign firms, the lowest mean bias is achieved when the matching is conducted using kernel matching. Even for domestic firms, it performs far better than nearest-neighbor matching. These confirm the aptness of selecting the technique for the procedure. It is also evident that the post-matching likelihood ratio tests fail to reject the joint insignificance of the differences in the mean values. Notably both the mean and median biases declined considerably, confirming the success of the matching.

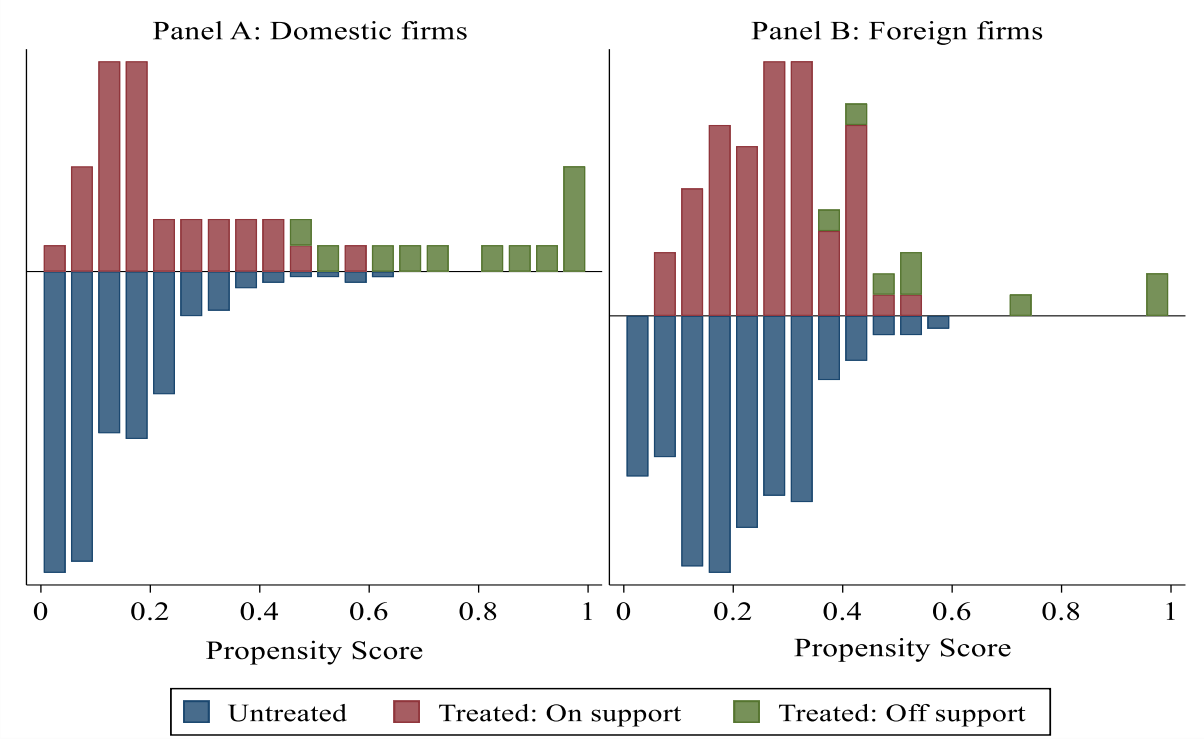

Fig. 3 – Distribution of P-scores for domestic (Panel A) and foreign (Panel B) firm samples. Source: Authors' estimations.

Tab. 3 – Performance of nearest neighbor, radius, and kernel matchings

Matching algorithms	Sample	Domestic firms					Foreign firms				
		Pseudo R^2	LR *chi2*	*p* > *chi2*	Mean bias	Median bias	*Pseudo* R^2	LR *chi2*	*p* > *chi2*	Mean bias	Median bias
Nearest neighbor (5)	Unmatched	0.219	52.11	0.000	14.9	11.9	0.104	35.28	0.013	13.1	12.9
	Matched	0.081	7.84	0.981	7.4	6.3	0.008	1.58	1.000	3.9	3.8
Radius, caliper (0.01)	Unmatched	0.219	52.11	0.000	14.9	11.9	0.104	35.28	0.013	13.1	12.9
	Matched	0.088	8.04	0.978	5.3	4.2	0.010	1.73	1.000	4	3.5
Kernel, bandwidth 0.06	Unmatched	0.219	52.11	0.000	14.9	11.9	0.104	35.28	0.013	13.1	12.9
	Matched	0.092	8.38	0.972	6.5	4.9	0.008	1.44	1.000	3.4	2.1

Source: Authors' estimations using *psmatch2* commands by Leuven and Sianesi (2003) that are available for STATA.

Note: The estimation is conducted. The ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

The subsequent analysis aims to infer the causal effects of the Czech investment incentive on firms' performance using DID based on the matching results discussed above.

Tab. 4 – Balancing property test

Variables	Obs.	Domestic firms					Foreign firms				
		Mean		Standardized bias		*t*-test	Mean		Standardized bias		*t*-test
		Incentivized	Non-incentivized	Bias (%)	Bias Reduction (%)	*P* >*t*	Incentivized	Non-incentivized	Bias (%)	Bias Reduction (%)	*P* >*t*
p-score	Unmatched	0.368	0.13415	103		0.000	0.315	0.207	74.0		0.000
	Matched	0.212	0.21252	-0.2	99.8	0.989	0.277	0.276	0.3	99.6	0.980
SIZE	Unmatched	19.006	19.122	-5.6		0.663	20.043	19.737	17.3		0.174
	Matched	19.801	19.722	3.9	31.4	0.800	20.284	20.257	1.5	91.1	0.923
LC	Unmatched	15.331	17.677	-45.6		0.000	17.474	18.236	-20		0.064
	Matched	18.371	17.983	7.5	83.5	0.247	18.739	18.709	0.8	96	0.892
DR	Unmatched	5.137	1.962	16.1		0.105	1.842	10.848	-10.2		0.531
	Matched	1.418	2.828	-7.2	55.6	0.177	2.844	2.733	0.1	98.8	0.951
PROF	Unmatched	0.051	0.042	22.9		0.134	0.032	0.021	23.8		0.065
	Matched	0.048	0.046	3.1	86.4	0.897	0.029	0.025	9.2	61.5	0.602
TANG	Unmatched	0.392	0.423	-14.4		0.346	0.450	0.457	-3.7		0.782
	Matched	0.433	0.452	-8.7	39.3	0.687	0.444	0.448	-2.1	44.3	0.888
AGE	Unmatched	22.021	24.037	-28.6		0.104	22.605	22.327	5.5		0.673
	Matched	24.182	24.003	2.5	91.1	0.905	22.754	22.402	6.9	-26.3	0.700

Source: Authors' estimations.

4.2 The impact of the investment incentive

This paper's primary purpose is to investigate how the Czech investment incentive scheme affects firms' performance. To this end, based on the matched sample produced by the procedures described in the previous section, we examined the impact over the monitored period using the DID method. We estimated two different models for each of the seven outcome variables. The first one is a baseline model (Model 1) and simply tests the effect of the investment incentives on the domestic and foreign firms' performance while adjusting for firm and year fixed effect only. Following, in Model 2, in addition to the panel and time effects, we control for the effects of firm attributes presented in Tab. 1 Panel C.

Tabs. 5 and 6[5] present estimates of the DID estimators based on Equation 2. The columns labeled "ATET" provide the estimates of the average treatment effect on treated, which captures the effect of the incentive on the various outcome variables provided in column 1. All variables are defined in Tab. 1 Panel B

Tab. 5 – **The** impact of investment incentives on domestic firms

Outcome variables	Model 1[+]			Model 2[++]		
	Obs.	ATET	*t*-value	Obs.	ATET	*t*-value
TFP	2,046	0.042	0.40	2,032	0.056	0.53
lnSALES	2,054	-0.806***	-2.59	2,044	-0.434**	-2.07
lnPROF	2,055	-0.784	-1.21	2,041	-0.91	-1.35
ROA	2,054	1.905	0.55	2,041	0.309	0.14
lnTFA	2,056	-0.281	-0.68	2,044	-0.356	-1.28
lnEMP	1,955	-0.309	-1.63	1,942	-0.205	-1.58
lnLC	2,055	-0.684**	-1.85	2,044	-0.443**	-2.2

Source: Authors' estimations using xtdidregress STATA command.

Note: [+] The estimates are adjusted for panel effects and time effects. [++] The estimates are adjusted for covariates, panel effects, and time effects. ***, **, * represent significance at 1%, 5% and 10% levels, respectively.

As Tab. 5 shows, the results indicate a significant negative effect of the incentives on the output of domestic recipient firms. The ATET estimate of the baseline specification indicates a significant 43.3%[6] sales reduction among domestic recipients during the post-treatment period. After including control variables in Model 2, the effect decreased to 35.21%, yet remains negative and significant. However, our analysis could not detect any significant effect on incentivized domestic firms' productivity, gross profit, ROA, or fixed assets. As for the incentive effect on employment level, the ATET for the number of employees (lnEMP) is negative but again statistically insignificant. However, the incentives' negative impact on domestic firms' employment is confirmed by the statistically significant ATET on labor cost (lnLC). The results show that the recipients' expenditure on employee compensation decreased by approximately 35.79 % in the years after the incentive receipt (2015–2019).

[5] To improve the readability of the tables, we only report estimated ATETs here. Full results are available upon request.

[6] Since the outcome variables are measured in logs, the effects are interpreted as $(e^{\beta_1} - 1) \times 100$ percentage changes.

Tab. 6 – The impact of investment incentives on foreign firms

Outcome variables	Model 1+			Model 2++		
	Obs.	ATET	*t*-value	Obs.	ATET	*t*-value
TFP	2,538	-0.052	-1.03	2,520	-0.065	-1.34
lnSALES	2,549	0.569*	1.81	2,535	0.617**	2.23
lnPROF	2,549	-1.035	-0.58	2,535	1.225	0.73
ROA	2,549	-0.006	-0.36	2,535	0.023	1.48
lnTFA	2,548	0.822***	2.6	2,535	0.727***	2.8
lnEMP	2,501	0.19	1.45	2,482	0.256**	1.93
lnLC	2,549	0.579**	1.85	2,535	0.629**	2.06

Source: Authors' estimations using xtdidregress STATA command.

Note: + The estimates are adjusted for panel effects and time effects. ++ The estimates are adjusted for covariates, panel effects, and time effects. ***, **, * represent significance at 1%, 5% and 10% levels, respectively.

Regarding foreign firms, Tab. 6 reports the ATETs of the investment incentives on their performance. Looking at the results presented in the table, it is safe to say that contrary to their effect on domestic firms, the incentives have positively impacted foreign firms. For instance, the estimated ATETs on lnSALES and lnTFA are consistently positive and significant across the two model specifications. Hence, as per the results from Model 2, the incentivized firms' output and tangible fixed assets were significantly raised by 85.34% and 106.9%, respectively. Considering the incentive employment effect on foreign firms, the results show positive treatment effects on both employment indicators, lnEMP and lnLC, with 5% significance levels. According to the estimated ATETs based on Model 2, these effects amount to 29.17% and 87.57% increments in the number of employees and their compensation, respectively. However, neither of the specifications detects a significant impact on TFP, profit, or fixed assets.

For a deeper understanding of these results and to check the timing of the effects, we further decomposed the investment incentive impact by each post-incentive year. Tabs. 7 and 8 present the treatment effects on domestic and foreign firms over time, respectively. These are estimated by including the control variables given in Tab. 1 Panel C.

Tab. 7 – Yearly treatment effects of the investment incentives on domestic firms.

Outcome variables	t = 2015		t = 2016		t = 2017		t = 2018		t = 2019	
	ATET	*t*-value	ATET	*t*-value	ATET	*t*-value	ATET	*t*-value	ATET	*t*-value
TFP	0.02	0.18	-0.009	-0.08	0.061	0.54	0.097	0.8	0.108	0.83
lnSALES	-0.357*	-1.93	-0.438**	-2.16	-0.489**	-2.57	-0.596**	-2.16	-0.287	-1.07
lnPROF	0.14	0.36	-1.432	-1.2	-1.601	-1.34	-1.092	-0.88	-0.556	-0.99
ROA	1.043	0.75	1.051	0.7	-0.377	-0.15	-0.053	-0.02	-0.104	-0.04

lnTFA	-0.315	-1.23	-0.343	-1.27	-0.354	-1.33	-0.413	-1.13	-0.355	-1.24
lnEMP	-0.184	-1.53	-0.166	-1.26	-0.257*	-1.73	-0.216	-1.45	-0.2	-1.55
lnLC	-0.253	-1.22	-0.398*	-1.97	-0.461**	-2.36	-0.605**	-2.08	-0.495**	-2.27

Source: Authors' estimations using xtdidregress STATA command.

Note: The ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

The estimates reported in Tab. 7 show that the negative ATET of domestic firms' sales increases with time until it becomes insignificant in 2019. Similar to the aggregated effect shown in Table 5, the ATETs of the number of employees remained statistically insignificant for most of the post-incentive periods considered. However, in 2017, the effect of the incentive was significantly negative at a 10% significance level. As for the effect on employee compensation, the impact of the incentive seems to take a while to appear in the regressions, as the ATET during the first post-incentive year is insignificant. Nevertheless, the negative effect in the subsequent years stayed significant and increased in absolute value over time.

Tab. 8 – Yearly treatment effects of the investment incentives on foreign firms.

Outcome variable	**t = 2015**		**t = 2016**		**t = 2017**		**t = 2018**		**t = 2019**	
	ATET	***t*-value**	**ATET**	***t*-value**	**ATET**	***t*-value**	**ATET**	***t*-value**	**ATET**	***t*-value**
TFP	-0.223***	-2.73	0.069	0.87	-0.045	-0.57	-0.073	-0.94	-0.052	-0.58
lnSALES	0.582**	2.06	0.658**	2.29	0.671**	2.31	0.621**	2.19	0.553**	2.14
lnPROF	2.181	1.2	-1.439	-0.7	1.369	0.65	0.268	0.11	3.847*	1.66
ROA	0.025	1.51	0.014	0.88	0.011	0.65	0.015	0.84	0.049**	2.57
lnTFA	0.51	1.28	0.817***	3.09	0.777***	3.02	0.781***	2.96	0.758***	3.13
lnEMP	0.273**	2.01	0.297**	2.21	0.235*	1.74	0.251*	1.85	0.223*	1.71
lnLC	0.604*	1.96	0.67**	2.15	0.676**	2.15	0.625**	2.01	0.57*	1.92

Source: Authors' estimations using xtdidregress STATA command.

Note: The ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

In the case of foreign firms, in line with the negative, albeit insignificant cumulative ATET, reported in Tab. 7, the yearly analysis shows a significant negative effect on TFP during the first year of the post-incentive period. However, this negative effect is unlikely to persist, as we do not find any significant effect in the following years. The positive effect of the incentive on firms' sales, on the other hand, persisted over the years, increasing during most of the initial years but slightly decreasing in the later years. The positive and significant ATET on profit and ROA in the last year may insinuate a possible profitability gain in the long run. Moreover, the favorable effect of the incentive on tangible fixed assets of firms stayed highly significant but slightly declined from the second year onwards. With respect to employment level, the effects on the number of employees and their compensation were always significantly positive. In terms of magnitude, the ATETs exhibited increasing trends for the first two and three years and minor decreases in the later years.

4.3 Further robustness checks

To confirm the sustainability of the previously presented achieved outcome, we conducted a set of robustness tests. First, to ensure that selecting a particular matching algorithm does not drive our estimation results during the matching stage, we apply two additional matching strategies and re-estimate the ATETs. Specifically, we use the nearest neighbor with a 5:1 matchup with replacement (to retain as many observations as possible in our sample) and radius matching methods with observations matched within a range of 0.01. The results from these activities are reported in Tab. 9. Columns 3 – 5 of the table show the results for the domestic firms, and columns 6 – 8 for foreign firms.

The results displayed in Table 9 largely confirm the previous findings. The ATETs from both nearest neighbor matching and radius-matching-based DID estimations show the negative effects of the investment incentive on domestic firms' output and employee compensation expenditure. As for the foreign firms, the return to the incentives is significantly positive in terms of output, fixed assets, number of employees, and labor cost. These, again, are consistent with our main findings reported in Tab. 6. In sum, the results from our first robustness test confirmed that our findings are not sensitive to the selected matching algorithm.

Tab. 9 – DID estimation results under alternative matching methods.

Matching method	**Outcome variables**	**Domestic firms**			**Foreign firms**		
		Obs.	**ATET**	***t*-value**	**Obs.**	**ATET**	***t*-value**
Nearest neighbor (5)	*TFP*	1,073	0.077	0.72	1,649	-0.066	-1.210
	lnSALES	1,077	-0.372*	-1.66	1,660	0.517**	1.88
	lnPROF	1,076	-1.017	-1.4	1,660	-0.53	-0.28
	ROA	1,077	-0.052	-0.78	1,660	0.026	0.99
	lnTFA	1,077	-0.127	-0.49	1,660	0.646***	2.2
	EMP	1,019	-0.119	-0.93	1,635	0.184	1.25
	lnLC	1,077	-0.327*	-1.46	1,660	0.548	1.63
Radius caliper (0.01)	*TFP*	1,651	0.064	0.59	2,229	-0.088	-1.69
	lnSALES	1,658	-0.289	-1.43	2,243	0.681***	2.31
	lnPROF	1,656	-0.828	-1.19	2,243	0.807	0.43
	ROA	1,658	-0.061	-0.93	2,243	0.018	1.12
	lnTFA	1,658	-0.339	-1.06	2,243	0.778***	2.89
	EMP	1,578	-0.239	-1.62	2,196	0.247*	1.8
	lnLC	1,658	-0.403*	-1.82	2,243	0.635**	1.95

Source: Authors' estimations using xtdidregress STATA command.

Note: The estimates are adjusted for covariates, panel effects, and time effects. ***, **, * represent significance at 1%, 5% and 10% levels, respectively.

Next, we check the robustness of our results to alternative indicators of firm productivity. As noted in Section 3, empirical studies' findings on the productivity effect of incentives have been inconsistent. Likewise, our PSM-DID regressions could not detect definite effects on TFP.

It has been hypothesized that the lack of effect on productivity could be due to the indicator one uses (DeNegri et al., 2011). Hence, we employ alternative productivity measures, namely total sales per worker (*LP*) and labor cost (*LCP*) to test whether the insignificant results are due to the specific indicator we are using. Tab. 10 presents the results of these activities.

Again, these outcomes are largely along the lines of our main findings. They confirm the overall ineffectiveness of investment incentives on the productivity of domestic and foreign firms, regardless of the indicator used.

Tab. 10 – Estimation results under alternative outcome variables.

Firm type	Outcome variables	Model 1 (Baseline)[+]			Model 2[++]		
		Obs.	ATET	*t*-value	Obs.	ATET	*t*-value
Domestic	*LP*	1,932	-951,000	-0.54	1,927	453,000	0.65
	LCP	2,029	-6.633	-1.04	2,025	-0.119	-0.05
Foreign	*LP*	2,467	-1,020,000	-1.14	2,465	-26,600	-0.04
	LCP	2,521	-1.762	-1.31	2,519	-1.234	-0.85

Source: Authors' estimations using xtdidregress STATA command.

Note: The estimates are adjusted for covariates, panel effects, and time effects. ***, **, * represent significance at 1%, 5% and 10% levels, respectively.

4.4 Discussion

Although there are several studies on the impact of different incentive policies on firm performance, there is insufficient empirical evidence on the variation of the effect across different ownership types. Therefore, this study examined how the Czech investment incentive scheme affects firms' performance and whether these effects vary in domestic and foreign firms.

Overall, the impact of receiving investment incentives between 2009 and 2014 on firm performance appears to be heterogeneous depending on the nationality of firm ownership. On the one hand, our results point out that the incentives' effect on the performance of domestic firms had mostly been insignificant at best and negative at worst. Particularly, its adverse effect on the firms' output was consistently significant over the years following the incentive. However, the effect is not found to be significant on firms' investment levels (tangible fixed assets) or their profitability (firms' profit for the period and ROA). Likewise, the incentives appear to be ineffective in improving domestic firms' productivity. As for the employment effect, the results show that the number of employees in the incentive recipient firms had not been significantly different from that of the non-recipients in the years after receiving the incentive. Nonetheless, they give evidence that suggests firms' employee compensation persistently responded to the incentive negatively throughout the post-incentive years. These results, which largely show negligible and negative effects of the investment incentive on domestic firms' performance, are in accordance with findings reported by Roper and Hewitt-Dundas (2001), Silva (2011), Brachert et al. (2018), and Srhoj et al. (2021), etc., to some degree.

In light of these findings, one may argue that the unfavorable treatment effects are because the domestic firms that applied for and received the incentive were already uncompetitive. However, by employing PSM before estimating the incentive impact, we have ensured that

such selection biases did not drive our results. Rather, one possible explanation for these phenomena could be that the incentive may have inhibited necessity-based production in the firms. Since the firms could count on this 'free funding' from the government, it may discourage them from employing more inputs (e.g., employees and physical capital) to produce more.

On the other hand, the incentive effects on foreign firms contrast sharply with those for domestic firms. The foreign firms appear to be investing in human and physical capital more (as indicated by the positive ATET on personnel expenditures and tangible fixed assets, respectively) after receiving the investment incentives. Consequently, the recipient foreign firms have had higher output than they would have without the incentive. The yearly analyses, which show the persistence of the treatment effects over the years following the incentive, strongly support these results. However, similar to domestic recipients, the supported foreign firms do not seem to register any changes in their productivity and profit due to the incentives. While we observe a negative association between being an incentivized firm and TFP during the first post-incentive year, it quickly disappeared and was not significant afterward. Moreover, ours is not the only study that found the ineffectiveness of public incentives in enhancing firms' productivity. Bernini et al. (2017), Dvouletý and Blažková (2019), and Dvouletý et al. (2021) are some of the empirical studies that reported similar results.

Looking at these findings, a question that naturally arises is what drives these distinctions between foreign and domestic firms' reactions to receiving investment incentives? Although the issue requires deeper empirical investigation, we attribute the difference to foreign firms' advantages and opportunities over domestic ones. Comparative studies frequently point out a significant performance gap between foreign and domestic enterprises. According to MNC theories, companies invest abroad to exploit their superior firm-specific advantages (Bellak, 2004). These firm-specific advantages, to which local firms do not have access, give rise to their superior performance over the host country's native firms. Moreover, due to their multinational nature, foreign firms enjoy superior global networks compared to domestic firms, which give them access to newer and improved technologies, know-how, markets, etc. Therefore, it is more likely that possessing these advantages enables foreign firms to use the incentives provided by the state more effectively and improve their performance more than their domestic counterparts.

5 CONCLUSION

Governments at various levels engage in the provision of investment incentive programs. However, although often overlooked, the effectiveness of these incentives tends to be different depending on the nationalities of the receiving firms' ownership. In this study, we evaluate the impact of the investment incentives provided by the Czech government on the recipient companies' performance. The findings from our counterfactual analysis reveal that the incentives affect foreign and domestic firms differently. They highlight that while the incentives positively affect the foreign firms' output level, investments in fixed assets, and employment, their effects on domestic firms' performance are insignificant at best and negative at worst.

Overall, the study offers useful insights for evaluators on the importance of taking firm heterogeneity into account while assessing state aid programs for businesses. Most notably, given their substantial differences in terms of structure, behavior, and performance (Bellak, 2004), there is a need to distinguish between domestic and foreign firms in evaluations of such interventions (such as tax incentives, grants, credits, etc.). In addition, as our findings pointed out, the effects of the investment incentive can vary depending on the firm performance

measure used for the evaluation. Hence, to get a comprehensive picture of the effectiveness of similar incentive schemes, we believe it is crucial to evaluate the impact on diverse outcomes of firms.

Furthermore, from a policy perspective, our findings suggest that using similar incentive systems across foreign and domestic firms may fail to achieve the intended goals and need to be reconsidered.

APPENDIX

Tab. A1 – Sample construction

Description	Domestic firms			Foreign firms		
	Incentivized	Non-incentivized	Total	Incentivized	Non-incentivized	Total
The initial number of firms in the dataset	211	739	950	513	622	1,135
Number of firms that received Czech investment incentives between 2009-2014	57	-	57	108	-	108
Excluding firms operating in sectors other than manufacturing	50	274	324	104	278	382
Excluding firms that do not have information for a sufficient number of pre-and post-treatment years	47	218	265	76	245	321

Tab. A2 – Descriptive statistics on the outcome variables of incentivized and non-incentivized firms in the pre-incentive period (2005 – 2008)

Firms	Outcome variables	Incentivized			Non-incentivized			T-test on the equality of mean	
		Obs	Mean	Std. dev.	Obs	Mean	Std. dev.	p-value	
Domestic	*TFP*	144	7.802	0.507	747	7.88	0.45	0.073	*
	SALES (CZK mill.)	143	1,895.07	5,637.40	750	609.40	929.28	0.000	***
	PROF (CZK mill.)	143	858.12	3,916.91	751	404.18	756.03	0.004	***
	ROA	143	-0.01	0.76	752	0.05	0.25	0.071	*
	TFA (CZK mill.)	144	470.56	1,489.81	752	164.21	379.17	0.000	***
	EMP	135	561.07	1,004.65	698	301.62	312.50	0.000	***

	LC (CZK mill.)	143	212.63	489.24	751	107.13	117.65	0.000	***
Foreign	*TFP*	263	8.01	0.52	796	7.97	0.51	0.214	
	SALES (CZK mill.)	265	5,433.40	25,593.19	798	1,443.45	3,268.37	0.000	***
	PROF (CZK mill.)	265	246.47	1,327.54	798	65.08	435.94	0.001	***
	ROA	265	0.05	0.14	798	0.02	0.26	0.066	*
	TFA (CZK mill.)	265	1,305.35	5,601.26	800	495.12	1,246.85	0.000	***
	EMP	262	818.95	2,925.70	762	414.08	590.53	0.000	***
	LC (CZK mill.)	265	383.75	1,475.68	798	184.06	330.97	0.000	***

Source: Authors' calculation

Note: ***, **, and * indicate the 1%, 5%, and 10% significance levels.

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Contact information

Etsub Tekola Jemberu
Tomas Bata University
Faculty of Management and Economics
Department of Finance and Accounting
Czech Republic
E-mail: tekola@utb.cz
ORCID: 0000-0003-2448-7565

Adriana Knápková
Tomas Bata University
Faculty of Management and Economics
Department of Finance and Accounting
Czech Republic
E-mail: knapkova@utb.cz
ORCID: 0000-0002-4130-6976