CECILIA LLAMBÍ
CAF – Development Bank of Latin America
and Center for Economic Research (CINVE)

ANDRÉS RIUS
University of the Republic, Uruguay

FEDORA CARBAJAL
Center for Economic Research (CINVE)

PAULA CARRASCO
University of the Republic, Uruguay

PAOLA CAZULO
Center for Economic Research (CINVE)

Are Tax Credits Effective in Developing Countries? The Recent Uruguayan Experience

ABSTRACT   Investment promotion through tax incentives has been a key component of the growth strategies pursued in Uruguay by the last three administrations. A new regime was established, regulated by Executive Decree 455, which implemented a major overhaul in the main channel for subsidizing investment. This regime immediately generated a battery of researchable questions about its effectiveness and efficiency. Using a large data set, first put together for this study from firm-level administrative records kept by the tax collection and pensions institutes between 2005 and 2011, we test the hypotheses of significant and positive effects of obtaining a tax credit through the new regime on investment and employment outcomes. A matched difference-in-differences strategy confirms that the promotion regime introduced in 2008 had a statistically significant effect on the firms' rate of investment (around 11 percent), while the effects on employment growth rate were more ambiguous. These findings are buttressed by several robustness tests. Further probing uncovers heterogeneity along the promotion timeline, with the greatest effect on the investment rate occurring in a project's first year.

JEL Codes: H25, D04, H32
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Microeconomic evidence tends to show that tax incentives influence the investment decisions of firms.[1] The evidence cannot be considered conclusive, however, at least not in every dimension. First, it comes disproportionally from rich developed economies, so we have only a very imprecise idea of how taxation affects investment in developing economies. Second, the scarce studies available on low- and middle-income countries tend to have partial coverage of the economy (by industry, geographic unit, and so forth). Third, the bulk of the research on tax incentives focuses on policies mainly designed to attract *foreign* investments, which present an important but specific set of challenges vis-à-vis investments in general. These limitations are regrettable, but they are not necessarily the most serious. In fact, there is an even greater paucity of studies based on research designs capable of sustaining credible causal inference.

Understanding the effects of tax incentives is key to all countries but crucial to emerging and developing ones. It is estimated that developing countries could be spending as much as US$139 billion per year on exemptions from corporate income taxes, much of it intended or justified as a stimulus for investment and a big share going to foreign companies. Moreover, whether large or small, tax incentives usually involve a reallocation of resources, which raises concerns about effectiveness, efficiency, and fairness. If government subsidies cannot be linked to additional investments by the companies that receive them (that is, to projects that would have not gone forward without the public support), then the public may become legitimately skeptical about the ethics of giving something for nothing.

Uruguay has suffered from chronic underinvestment for about half a century. In economics, tax incentives find their strongest justification as responses to market failures that make the social value of certain investments diverge from their private value. Private investment may be lower than socially desirable when, for example, there are positive spillovers from some firms' enlarged capital stock (or from the level of activity that comes with it). However, an extended investment deficit such as Uruguay has experienced could reflect other kinds of massive coordination failures that would justify policy interventions in a more Keynesian style. In fact, underinvestment may be the bad outcome of a coordination game in which every investment project (or a sufficient number of them) needs a minimum aggregate demand to be profitable, and the whole economy could be driven to good or bad outcomes depending on the existence and proper use of a switching factor (such as a

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1. Agostini and Jorratt (2013).

positive fiscal shock or a major public investment) that derives its importance from its power to align expectations.

Investment promotion through tax incentives has long been a feature of industrial policies in Uruguay, including in the last decade. The left-wing administration that took office in 2005 sought to achieve several goals through a redesigned promotion scheme defined in detail by Executive Decree 455/007 (ED-455). ED-455 translated the general rules established in Law 16,906 of 1998 (the so-called Investment Law) into a specific investment regime.

Within this legal framework, several important innovations were introduced with respect to recent past experience. First, the eligibility conditions and benefits were extended to all economic sectors, generating a major expansion of its scope since the previous regime was only available to the agriculture and industrial sectors. Second, the new regime allowed firms of varied legal status and size to enjoy the benefits, and special measures were taken to ease the access of small and medium-sized firms. Third, the regime of 2007 linked the size of the subsidies to projects' contributions to the attainment of several predefined development objectives.

The resulting investment regime sought to influence some key economic variables, in forms that reflect the urgency to consolidate the incipient recovery from the devastating macroeconomic crisis of 2001–02. In particular, job creation and export growth were explicit top priorities, while geographic decentralization, national value added, investments in research and development (R&D), and the introduction of clean production technologies were second-order criteria that would nonetheless give opportunities to investors to increase the size of the earned benefits.[2]

A complex public policy innovation such as the one associated with ED-455 always prompts questions about its effectiveness, efficiency, and unintended effects. Those questions have been in the public domain since the regime was established, but the institutional coordination required to put together large databases from administrative records, and the political commitment to evaluating the policies, were not fully aligned until 2011.

Existing evaluations of the Uruguayan tax incentive regime are scarce, and their results, though generally favorable, do not completely account for identification issues arising from the nonrandom assignment of firms into the promotion scheme. Two previous studies assessed the effects of the ED-455

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2. All these objectives were maintained in the revision to the regime that took place in 2011, which mainly raised the bar for investors in terms of the size of development gains that were required for each unit of tax incentives claimed.

regime. The first was carried out by Gervaz, Goday, and Traiman and showed a positive effect of the regime on investment, exports, and employment.[3] However, the authors used aggregate data and could not rule out the presence of unobservable confounders. The second study, by Artana and Templado, was based on firms' microdata from tax collection records, with a sample that included beneficiary and nonbeneficiary firms before and after ED-455.[4] They found positive effects on investment, but because of data constraints, they could not control for a common factor that would possibly have affected both the probability of being a beneficiary and the level of investment.

This article tackles three basic questions from a policy point of view. Does the new regime succeed in raising the investment rate of firms that receive the subsidy? Does the new regime have a positive and significant effect on employment levels in subsidized firms? Are these positive outcomes achieved efficiently? To explore these issues, we performed a matched difference-in-differences estimation on a common support of firms. The common support was obtained through the propensity score estimator on a set of observable characteristics and trends of outcome variables before the implementation of the policy. We used the Hirano-Imbens-Ridder approach by weighting units in the control group according to the propensity score.[5]

As mentioned, the growth of employment and exports were two key objectives for the program, almost on par with investment. We sought to evaluate both, but the available data prevented us from applying the same methodological approach to both exports and employment. Thus, the article includes only a complete evaluation of the investment and employment effects of the tax regime.

The main empirical result is the outcome of the difference-in-differences regression, designed to compare firms that obtained the tax credit from the ED-455 (treatment) against a control group of firms that did not. To the best of our knowledge, this is the first study based on a nationwide data set of all the firms eligible to apply to the scheme, with enough prior and subsequent yearly observations usable for the evaluation. For this purpose, we constructed a panel database of taxpayers' firms in Uruguay based on administrative records from the National Tax Agency and the Social Security Bank, with information before and after the implementation of the policy (2005–11). According to the results, ED-455 seems to be effective in the accomplishment of the main objective, that

3. Gervaz, Goday, and Traiman (2011).
4. Artana and Templado (2012).
5. Hirano, Imbens, and Ridder (2003).

is, it has had positive effects on the investment rate. This result is robust to different specifications and differs by economic sector. Furthermore, we uncover some policy implications based on the heterogeneity of the potential effects (considering time and size dimensions). First, ED-455 has positive effects mainly in the first year after the project is promoted. Second, the effect on the investment rate varies depending on the number of promoted investment projects and their intensity (measured through the size of the project). Finally, the effect on the employment growth rate is positive but not robust to all specifications.

The rest of the article is organized as follows. In the next section, we review some of the more relevant features of the literature of tax incentives. We then describe the investment promotion system and the subsequent changes introduced by ED-455. Subsequent sections develop the empirical strategy, explain the main characteristics of the database used in the estimations, and present the main results. Finally, we present our conclusions in the final section.

Tax Incentives: Foundations and Applicability

About a decade ago, an international literature review reported the extended use of fiscal subsidies to stimulate investment.[6] The essay opened with a quote from Sir Nicholas Kaldor, who had observed the pattern a few decades earlier. Since early times, those policies have been controversial. On one side of the equation, a national or subnational government may feel that it is its duty to appeal to investors, to bring projects to shores that may not have been considered had it not been for the tax incentives. On the other hand, even the best-designed programs have leakage and information asymmetries that may prevent policymakers from seeing the redundancy and inefficiencies (and sometimes sheer corruption) surrounding the schemes. Within the expert community, benefits and costs are confronted, still inconclusively.

As a working definition, fiscal incentives are reductions of the tax burden, to stimulate certain firms and projects that the government wants to promote.[7] The definition makes clear that incentives represent a positive discrimination toward desirable investments. However, as long as the benefits are available to a broad set of firms regardless of industry or other characteristics, the policy can be classified as horizontal, in the language of recent industrial policy, and

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6. Zee, Stotsky, and Ley (2002).
7. This definition is adapted from Zee, Stotsky, and Ley (2002, p. 1,498).

it does not entail picking winners.[8] To the extent that additions to the capital stock are the mechanism through which many technological innovations take place, a fiscal incentive regime is a potentially valuable tool in the industrial policy toolbox.

From an economic perspective, tax incentives can be justified in two ways: they may respond to some form of market failure, or they may represent the best available policy in a second-best world. The existence of externalities, public goods, liquidity constraints, and coordination failures may determine that the free market policy results in inefficient underinvestment, which provides a rationale for subsidizing investment.

The economic justification for tax incentives becomes more questionable when it is based on the objective of leveling the playing field or when tax policy is used to compensate for other distorting but hard-to-avoid policies. The existence of justified deviations from tax neutrality does not mean that they have to be used. Once a market failure is identified, the analysis should demonstrate that a tax benefit would fix or mitigate the problem that caused it in the first place. In other words, the policy must be effective.

Agostini and Jorratt provide a careful review of the recent international experience and literature.[9] For the purposes of the present study, it is worth highlighting several of their findings.

—There is a variety of tax incentives to promote investment, with varying strengths and weaknesses. Roughly, there is a trade-off between administrative simplicity and effective targeting. Investment credits—the mechanism that most closely resembles Uruguay's investment promotion regime—are somewhere between the extremes of administration costs and economic efficiency.

—While developed countries use mainly subsidized credit, accelerated depreciation, investment-oriented tax credits, and a reduction in local taxes, developing countries more often rely on tax exemptions for imports of capital goods, tax holidays, and tax credits.

—The effectiveness of investment promotion regimes has been assessed with different empirical strategies. Broadly speaking, estimations tend to converge on an average investment elasticity to a tax rate of 0.6; in other words, a 10 percent reduction in the tax rate on corporate benefits yields additions of 6 percent to the capital stock. Most of the available studies reflect the circumstances of developed economies. The few available studies for developing

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8. See, for example, Hausmann, Rodrik, and Velasco (2005).
9. Agostini and Jorratt (2013).

countries show similar results, but there are not enough studies to assume that it is a robust empirical regularity.

   —The effects of the policy vary widely between the short and the long run. The duration of the incentive, its design (that is, whether it promotes longer-term investments), and the supply of capital goods are determinants of the impacts that can be observed over different time horizons.

   —The evidence seems to confirm that incentives to promote geographic decentralization and employment growth in depressed regions tend to result in the relocation of some firms, without substantial net additions of economic activity to the whole country.

   Among the mechanisms to deliver the tax incentive, investment tax credits are the most widely used in different contexts. They consist in authorizing the deduction of a percentage of capital goods investments directly from the tax bill. The advantages over other regimes include the fact that it is delivered only once the investment has occurred, and project support can be varied according to policy priorities. Tax holidays, in contrast, tend to benefit mostly big investments that are normally also the most profitable, so they are likely to have occurred regardless of the incentives. Compared to deductions for investments, which authorize expensing a larger fraction than the regular depreciation, tax credits for investments are not biased toward shorter-term investments. Accelerated depreciation, in turn, has mainly a financing effect, while it has targeting advantages and is less prone to abuses.

Policy Description

Executive Decree 455/007, approved in December 2007, is a regulatory act of the so-called Investment Law of 1998. This law declared that the promotion and protection of investments made by domestic and foreign investors in the country was in the national interest. Its aim was not only to attract foreign investment but also to increase reinvestment by domestic firms. The 1998 regulation of the investment law established manufacturing, mining, and agricultural firms as potential beneficiaries. Promoted investment included machinery and equipment directly related to production, equipment for electronic data processing, industrial and agricultural fixed investment, certain intangible assets, and investment incorporating technological innovation.[10]

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   10. Articles 6 and 7 of Law 16,906.

The established benefits were exemptions from the net wealth tax due to the presence of promoted goods, exemptions from value-added tax (VAT) and excise taxes on imported goods that are part of promoted investment, and VAT rebates on domestic purchases of these goods. The law also empowered the government to grant an accelerated depreciation regime for promoted investment, which mainly has a financing effect through corporate income tax payments.[11] The Commission on the Application of the Investment Law (COMAP) was created to advise the Ministry of Economic Affairs and Finance on implementing the promotion scheme.[12]

The ED-455 of December 2007 modified the 1998 Investment Law. The specific objectives explicitly prioritized were, first, to increase investment, employment, and exports, and second, to contribute to economic decentralization, promote investment in less developed areas, encourage the use of clean technologies, promote investment in research, development, and innovation (R&D&I), and contribute to the growth of gross domestic product (GDP) and the generation of domestic value added.

Several innovations were introduced with respect to the previous regime. First, the eligibility conditions and benefits were extended to all economic sectors, generating a major expansion of the original law's scope. Second, the new regime allowed firms of varied legal status and size to enjoy the benefits, and special measures were taken to ease the access of small and medium-sized firms. Third, the size of the tax credit was linked to the specific project's contributions to the attainment of the previously mentioned objectives. Fourth, the tax incentive was modified, the main benefit now being reductions in the corporate income tax. Fifth, the concept of promotable investment was broadly expanded to include all investment directly linked to the firms' activity.

To apply for the tax benefits, firms must submit an investment project to the COMAP, along with a letter of agreement to comply with the conditions that lead to the granting of the benefits. The COMAP then evaluates the project in coordination with the relevant ministries. If the project is approved for promotion, the beneficiary firm must annually submit to the COMAP its balance sheets and any additional information required for the analysis of compliance with the goals that justify the received benefits. In the event of failure to meet the targets, the COMAP can revoke the benefits. Two key

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11. Articles 8 and 9 of Law 16,906.

12. The COMAP is currently integrated by delegates of the Ministries of Finance; Livestock, Agriculture, and Fisheries; Industry, Energy, and Mining; Labor and Social Security; and Tourism; and the Office of Planning and Budgeting.

T A B L E 1 . Maximum ED-455 Corporate Income Tax Exemption Rates and Maximum Benefit Period, by Investment Project Size

Project size	Investment (US$)[a]	Maximum tax exemption (%)	Maximum period (years)
Small	< 400,000	51–60	3–5
Medium 1	400,000–1,626,344	70	15
Medium 2	1,626,345–8,131,724	80	20
Large 1	8,131,725–16,623,479	90	25
Large 2	16,623,480–58,083,749	90	25
Large 3	58,083,750–813,172,494	100	25
Very Large	≥ 813,172,495	100	25

Source: Private Sector Support Agency (UNASEP) of the Uruguayan Ministry of Economic Affairs and Finance.
a. Investment amounts are converted from Uruguayan pesos to U.S. dollars using the 2011 exchange rate.

features of the investment credit make it appealing as a mechanism to reduce the cost of capital and expand genuine investments: first, the state reduces the income tax bill by an amount that is known and has a known phase-out from the beginning; and second, the state only incurs a loss (foregone taxes) if the firms actually generate rents, since otherwise there will be no corporate income tax to collect.

Projects are classified by size into six groups, from small projects with an investment of less than US$400,000 to megaprojects with a projected investment of over US$813 million. For each group, there are different maximum percentage exemptions from the corporate income tax and different deadlines for the implementation of the investment and the application of the benefit. Each group also has a specific evaluation matrix with explicit weights and scores for each objective or goal.

The amount of the corporate tax exemption is established as a percentage of actual investment by the firm. The total exemption ranges from 60 percent of investment in the case of small projects to a maximum of 100 percent for the largest projects (see table 1). The effective rate of exemption is determined by an explicit rule that links the maximum potential exemption (second column, in percent) with the score of the project arising from the evaluation matrix. A simplified regime was established for small projects, which are evaluated based on a single goal, selected by the firm (see figure 1). Medium and large projects are evaluated through the entire matrix of goals, although they can request to be evaluated for just one. In that case, the maximum exemption is 60 percent of investment, the same as for small projects.

The period in which tax exemptions can be applied ranges from five years for small projects to twenty-five years for larger projects. The period starts

FIGURE 1. Evaluation Criteria
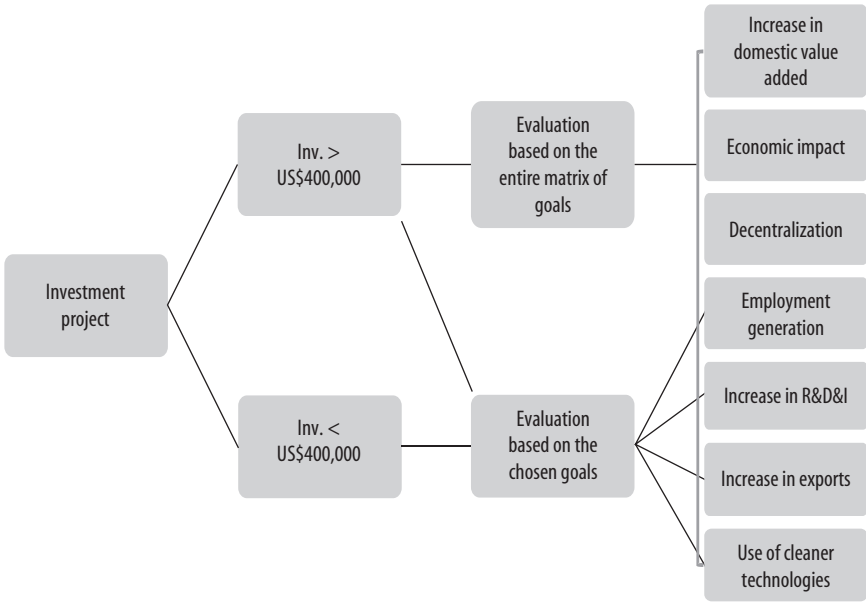
in the first year in which a positive taxable corporate income is generated by the firm. A decreasing maximum application rate was established for the tax exemption. The firm can deduct up to 90 percent of its corporate income tax in the first half of the period for which the project was approved; the tax deduction rate then drops to 80 percent for the ensuing years corresponding to 10 percent of the period, then to 60 percent for the next 10 percent of the period, and subsequently to 40 percent, to 20 percent, and to 10 percent in the last 10 percent of the approved period. For example, in the case of a project approved for a term of ten years, during the first five years, the firm would be eligible for an exemption of up to 90 percent of its corporate income tax; in the sixth year, 80 percent; in the seventh year, 60 percent; in the eighth year, 40 percent; in the ninth year, 20 percent; and in the last year, 10 percent.

The investment promotion regime regulated by ED-455 coexists with another tax incentive mechanism, the Exemption for Investment, which dates back to 1987.[13] This scheme establishes a 40 percent rebate on the purchase

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13. Article 447 of Law 15,903, November 1987.

T A B L E   2 .   Number of Promoted Projects and Firms by Sector, 2008–11

Sector	Promoted projects	Promoted firms	Promoted investment (%)
Agriculture	165	134	7
Industry	581	421	46
Commerce and services	1,167	810	36
Tourism	105	89	12
Total	2,018	1,454	100

Source: Authors' calculations, based on data from DGI, COMAP-MEF, MGAP, and MIEM.

of capital goods such as machinery, industrial and agricultural facilities, and equipment for data processing. The regime is also applicable to investments made by hotels and entertainment services. The rebate is set at 20 percent for construction and expansion of buildings for industrial activities or hotels. Since 2006, more items were added to the list of goods that are eligible for the rebate, and the expiration date of the rebate was extended to two years. The Exemption for Investment does not conflict with ED-455.

One main difference between the two mechanisms is that ED-455 requires firms to submit a specific project, which is then evaluated and rated with the aid of an evaluation matrix, while the Exemption for Investment is automatically granted to the firms that buy capital goods in a given year. Another main difference relates to the amount of the benefit: ED-455 allows for exemptions of 60–100 percent of the total cost of the investment; the Exemption for Investment establishes a deduction of 20–40 percent of the cost of capital goods.

Between 2008 and 2011, 2,018 projects submitted by 1,454 firms were approved under ED-455. Firms could submit one or more investment projects. Of the investment projects approved for the exemption, 46 percent were in the industrial sector and 36 percent in commerce and services. The latter tended to submit smaller investment projects, which account for 58 percent of total projects (see table 2).

Finally, Uruguay has one of the highest ratios of total tax expenditure to GDP (5.8 percent in 2011) in the Latin American region, above Argentina, Brazil, and Chile. The tax expenditure related to the corporate income tax represented around 1.74 percent of GDP in 2010.[14] In 2011, exemptions from the corporate income tax deriving from ED-455 were 18.1 percent of total corporate income tax revenues, or 0.4 percent of GDP.[15]

14. Peláez and Olmos (2012).
15. DGI (2012).

Empirical Approach and Data

A growing literature empirically examines the effect of incentives to promote investment and exports for developing countries, using different impact evaluation methodologies.[16] In general, difference-in-differences and matching techniques are frequently used in the empirical literature. If there are differences a priori between the treatment and control groups, impact evaluation analysis is complemented with matching techniques for robustness. Also, some empirical studies combine both techniques and use the matching difference-in-differences estimator, comparing the change in the outcome variable before and after the policy, between firms that participated and the paired firms that did not participate in the program.

Empirical Strategy

To assess the effectiveness of incentives to promote investment, the essential problem is that we cannot observe the counterfactual outcomes for beneficiary firms had they not participated in the program. It is possible to approximate this result by constructing an appropriate counterfactual that reflects how participants (that is, treated firms under the investment promotion law regulated by ED-455) would have performed in the absence of the treatment.

One way to compute the impact of the program is by combining difference-in-differences (DID) and propensity score matching (PSM) techniques.[17] The DID method consists in comparing results between beneficiary firms (treatment group) and nonbeneficiary firms (control group) before and after policy implementation. The main idea is to use repeated observations of firms to control for unobserved and time-invariant characteristics correlated with both participation in investment promotion benefits and investment performance.[18] The key identifying assumption of the DID method is that investment trends would be the same for both groups in the absence of the treatment. In turn, the PSM method is used to select a control group of firms similar to the treatment group on the basis of observable characteristics.

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16. In particular, impact evaluation techniques have been used to explore the effect of export promotion in developing countries (Volpe and Carballo 2010a, 2010b; Volpe, Carballo, and García 2012), the impact of tax incentives on innovation and performance (Benavente, Crespi, and Maffioli 2007; Castillo and others 2011), and the effect of fiscal incentives on investment in research and development (Bérubé and Mohnen 2007; Carboni 2008; Bronzini and Iachini 2011).

17. Volpe and Carballo (2008); Castillo and others (2011).

18. Angrist and Krueger (1999).

ECONOMETRIC MODELING. Formally, let D_{it} be a binary variable that gives information about treatment by ED-455. Since ED-455 changes the rules of investment decisions, firms' behavior could have been modified after they qualified for the investment promotion scheme. In this sense, an accurate definition of D_{it} is that D takes the value of one for each beneficiary firm from the year it began receiving benefits from the policy through the end of the period under analysis, and zero otherwise. Under this specification, the associated coefficient estimates the overall impact of the regime in the entire period that it was in force (see equations 3 and 4 below). We then modified the treatment specification to account for different effects of the policy over time.

We consider 2008 as the year of implementation of the regime. Although the law was approved in December 2007, all projects were approved for tax benefits in 2008 or later. Therefore, 2007 is not considered a treatment year.

Finally, since one of the main objectives of the investment promotion policy was to improve capital investment and employment, we explore the effects on both the investment rate and the employment growth rate.

Assuming that unobserved heterogeneity is constant over time, some types of potential selection biases can be mitigated using a fixed-effects model. More precisely, we start from the following specification:

$$(1) \qquad Y_{it} = \mathbf{X}_{it}\theta + \beta D_{it} + \alpha_i + \gamma_t + \varepsilon_{it},$$

where Y_{it} represents either the investment rate, approximated by the difference (in logs) in fixed assets (capital stock growth) at constant prices, or the employment growth rate, approximated by the difference (in logs) in aggregate employment for each firm.[19] Coefficient β is the parameter of interest and would provide an unbiased estimate of the overall effect of the tax incentive regime if D_{it} is not correlated with the error term ε_{it} (that is, if there are no omitted variables that are correlated with both the treatment variable and the dependent variable). Coefficient α_i reflects unobservable firm fixed effects, and γ_t controls for year common effects (such as annual macroeconomic effects). Finally, a set of covariates $\mathbf{X}_{it}$ controls for firms' observable characteristics before the policy implementation. Control variables such as interactions between sectors and years were included.

19. Fixed assets correspond to assets declared by firms to the tax authority every year. The assets reported are revalued and netted to account for accumulated depreciation. For estimations at constant prices, we use the national producer price index, which is used by the tax authority to calculate real assets. Although export promotion was an explicit objective of the ED-455, it was not possible to perform the impact evaluation on this variable. In the database, only the amount of exports in intervals was available, so we could not identify the potential effects for each firm.

Under the assumption that unobservable firm heterogeneity is time invariant, the fixed-effects model in equation 1 gives a consistent estimate of the effect of the policy. Nonetheless, bias could exist if the constant unobservable heterogeneity assumption does not hold; that is, beneficiary and nonbeneficiary firms might be highly heterogeneous and could differ in unobservable time-variant components. Moreover, introducing linearity in covariates could lead to a misspecification of the model.[20]

The matching difference-in-differences method allows us to reduce this problem by estimating fixed effects on a common support. Treated and untreated firms are similar in their observable characteristics and in the trend of the outcome variable before policy implementation. The common support is obtained through the propensity score matching estimator, $P(\mathbf{X}_i) = P(D_i = 1 \mid \mathbf{X}_i)$.[21] It indicates the propensity for a firm to be approved for promotion under ED-455 based on a set of observable characteristics before the implementation of the policy. In our model, these observable characteristics are as follows: fixed assets (in logs); total employment (in logs); productivity (in logs); variation of fixed assets, employment, and productivity between 2006 and 2007; and a dummy variable reflecting whether the firm is an exporter before the policy. We took into account the Hirano-Imbens-Ridder approach by weighting units in the control group according to a propensity score (with weights defined as one for treated firms and

$$\frac{\hat{P}(\mathbf{X})}{1 - \hat{P}(\mathbf{X})}$$

for control firms).[22]

The matching difference-in-differences method generates consistent estimates of the impact of the policy under the assumption that there are no unobservable time-varying effects that influence both the selection for treatment and the outcome variable.[23] Formally, the equation is given by

(2) $$Y_{it} = \beta D_{it} + \alpha_i + \gamma_t + \varepsilon_{it}.$$

20. See Blundell, Dearden, and Sianesi (2004); Imbens and Wooldridge (2008).
21. The common support condition implies that only nonbeneficiary firms with a similar participation probability $P(\mathbf{X})$ relative to beneficiary firms were considered.
22. Hirano, Imbens, and Ridder (2003).
23. See Blundell and Costa Dias (2009).

Equation 2 is estimated on the common support performed in a previous step, with a weighted sample as proposed by Hirano, Imbens, and Ridder.[24]

We estimated an additional specification to measure the dynamics of the impacts. While all firms were eligible to submit an investment project for promotion under ED-455, in practice, firms that submitted projects were approved in different years of the period of analysis. The above specifications capture an overall effect, but they do not take into account that the policy might have different effects over time.[25]

The following additional equation was specified for the fixed-effects model using the investment rate and employment growth rate as outcome variables:

(3)
$$Y_{it} = \sum_{j=1}^{k} \beta_j D_{it}^j + \alpha_i + \gamma_t + \varepsilon_{it},$$

where D_{it}^j takes a value of one for the jth year of effective promotion. For instance, D_{it}^1 takes a value of one in the first year that a firm had an approved project, D_{it}^2 takes a value of one in the second year, and so forth, where each variable represents the total effect of each year.

Given that we analyze a four-year period after the policy was put in place, we assume that most of the firms continue to follow their promotion timeline. The change in the signs or values of the time dummy variables for different periods will essentially capture changes in the investment decisions of firms still receiving the treatment. Although we do not have information on the exact timeline of each project, we do know that two-thirds of promoted firms have a timeline of more than five years, and the other third presented projects with a three- to five-year implementation period. According to interviews with policy implementers, the majority in the second group have a five-year investment period. Additionally, only 30 percent of the overall potential tax exemption was effectively used between 2008 and 2011.

The fixed-effects model was estimated for the overall economy and disaggregated into three activity sectors: services, commerce, and manufacturing.[26]

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24. Hirano, Imbens, and Ridder (2003).

25. The estimated impacts are mainly short term, since our data only cover the first four years after ED-455 was implemented.

26. Aggregate data are available for the following economic sectors: agriculture, manufacturing, commerce, services, and tourism. Only three were selected for analysis owing to their considerable sample size.

SOME ADDITIONAL MODELING EXTENSIONS AND ROBUSTNESS TESTS. A first concern is about the self-selection of firms that obtained the tax credit. Unfortunately, we do not have information on firms that applied but were not approved for the benefits (which at any rate did not happen frequently). Consequently, the set of estimations described above compares firms that received the tax credit against a comparable set of firms that did not, using the matched difference-in-differences approach. To check for self-selection of firms in applying for tax credits, we performed another set of estimations restricting the sample to firms that self-select in either of the existing mechanisms of promotion, namely, ED-455 or the Exemption for Investment. In this way, we built a counterfactual considering only firms that may have had a certain propensity to invest, as they obtained at least one of the existing mechanisms of investment promotion.

A second concern is that the impact of ED-455 may vary depending on the size of the investment project. As shown in table 1, projects ranged from less than US$400,000 to over US$800,000,000, so potentially heterogeneous effects may arise. To assess this source of heterogeneity, we modified the treatment variable to consider the size of the project.

Last, beneficiary firms could behave strategically by slowing their investment in the years before they receive their investment promotion benefits. If this strategic behavior takes place, the chosen specification could overestimate the true impact. We tested this possibility by running a falsification test in which the promotion takes place in a previous year than the actual one; we found no significant effect. The falsification tests were also performed to assess the validity of the results under the assumption of no selection on observables from the standard specification of equation 2.

Data and Descriptive Statistics

Our data set consists of two databases that are novel in Uruguay and the region. The first is an administrative database with sworn statements of firms that paid corporate income taxes to the National Tax Agency (DGI) in 2005 to 2011.[27] The second comprises administrative data from the Social Security Bank (BPS) on employment and remunerations for a set of firms, which we

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27. The DGI database contains annual firm-level data on revenues, costs, accounting and fiscal results, fixed and total assets, taxes, sector of activity, year(s) in which the firm was promoted under the ED-455 regime, the effective benefit received through the program, and other benefits to investment, and so forth.

T A B L E   3 .   Balance Indicators before and after Matching at the Baseline[a]

Variable	Mean		Bias (%)	Bias reduction (%)	t test	
	Treatment	Control			t	$P > \lvert t \rvert$
Fixed assets						
Unmatched	16.71	13.67	144.20		52.01	0.00
Matched	16.71	16.76	−2.80	98.10	−0.73	0.47
Employment						
Unmatched	3.89	2.13	143.20		56.20	0.00
Matched	3.89	3.87	1.50	99.00	0.37	0.71
Productivity						
Unmatched	11.63	11.08	90.80		32.15	0.00
Matched	11.63	11.63	0.20	99.80	0.05	0.96
Fixed-asset growth						
Unmatched	0.05	−0.01	16.00		5.47	0.00
Matched	0.05	0.04	1.90	88.40	0.53	0.60
Employment growth						
Unmatched	0.14	0.09	16.90		5.87	0.00
Matched	0.14	0.14	−1.70	90.10	−0.41	0.69
Productivity growth						
Unmatched	0.23	0.26	−11.10		−3.94	0.00
Matched	0.23	0.22	1.60	85.70	0.44	0.66
Export						
Unmatched	0.51	0.15	83.00		34.99	0.00
Matched	0.51	0.50	3.20	96.10	0.77	0.44

Source: Authors' calculations, based on DGI and BPS data.

a. Fixed assets, total employment, and productivity are expressed in logarithms. The growth estimates are calculated with the variables in logarithms. The data correspond to the period before the policy (2006 and 2007).

used to perform the PSM. The two databases were merged at the firm level for the same period (2005–11).[28]

Only firms with information for the years before the policy implementation and with records in both databases in all years were considered. New firms (created after 2007) were not included.

Table 3 presents the matching estimation results for the period before the policy implementation (2006 and 2007). It shows results for the variables used in the propensity score and balance indicators between promoted and not

28. We assume that the selection bias that may arise by considering firms that pay both corporate taxes and BPS social security should not be important. The vast majority of taxpaying firms also pay social security to the BPS. The only exceptions are financial services and independent professionals, which contribute to other social security systems, but these were not eligible to receive benefits from ED-455. Most of the firms that benefited from the investment promotion regime are in manufacturing, commerce, tourism, and other services sectors, all of which contribute to the BPS system.

T A B L E 4 . Descriptive Statistics for All Firms and by Economic Sector: Matched Sample[a]

Variable	Total		Manufacturing		Commerce		Services	
	Treatment	Control	Treatment	Control	Treatment	Control	Treatment	Control
Fixed assets	16.71	16.76	17.40	17.37	15.81	15.58	16.76	17.27
Total employment	3.89	3.87	4.33	4.30	3.52	3.32	3.73	3.98
Productivity	11.63	11.63	11.70	11.67	11.55	11.41	11.70	11.68
Fixed-asset growth	0.05	0.04	0.05	0.03	0.06	0.04	0.03	0.07
Employment growth	0.14	0.14	0.14	0.15	0.14	0.12	0.15	0.17
Productivity growth	0.23	0.22	0.21	0.21	0.25	0.24	0.21	0.23
Exports	0.51	0.50	0.76	0.75	0.46	0.36	0.20	0.25
No. firms	705	8,096	281	1,879	237	3,817	151	1,402

Source: Authors' calculations, based on DGI and BPS data.
   a.   Fixed assets, total employment, and productivity are expressed in logarithms. The growth estimates are calculated with the variables in logarithms. The data correspond to the period before the policy (2006 and 2007).

promoted firms. As the table shows, the matched sample is balanced, considering a set of relevant observable characteristics.[29] The kernel density of the propensity score in the common support is presented in figure A1.

The final database included 8,801 firms, of which 705 were promoted. Table 4 shows firm characteristics in terms of key variables for the total sample and by three economic sectors (services, commerce, and manufacturing) and for treated and control groups, considering the matched sample. After performing the matching, we find no substantial mean differences in key variables between treated and control firms in the total sample and by sector of activity.

Figure 2 illustrates the composition of promoted firms by year and by the amount of time since they were granted the investment promotion benefits (considering observations in the common support). A total of 117 firms received benefits in 2008 (the first year of implementation of ED-455). The number of promoted firms increased gradually along the period, reaching a total of 705 firms in 2011. In the last year considered, 22.8 percent of firms were in their first year of the program (161 firms), 36.5 percent in their second year, 24.1 percent in their third year, and 16.6 percent in their fourth year (117 firms).

Figure 3 displays the investment rate (panel A) and the employment growth rate (panel B) for treated and control groups of firms (considering the total sample and the common support, weighted to guarantee an accurate balance in observable characteristics). As observed, the gap in the investment rate

29. See also the summarized indicators of balanced testing in appendix table A1.

F I G U R E 2 .   Number of Promoted Firms by Year and Time in the Program: Common Support Region
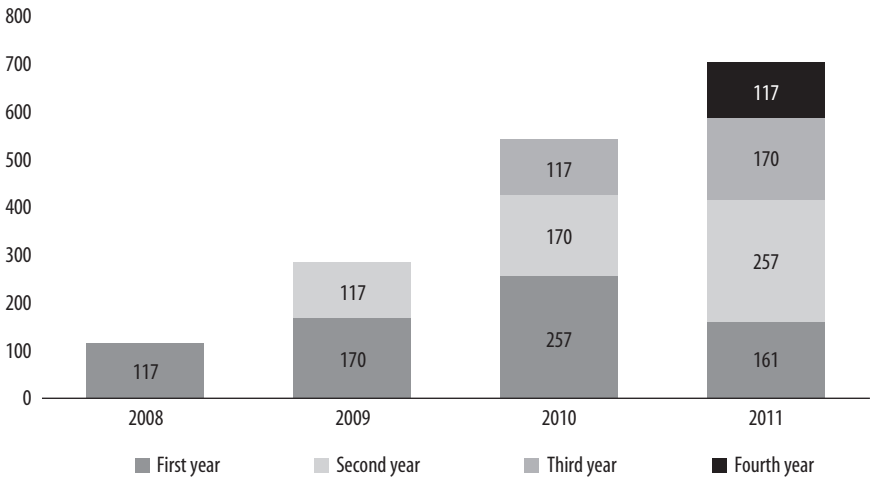
Source: Authors' calculations, based on DGI and BPS data.

F I G U R E 3 .   Investment Rate and Employment Growth Rate for Treated and Control Firms: Common Support[a]
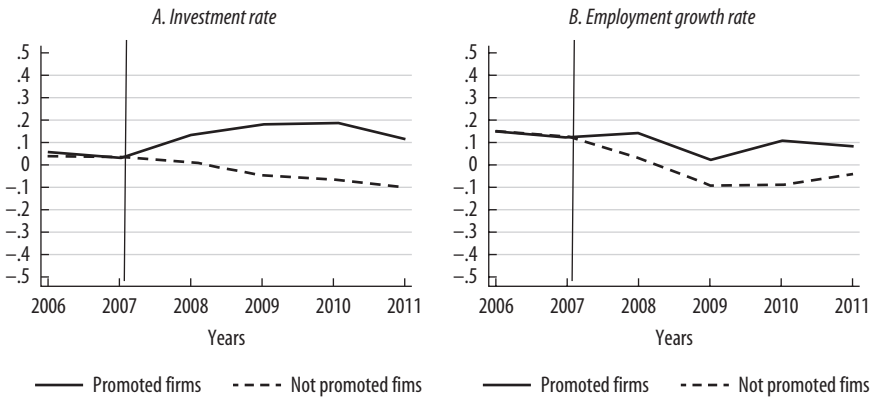
Source: Authors' calculations, based on DGI and BPS data.
a. Control firms were reweighted by [p(x)/1−p(x)].

and in the employment growth rate between the two groups expanded after policy implementation.

Main Results

This section presents the results of the estimated impact of ED-455 on the investment rate and the employment growth rate, both the effect for all promoted firms and the sectoral effects within the main sectors (that is, manufacturing, commerce, and services). While ED-455 does not select economic sectors ex ante, it does select them ex post, based on the goals set to obtain the benefit. Since sectors have different intensities in the activities awarded, this could lead to an ex post selective policy. This section is divided into three subsections. First we present the overall results on investment and employment. Then we present differential impacts related to the elapsed time since the promotion. Finally, we present some extensions and robustness checks of the results.

Overall Effect on the Investment Rate and Employment Growth Rate

This section shows the estimates for the impact of ED-455 on investment and employment based on the specified models in equation 2. We are interested in those outcomes in particular because they include the very purpose of the project (to prop up investment) and the second leading goal (to create jobs). Third-level objectives explain the shape of the projects' merit assessment. For all the estimations, a sample of promotion beneficiaries confronts a control group meant to provide a comparable group of untreated firms (that is, firms that did not receive benefits from the ED-455 regime). Table 5 presents the effects of the ED-455 considering the fixed-effects model for both the investment rate and the employment growth rate for the overall economy and for the manufacturing, commerce, and services sectors. The first two columns show the estimates for the overall economy considering two alternative specifications: time dummy variables and interactions accounting for different timing effects within the economic sectors. The remaining columns show results for the manufacturing, commerce, and services sectors, respectively.[30]

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30. We also considered interactions between the time dummy variables, γ_t, and dummy variables for each sector (agriculture, manufacturing, commerce, services, and tourism).

TABLE 5. **Investment and Employment Impact Estimates: Full Sample and Sectoral Breakdown**[a]

Dependent and explanatory variable	Full sample		Manufacturing	Commerce	Services
	FE (1)	FE (2)	FE (1)	FE (1)	FE (1)
Dependent variable: Investment rate					
DID	0.115***	0.115***	0.086***	0.147***	0.162***
	(0.025)	(0.025)	(0.030)	(0.046)	(0.055)
No. observations	44,005	44,005	10,800	20,270	7,765
Dependent variable: Employment growth rate					
DID	0.053*	0.053*	0.072**	0.044*	0.057
	(0.028)	(0.028)	(0.033)	(0.024)	(0.087)
No. observations	43,982	43,982	10,793	20,266	7,759
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Time dummy variables	Yes	Yes	Yes	Yes	Yes
Sector*time dummy variables	No	Yes	No	No	No

Source: Authors' calculations, based on DGI and BPS data.
* Statistically significant at the 10 percent level.
** Statistically significant at the 5 percent level.
*** Statistically significant at the 1 percent level.
a. The dependent variable is the investment rate or the employment growth rate, as indicated. The regressions are estimated using a fixed-effects model, where FE(1) is the baseline specification and FE(2) includes an interaction of sector and time dummies. Robust standard errors are in parentheses.

The overall effect of the policy on the investment rate is significant and positive in the whole period and does not differ significantly between the two specifications considered for the full sample. Receiving the investment promotion benefits under ED-455 is associated with an investment rate increase of 11.5 percent. In other words, ED-455 increased capital accumulation by around 11.5 percent, on average, in the five years after the policy was implemented.

The overall estimated effect of the policy on investment rate is also positive and significant within each of the main sectors (namely, manufacturing, commerce, and services). The estimated effect on firms in the commerce and services sectors is higher than the global effect, at around 14.7 percent for the former and 16.2 percent for the latter. The lowest estimated impact, however, is in the manufacturing sector, with an increase of around 8.6 percent.

ED-455 also had a positive and significant impact on the employment growth rate (see table 5). In fact, the investment promotion policy increased the employment growth rate by 5.3 percent in the period. When this effect is disaggregated by the economic sector, we find that the manufacturing sector experienced the highest increase in employment growth rate, at around 7.2 percent, while the services sector recorded no significant impact.

Regarding the effect on employment outcomes, the positive effect may include the formalization of employment, in addition to net employment growth. That is, if prior to applying for the ED-455 program, firms employed some fraction of informal workers, they would have an incentive to formalize these workers to achieve the employment growth objective. If this was case, the effect of the policy would be an improvement in the quality of employment (that is, creating more formal jobs) rather than job creation. Unfortunately, we do not have additional information to account for these effects separately.

The Timing of the Effect

In this section, we analyze whether there is a differential effect of the policy over time, since it could be expected that firms would behave differently immediately after obtaining the benefit than several years later. Given the heterogeneity in the duration of the treatment within the promoted firms in these years, this analysis is relevant for assessing the longer-term impacts.

The results shown in table 6 indicate that the effect on the investment rate is positive and decreases progressively over time. In particular, it is positive for the first two years and null (not statistically significant) in the third and fourth years for the whole sample of promoted firms. The annual effect is substantially higher in the first year, implying around a 15 percent increase in the investment rate due to the policy, but it decreases by more than half in the second year. The analysis by economic sector shows that only in the services sector does ED-455 have a significant positive impact on the investment rate in both the first and the second year after the promotion (an increase of 19.2 percent and 11.4 percent, respectively), whereas the positive effect is totally captured in the first year in the manufacturing and commerce sectors.

ED-455 seems to have a similar temporal pattern on employment outcome. Table 6 shows that there is a significant positive effect on the employment growth rate mainly in the first year after the firm receives the tax benefit. The impact is positive, both for all firms and by sector. In the first and second year, the increase in the employment rate is around 5.3 percent (column 2) and zero thereafter. The commerce sector has a similar increase (5.6 percent in the first year), while the manufacturing sector has the largest estimated effect (8 percent in the first year). No significant effects on the employment growth rate were found for the services sector.

The results showing positive impacts on the investment and employment growth rates mainly in the first year, with no effects afterward, are expected

T A B L E 6. Temporal Pattern of Investment and Employment Impacts: Full Sample and Sectoral Breakdown[a]

Dependent and explanatory variable	Full sample		Manufacturing	Commerce	Services
	FE (1)	FE (2)	FE (1)	FE (1)	FE (1)
Dependent variable: Investment rate					
DID 1st year	0.151***	0.151***	0.117***	0.195***	0.192***
	(0.027)	(0.027)	(0.030)	(0.051)	(0.058)
DID 2nd year	0.060**	0.059**	0.048	0.057	0.114*
	(0.030)	(0.030)	(0.041)	(0.050)	(0.069)
DID 3rd year	0.000	0.000	0.005	−0.040	0.086
	(0.036)	(0.035)	(0.045)	(0.066)	(0.088)
DID 4th year	−0.032	−0.030	−0.019	−0.067	0.032
	(0.043)	(0.043)	(0.059)	(0.071)	(0.109)
No. observations	44,005	44,005	10,800	20,270	7,765
Dependent variable: Employment growth rate					
DID 1st year	0.054*	0.053*	0.080***	0.056**	0.020
	(0.029)	(0.029)	(0.031)	(0.028)	(0.095)
DID 2nd year	0.051	0.053*	0.058	0.016	0.121
	(0.032)	(0.032)	(0.039)	(0.026)	(0.099)
DID 3rd year	0.045	0.047	0.063	0.025	0.101
	(0.044)	(0.042)	(0.052)	(0.031)	(0.131)
DID 4th year	−0.005	−0.003	0.039	−0.055	0.004
	(0.050)	(0.050)	(0.067)	(0.042)	(0.153)
No. observations	43,982	43,982	10,793	20,266	7,759
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Time dummy variables	Yes	Yes	Yes	Yes	Yes
Sector*time dummy variables	No	Yes	No	No	No

Source: Authors' calculations, based on DGI and BPS data.
* Statistically significant at the 10 percent level.
** Statistically significant at the 5 percent level.
*** Statistically significant at the 1 percent level.
a. The dependent variable is the investment rate or the employment growth rate, as indicated. The regressions are estimated using a fixed-effects model, where FE(1) is the baseline specification and FE(2) includes an interaction of sector and time dummies. Robust standard errors are in parentheses. Tests of significance of the coefficients are presented in table A2 in the appendix.

given the policy design. They imply a permanent shock to both capital stocks and formal employment levels.

Robustness Checks and Extensions

We performed a set of robustness checks for the estimates to assess the reliability of the results, as described in the previous section.

FALSIFICATION TEST.   The purpose of the placebo test is to assess the trend of the change in investment performance between promoted and nonpromoted firms before and after the policy. We designed placebo tests in which the intervention took place in a previous year than when the firm was actually

T A B L E 7 . Placebo Test: General Effects[a]

Dependent and explanatory variable	Placebo (1)		Placebo (2)		Placebo (3)	
	FE (1)	FE (2)	FE (1)	FE (2)	FE (1)	FE (2)
Dependent variable: Investment rate						
DID	−0.023	−0.024	−0.019	−0.019	−0.023	−0.024
	(0.050)	(0.050)	(0.032)	(0.032)	(0.029)	(0.029)
Total observations	17,425	17,425	17,425	17,425	17,425	17,425
Dependent variable: Employment growth rate						
DID	0.031	0.037	0.037	0.045	−0.002	−0.005
	(0.039)	(0.038)	(0.036)	(0.034)	(0.043)	(0.043)
Total observations	17,598	17,598	17,598	17,598	17,598	17,598
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time dummy variables	Yes	Yes	Yes	Yes	Yes	Yes
Sector*time dummy variables	No	Yes	No	Yes	No	Yes

Source: Authors' calculations, based on DGI and BPS data.
* Statistically significant at the 10 percent level.
** Statistically significant at the 5 percent level.
*** Statistically significant at the 1 percent level.
a. The dependent variable is the investment rate or the employment growth rate, as indicated. The regressions are estimated using a fixed-effects model, where FE(1) is the baseline specification and FE(2) includes an interaction of sector and time dummies. Placebo (1) defines as promoted firms in 2007 those firms promoted in 2008. Placebo (2) defines as promoted firms in 2007 those firms promoted in 2008 and 2009. Placebo (3) defines as promoted firms in 2007 those firms promoted at any time in the period. Robust standard errors are in parentheses.

approved for the investment promotion benefits. We applied the test to the following groups: firms that were treated in 2008, firms that were treated in 2008 and 2009, and firms that were treated sometime in the period 2008–11. The falsification test was performed with the investment rate and the employment growth rate as dependent variables.

As shown in table 7, the coefficient associated with the dummy variable that identifies treated firms before the policy implementation for the different placebo specifications is not statistically significant for either the investment or employment outcomes. This means that matched treated and control groups did not differ in terms of the investment or employment growth rates before ED-455.

SOME ADDITIONAL EXTENSIONS: THE TREATMENT EFFECT IN FIRMS THAT RECEIVED ANY INCENTIVE TO INVESTMENT.   In this section, we show the results of a set of estimations where we restrict the sample to firms that received either of the two most important tax incentive mechanisms: the benefits from ED-455 or the Exemption for Investment described earlier. Although the two programs are very different, they could give rise to a common confounder (perhaps an unobservable tendency among some firms to apply for any available tax benefit), since firms that participate frequently in any of the promotion programs are generally characterized by high investment and employment

T A B L E 8 .   Investment Impact Estimates: Firms That Received Any Tax Benefit[a]

	General effect		Effect by year	
Explanatory variable	FE (1)	FE (2)	FE (1)	FE (2)
DID	0.105***	0.106***		
	(0.025)	(0.025)		
DID 1st year			0.139***	0.142***
			(0.026)	(0.027)
DID 2nd year			0,.053*	0.052*
			(0.030)	(0.030)
DID 3rd year			−0.009	−0.008
			(0.036)	(0.035)
DID 4th year			−0.043	−0.041
			(0.043)	(0.043)
No. observations	12,515	12,510	12,515	12,510
Firm fixed effects	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes
Sector*time dummies	No	Yes	No	Yes

Source: Authors' calculations, based on DGI and BPS data.
   * Statistically significant at the 10 percent level.
   ** Statistically significant at the 5 percent level.
   *** Statistically significant at the 1 percent level.
   a. The dependent variable is the investment rate. The regressions are estimated using a fixed-effects model, where FE(1) is the baseline specification and FE(2) includes an interaction of sector and time dummies. Robust standard errors are in parentheses.

growth. For these reasons, we undertook additional estimations to assess the robustness of our main findings.

To perform this additional set of estimations, we restricted the sample to firms that received benefits from any available tax benefit. Treated firms are again defined as firms that received benefits from ED-455, whereas a comparable control group of firms that received benefits from the Exemption for Investment was rebuilt by obtaining a new common support through the propensity score matching estimator.

The results can be read as the effect of receiving ED-455 benefits on the investment and employment growth rates among firms that demonstrate a high propensity to invest. Tables 8 and 9 show the results of these estimations for the investment rate and the employment growth rate, respectively. The estimated impact of ED-455 on the investment rate is slightly lower than our baseline estimation (10.5 percent), and it is also totally captured in the first two years, mostly in the first year of promotion.

The fact that our impact estimates on the investment rate are very similar to our baseline estimation (only one percentage point lower in the case of the point estimate when we restrict the comparison to firms that obtained benefits from the Exemption for Investment) reinforces the positive impact of ED-455

T A B L E   9 .   Employment Impact Estimates: Firms That Received Any Tax Benefit[a]

Explanatory variable	General effects		Effect by year	
	FE (1)	FE (2)	FE (1)	FE (2)
DID	0.0373	0.0381		
	(0.0274)	(0.0279)		
DID 1st year			0.0413	0.0421
			(0.0281)	(0.0293)
DID 2nd year			0.0296	0.0306
			(0.0316)	(0.0311)
DID 3rd year			0.0217	0.0210
			(0.0425)	(0.0414)
DID 4th year			−0.0283	−0.0281
			(0.0490)	(0.0479)
No. observations	12,515	12,510	12,515	12,510
Firm fixed effects	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes
Sector*time dummies	No	Yes	No	Yes

Source: Authors' calculations, based on DGI and BPS data.
  * Statistically significant at the 10 percent level.
  ** Statistically significant at the 5 percent level.
  *** Statistically significant at the 1 percent level.
  a. The dependent variable is the employment growth rate. The regressions are estimated using a fixed-effects model, where FE(1) is the baseline specification and FE(2) includes an interaction of sector and time dummies. Robust standard errors are in parentheses.

on the investment rate, taking into account the possible self-selection bias of firms that are benefit-seekers when deciding to invest. These results do not allow us to draw valid conclusions about the effectiveness of the Exemption for Investment, which would require a series of additional estimations that would detract from our main focus.

In the case of the employment growth rate, the overall effect of the policy is still positive but not statistically significant (see table 9). So the evidence does not allow us to conclude that there is a positive effect of ED-455 on the employment growth rate in this subsample. This result introduces some ambiguity about the effectiveness of ED-455 in terms of employment outcomes, one of the main policy goals besides investment. Further research is needed to identify the design elements of the policy that may be inducing this behavior.

SOME ADDITIONAL EXTENSIONS: DIFFERENTIAL EFFECTS CONSIDERING THE NUMBER AND SIZE OF PROMOTED PROJECTS.   The impact of ED-455 on the investment rate could potentially vary depending on the size of the promoted project— in other words, depending on the intensity of the treatment. Table 10 presents the results of estimates measuring the intensity of the treatment through

TABLE 10. Intensity of the Treatment: Number and Size of Promoted Projects[a]

	Number of projects		Size of projects	
Explanatory variable	FE (1)	FE (2)	FE (1)	FE (2)
One project	0.118***	0.119***		
	(0.0306)	(0.0307)		
Two projects	0.0888***	0.0891***		
	(0.0323)	(0.0325)		
Three or four projects	0.151***	0.143***		
	(0.0446)	(0.0450)		
Five or more projects	0.0868	0.0737		
	(0.0768)	(0.0783)		
DID (Small)			0.090**	0.088**
			(0.039)	(0.039)
DID (Medium)			0.172***	0.172***
			(0.031)	(0.031)
DID (Large)			0.033	0.039
			(0.039)	(0.039)
No. observations	44,005	43,955	44,002	44,002
Firm fixed effects	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes
Sector*time dummies	No	Yes	No	Yes

Source: Authors' calculations, based on DGI and BPS data.
* Statistically significant at the 10 percent level.
** Statistically significant at the 5 percent level.
*** Statistically significant at the 1 percent level.
a. The dependent variable is the investment rate. The regressions are estimated using a fixed-effects model, where FE(1) is the baseline specification and FE(2) includes an interaction of sector and time dummies. For the number of projects, the treatment variable is a categorical variable that counts the number of promoted projects. For size, the treatment variable is a categorical variable identifying the size of the projects (small, medium, large). Robust standard errors are in parentheses.

either the number of promoted projects for each firm or the average size of all the promoted projects for a given firm. The estimates show that the policy has significant positive effects for firms with either one, two, or three promoted investment projects, and the effect does not differ significantly among categories.[31] With regard to size, ED-455 has positive effects for small and medium-sized projects, with a significantly larger effect for medium-sized projects. However, we do not find significant effects for large projects, even though they could potentially receive higher benefits (that is, the investment exemption is higher). This result may be related to the fact that large investments tend to have a longer project timeline, and our focus is on the first four years of policy implementation. A longer-term analysis is necessary to fully assess the impact of the policy for large and long-term investment projects.

31. The corresponding tests were performed considering the confidence intervals.

Evidence on Policy Efficiency

Although the focus of this article is on the tax credit's effectiveness (that is, whether the mechanism has expanded investment), its efficiency must also be taken into account in any decision on whether to consider the program. If the subsidies granted through the tax credit are greater than the additional investments induced, or if there are less expensive ways of delivering a similar subsidy to a similar group of beneficiaries, then there would be net losses to society, and the policy would need to be reformulated or abandoned.

As shown earlier, the average effect of the treatment on the treated firms represents an increase in the investment rate of around 10.5–11.5 percent. Peláez and Olmos estimate that the situation before and after the treatment involves a reduction in the corporate income tax burden of about 21 percent.[32] Therefore, the elasticity of the investment rate to changes in the tax burden would be about –0.6. Because elasticities below 1.0 in absolute value tend to be considered low, the estimates imply a medium to low policy effectiveness. These elasticities amount to saying that investment responds sluggishly to changes in the corporate income tax burden.

The economic justification for investment incentives should also take into account the costs of the policy. James proposes a simple accounting tool to detect and quantify the efficiency or inefficiencies of a tax credit scheme.[33] There will be absolute efficiency if the additional tax revenue from the greater economic activity that results from the subsidized investments (REV) and the direct social benefits from the additional investment (SOCBENEF) are greater than the fiscal loss from redundant subsidies (REDUND) plus the enforcement, evasion, and management costs of the regime (ADMIN). Synthetically, the efficiency criterion is such that

$$REV + SOCBENEF > REDUND + ADMIN.$$

The terms on the left-hand side of the inequality are notoriously difficult to estimate and involve controversial assumptions about parameters. Instead, a comparison between the direct benefits from additional investments and the direct administrative costs is more feasible and provides an assessment of the efficiencies of interest that does not stray too far from the scope of this article. ADMIN should include the costs of managing the regime, possible

32. Peláez and Olmos (2012).
33. James (2009).

TABLE 11. Some Evidence on Policy Efficiency

Metric	Amount or percent
Tax expenditure in investment promotion regime, 2008–11	US$611,000,000
Credit used to pay back corporate income tax, 2008–11	US$647,000,000
Additional investment (counterfactual), 2008–11	US$1,848,000,000
Tax expenditure/additional investment	33%
Credit used to pay corporate income tax/additional investment	35%

Source: Authors' calculations, based on DGI and BPS data and DGI (2012).

losses related to evasion and avoidance, and the application and reporting costs incurred by firms interested in participating. Although we did not have estimates of those three items, it would seem that they have been comparatively low, in light of the overall design of the mechanism and the socioeconomic and political context in which it was implemented.

Table 11 compares estimates of the lost tax revenue and added investment. The results confirm that the policy as implemented in Uruguay meets a first, very basic efficiency criterion that consists in ensuring that the benefits distributed (among investing firms) are not lower than the costs of implementing (key elements of) the policy.

Concluding Remarks

In this article, we investigated the causal effect on investment and employment of the promotion regime laid out by ED-455. For this purpose, we constructed a novel large data set of administrative records from the National Tax Agency (individual tax returns of firms eligible for the incentive) and the Social Security Bank (firms' payroll records) for the 2005–11 period.

We estimated the global impact of the promotion regime on the investment rate for the whole period, as well as the specific effect over the timeline of the firm's investment project, applying several robustness checks and additional extensions. Based on the results, we conclude that ED-455 has indeed increased the investments of the beneficiary firms on average, relative to what they would have invested in the absence of the regime. Specifically, we find that the regime has had a positive impact on the investment rate of around 10.5–11.5 percent. Effects on the employment growth rate are more ambiguous, as our estimations find positive effects (around 3.7–5.3 percent, on average, in the four years after policy implementation), but they are not significant

when we restrict the sample to firms with a high propensity to participate in investment promotion programs. In addition, part of the positive effect on employment may reflect the formalization of existing jobs rather than net job creation alone.

The positive effects on investment are temporary, at most lasting two years after the tax benefits were granted. The fact that the effects on invest-ment are not permanent was predictable insofar as benefits are assigned to projects that have decreasing investment schedules. These projects represent a shock to the stock variable, fixed assets. The finding that the effects on investment are predominantly short term is in line with similar findings, such as the short-term effects of mechanisms such as grants and loans on innovation investments.[34]

The effects on the investment rate differ by sector, with a larger effect in the services sector than in manufacturing and commerce. Nevertheless, positive impacts in all sectors suggest that a wide range of firms could take advantage of the incentive.

The analysis has some limitations. First, there is no information on firms that submitted a project but were not awarded the benefits, so we were unable to restrict the analysis to firms that applied for the tax credit; however, robust-ness checks reinforced the results of our baseline estimations. Second, there are relatively few observations before the policy intervention. With a larger sample, we could better assess the common-trend assumption before the pol-icy implementation. Finally, a third limitation is the exclusion of new firms that were created after the implementation of ED-455. The applied method-ology comparing beneficiary and nonbeneficiary firms before and after the policy forced us to exclude those firms from the analysis.

In brief, the investment promotion regime introduced by ED-455 is an appropriate tool for stimulating the accumulation of fixed assets in Uruguay. It has strong economic justifications; and it seems to have the power to modify the speed of capital accumulation in the desired direction. On the other hand, the effects are mostly concentrated in the first year of promo-tion, and we could not find robust effects on employment growth. Future research should explore the design elements of the policy that induce this behavior. Another useful line of research could inform policies by focusing on the specificities of the market and coordination failures justifying the government subsidies.

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34. Crespi and others (2015).

Appendix: Supplemental Figures and Tables

FIGURE A1. Kernel Density of Propensity Score after Reweighting at the Baseline: Common Support
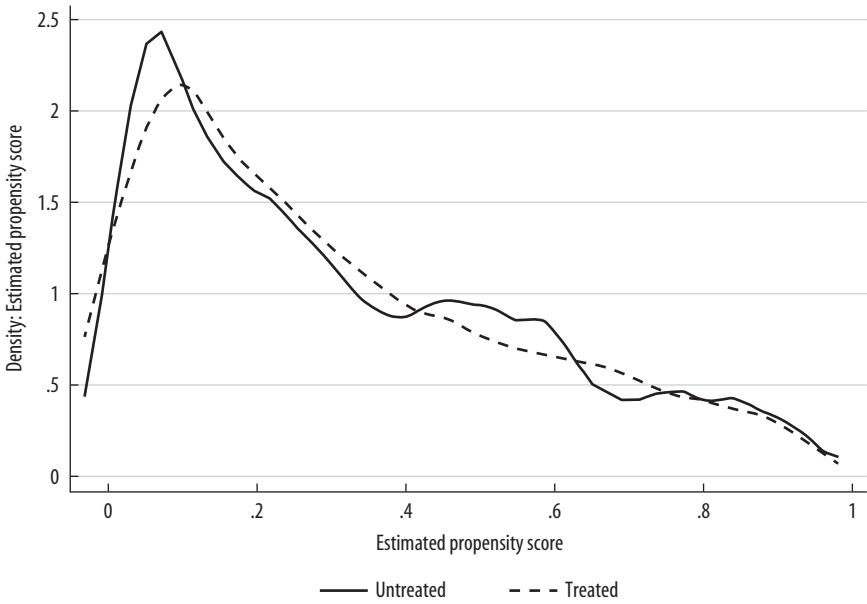
Source: Authors' calculations, based on DGI and BPS data.

TABLE A1. Summarized Indicators before and after Performing Matching at the Baseline

Sample	Pseudo-R^2	Likelihood ratio (χ^2)	$P > \chi^2$	Mean bias	Median bias
Raw	0.307	3,036.24	0.000	72.1	83.0
Matched	0.001	4.20	0.756	1.8	1.7

Source: Authors' calculations, based on DGI and BPS data.

T A B L E A 2 . Tests of Significance of the Coefficients[a]

	Dependent variable	
Sample and model	Investment rate	Employment growth rate
Full sample		
FE (1) model	$F(18, 800) = 12.15$	$F(18, 800) = 0.02$
	Prob $> F = 0.0005$	Prob $> F = 0.8988$
FE (2) model	$F(18, 790) = 13.06$	$F(18, 790) = 0.00$
	Prob $> F = 0.0003$	Prob $> F = 0.9997$
Manufacturing sector		
FE (1) model	$F(12, 159) = 3.94$	$F(12, 159) = 0.92$
	Prob $> F = 0.0474$	Prob $> F = 0.3364$
Commerce sector		
FE (1) model	$F(14, 053) = 8.65$	$F(14, 053) = 2.33$
	Prob $> F = 0.0033$	Prob $> F = 0.1271$
Services sector		
FE (1) model	$F(11, 552) = 1.81$	$F(11, 552) = 1.24$
	Prob $> F = 0.1786$	Prob $> F = 0.2658$

a. Test: DID 1st year = DID 2nd year. The treatment group comprises firms that received the investment promotion benefits.

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