




Impact of the Innovative Entrepreneurship Program in Uruguay

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Abstract

The objective of this research is to evaluate the impact of the Innovative Entrepreneurship instrument, implemented by the National Agency for Research and Innovation (ANII by its Spanish acronym) of Uruguay. This study presents several significant contributions. First, it uses data from innovative start-ups funded between 2008 and 2021, which were compiled into one of the largest databases used for this type of research. As well, an innovative econometric technique is applied that allows to work with unbalanced panels—an especially important aspect when analyzing a program that supports innovative start-ups, for which mortality rate is high—while also estimating the duration of the treatment effect. The findings provide evidence of investment leverage in innovation activities of 195%, indicating that firms supplement public funds with their own resources. Furthermore, it is observed that participation in the program induces persistent changes in the innovative behavior of companies, which persist over time. No impacts were found on the economic performance of companies.

Keywords: entrepreneurship; innovation; impact evaluation; econometrics.

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1. Introduction

In recent decades, innovative start-ups have been recognized as key drivers of economic growth and social transformation. The specialized literature highlights that these initiatives not only generate new products and services, but also energize labor markets, diversify the productive fabric and strengthen the competitiveness of economies (Audretsch, 1995; Acs et al. , 2017; Kantis & Federico, 2014).

Unlike traditional ventures, innovators face two main challenges: a) they operate in highly uncertain environments, and b) they face significant barriers to access financing (Fracica, 2009; Barona & Gómez, 2010). The information asymmetry between entrepreneurs and investors particularly limits access to resources for R&D-intensive activities, a key characteristic of this type of company (Himmelberg & Petersen, 1994; Hall, 2002; Hall & Lerner, 2010). Furthermore, these restrictions are aggravated by the lack of tangible assets that can be used as collateral, and by the perception that R&D investments are high risk and present high sunk costs (Hall et al., 2016).

To overcome these problems, governments have developed specific policies aimed at correcting these market failures. The experience of countries that have successfully promoted the creation and consolidation of innovative companies shows that these barriers can be overcome by strengthening the entrepreneurial ecosystem and providing effective financing alternatives (Lozada, 2022). As highlighted by the Organization for Economic Co-operation and Development (2016), governments play a key role in promoting entrepreneurship and creating conditions conducive to its development and sustainability.

In Uruguay, since 2008 the National Agency for Research and Innovation (ANII) has implemented the Innovative Entrepreneurship

program, which was designed to promote the creation and development of young companies seeking to market innovative products or services.

Through non-experimental quantitative techniques of causal inference, this study aims to evaluate the impact of the public policies implemented by ANII to promote innovative entrepreneurship. Three main hypotheses are proposed: 1) public funding increases investment in innovation-related activities, demonstrating additionality; 2) ANII-supported innovative start-ups show a greater propensity to innovate compared to those that do not receive support; and 3) funded companies achieve higher economic performance than non-funded ones.

This study makes relevant contributions to the literature on the evaluation of public policies supporting innovative entrepreneurship, particularly by building upon and significantly advancing previous assessments of the Innovative Entrepreneurship program in Uruguay. While earlier reports, such as Bukstein et al. (2020), provided valuable initial insights into the program's performance, this manuscript offers a more robust and comprehensive analysis.

Specifically, our work distinguishes itself through two key advancements. First, we leverage an expanded and updated dataset, incorporating information on innovative start-ups funded between 2008 and 2021. In contrast to Bukstein (2020), this study employs an unbalanced panel dataset, which substantially augments the observations and available information for researchers. This extended temporal scope and larger sample size—compiled into one of the most comprehensive databases for this type of research in the region—allow for a more granular and long-term examination of program impacts. Second, and crucially, we apply an innovative econometric approach developed by Liu, Wang, and Xu (2022). This generalized difference-

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in-differences (DID) model is particularly well-suited for evaluating programs with staggered treatment entry and high attrition rates, common characteristics of start-up support initiatives. Unlike methodologies used in previous evaluations, this advanced technique allows us to work effectively with unbalanced panels, estimate heterogeneous treatment effects by cohort or treatment duration, and critically assess whether the effects of public funding persist after the subsidy ends. These methodological enhancements provide a more precise and nuanced understanding of the program's causal impact, offering novel insights beyond prior descriptive or less causally identified analyses.

The paper is structured as follows: Section 2 reviews the literature on public support for innovative entrepreneurship; Section 3 describes ANII's promotion instrument and its theory of change; Section 4 describes the methodology; Section 5 presents the results; Section 6 discusses the findings in relation to existing evidence; and Section 7 concludes with recommendations.

2. Literature review

State intervention through support programs for innovative entrepreneurs is justified by the need to correct market failures that limit the development of innovative activities. High initial costs, the uncertainty inherent in innovation processes, and information asymmetries make it difficult for entrepreneurs to access private financing (Hall & Lerner, 2010; Himmelberg & Petersen, 1994). To address these limitations, governments have implemented specific policies that seek to encourage the creation of innovative companies, promote investment in research and development, and strengthen the competitive capacity of entrepreneurs.

The literature on the effects of public support policies fall under two main categories: 1) studies that analyze instruments aimed at innovative small and medium-sized enterprises (SMEs); and 2) research focused on programs specifically designed for innovative start-ups. Although empirical evidence on the impact of public subsidies on SMEs is abundant, studies evaluating programs aimed exclusively at innovative start-ups are relatively scarce.

A key issue in this field is the debate on crowding-out effects, i. e. whether public support replaces or supplements private investment in innovation. After analyzing a national program in Germany, Czarnitzki and Lopes-Bento (2014) found that subsidies not only do not displace private investment, but rather supplement it, significantly increasing the total investment in innovative activities. Similar results were reported by Aerts and Czarnitzki (2004) and Almus and Czarnitzki (2003) in studies conducted in Belgium and Germany, where subsidies increased R&D activities and improved the innovative performance of beneficiary firms.

In terms of innovative performance, several studies have documented positive impacts. Liu and Ramer (2016) found that regional subsidies to small firms in Germany significantly boosted new product introductions, both at the firm and market levels. In Croatia, Radas et al. (2015) identified increases in sales resulting from innovative products developed thanks to SME support programs. In the United Kingdom,

Foreman-Peck (2012) concluded that companies benefiting from public programs are more likely to innovate compared to those that do not receive support.

Regarding economic impact, Kolling (2015) analyzed the effects of various public subsidies in Germany between 1996 and 2009, reporting positive contributions to employment, wages, productivity and added value. Srhoj et al. (2019a, 2019b) found that in Croatia, subsidies to micro and small businesses improved their chances of survival and access to financing, although the effects on employment and sales were more limited.

Regarding programs specifically targeting innovative start-ups, a prominent example is the Italian Start Up Act, evaluated by Biancalani and Dirk Czarnitzki (2021). This programme has proven to be effective in generating employment and facilitating access to capital for innovative startups in Italy.

In Latin America, the results of support programs for innovative entrepreneurship have been mixed. Goñi and Reyes (2019) and Lozada (2022) identified significant increases in sales for the startups participating in Start-Up Peru. However, Butler (2016) and Verde (2016) did not find significant effects on sales revenue when analyzing the Buenos Aires *Emprende* and Start-Up Chile programs. In Mexico, González et al. (2018) reported that supported innovative start-ups improved their capacity for innovation, but the effects on immediate economic performance were limited. For Uruguay, Bukstein et al. (2020) evaluated the Innovative Entrepreneurs program using a different methodology than the present study. Their results show an impact on investment in innovation activities and innovative behavior. However, they find no evidence of changes in the economic performance of new firms.

3. ANII's support instrument for innovative start-ups

ANII's Innovative Entrepreneurship instrument was launched in 2008, in a context where initiatives to encourage the creation of new companies were limited and recent. Its main objective is to promote the creation and development of emerging or young companies focused on marketing innovative products or services.

In order to access the benefits, startups must meet certain requirements, such as demonstrating the innovative nature of their proposals, the technical and commercial viability of the project, and the commitment of the entrepreneurial team.

Since its implementation, the instrument has evolved in terms of the amounts financed and the execution deadlines. Between 2008 and 2012, the instrument offered non-reimbursable financing of up to 80% of the total cost of projects, with a cap of USD 25,000 and a maximum duration of one year.

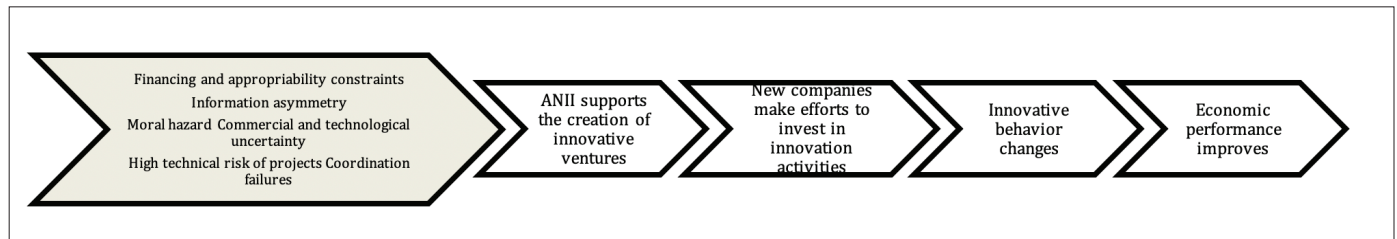
In 2013, a second stage of support was introduced for successfully completed projects, aimed at strengthening the marketing or internationalization of companies. At this stage, an additional amount of USD 45,000 was granted, for a duration of one year.

Since 2021, the instrument offers financing of up to 80% of the total cost of the project, with a maximum amount of USD 70,000 and an execution period of up to two years. In addition, projects linked to climate change or led by women can access funding for 90% of the cost, and the same maximum amount. It is important to note that the start-ups financed under the conditions established in 2021 are not included in the impact evaluation in this study due to the time horizon of the analysis.

Since its creation, the Innovative Entrepreneurship program has financed more than 300 projects, allocating approximately USD 12 million and significantly contributing to the innovation and entrepreneurship ecosystem in Uruguay.

Figure 1 presents the theory of change of the instruments designed by ANII to support the creation of innovative start-ups. The design of these instruments seeks to address various restrictions that hinder the creation and launch of this type of company.

Figure 1: Theory of change of the Innovative Entrepreneurship instruments of ANII



Source: Adapted from Bukstein et al. (2017)

According to the theory of change of the Innovative Entrepreneurship instrument, support policies are expected to generate a positive impact in three main dimensions. First, the effect on investments in R&D and innovation activities is considered. This analysis focuses on identifying whether access to public funds encourages beneficiary companies to increase their own investments in innovation, reflecting a phenomenon of additionality or crowding in, or whether, on the contrary, public funds replace company resources, indicating an effect of displacement or crowding out.

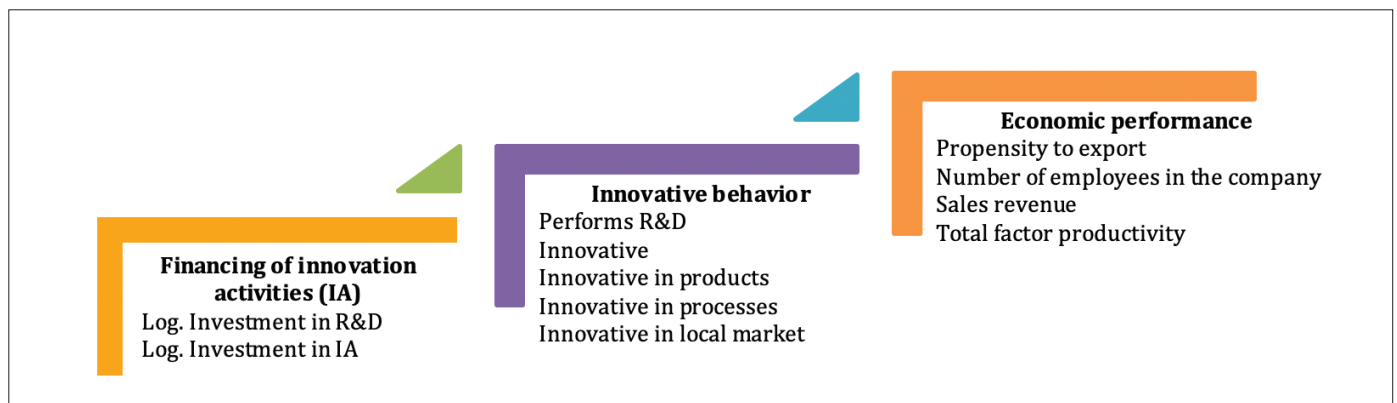
Secondly, it is necessary to assess whether the support received enables new companies to be more innovative. This analysis focuses on the innovative behavior of beneficiary companies. The specific literature indicates that the relevant variables to measure innovative performance are the introduction of innovations in products or processes, the scope of the innovations achieved, and the sales derived from new products.

Finally, innovation activities are not seen as an end, but as a means to promote economic development. It is therefore crucial to analyze whether companies that receive public support perform better in terms of indicators such as productivity, employment and exports, compared to those that do not receive financing.

Based on the above, we evaluate the impact of the instrument based on three hypotheses: that public financing should encourage efforts in efforts in innovation activities; that this increase in efforts should translate into concrete innovation results; and finally, that these innovations should have a positive impact on the economic performance of companies.

Figure 2: operationalizes the theory of change by showing the outcome variables that allow the impact of the instrument to be measured according to a temporal logic, as summarized below.

Figure 2: Impact evaluation outcome variables



Source: Adapted from Bukstein et al. (2017).

4. Methodology

4.1. Sources of information

Three complementary sources of information were used for this evaluation. First, the Innovation Activities Survey (Encuesta de Actividades de Innovación, EAI), whose sample design and field work are carried out by Uruguay's National Statistics Institute of Uruguay (INE by its Spanish acronym). This survey constitutes the main source of information for the construction of national innovation indicators and, according to the criteria of the International Standard Industrial Classification (ISIC) Revision 4, it covers the entire manufacturing industry (section A) and some selected service sectors (sections B, C, D, F, G, H, I).

The sample design used by the INE combines a panel with a refresh sample which allows to obtain longitudinal information on a significant number of companies. In each wave, approximately 2,400 companies are surveyed, which represent around 12,000 firms in the national business landscape.

Secondly, apart from the selected sample, ANII asks the INE to survey a specific group of approximately 1,600 companies that have applied for the institution's programs, regardless of the result of their application. The same EAI questionnaire is applied to both groups of companies, thus ensuring comparability of the data.

Finally, both databases are integrated with ANII's administrative records, incorporating key variables such as application results, the start date of treatment and other ANII support that the company may have received. This combination of sources allows us to construct the treatment and control groups.

The quantitative methodology used in this evaluation makes it possible to take advantage of all the information available on the beneficiary companies from the different editions of INE surveys. The database was built from surveys corresponding to the following periods: 2007-2009, 2010-2012, 2013-2015, 2016-2018 and 2019-2021. For the construction of the database, it is important to consider that surveys are triennial, which implies that whether a company is observed or not, and the number of periods when it is observed, depends in part on the date of signature of their contract with ANII and the dates of the survey's field work.

Based on the available information, a longitudinal or panel database was constructed, given that the same units (in this case, companies) are observed at different points in time. The type of panel used in the evaluation was an unbalanced panel, since observations are not available for all companies in all periods.

First, this is due to the fact that beneficiary companies included in the database receive the ANII subsidy at different points in time: some enter the program later, which generates an uneven distribution in the observations available per company. Furthermore, some beneficiaries sign their contracts after the EAI field work has begun, and therefore the company is not established in time for it to be included

in said edition, which causes it to be observed for the first time several years later. This causes some gaps in data for several companies.

In addition to this, there are several companies that responded to the survey in some periods but then closed and were no longer observed. This phenomenon, known as attrition or sample loss, requires special attention to prevent it from affecting the validity of the analysis.

To correct the possible selection bias derived from attrition, a procedure similar to that proposed by Heckman (1979) was used, calculating the inverse of the Mills ratio for each company-year pair and using this variable in the econometric models detailed in the following section.

4.2. Definitions of treatment group and control group

In any impact evaluation, the construction of both the treatment group and the control group to be used as counterfactual is fundamental to correctly identify the impact of the program. This choice must be made based on the characteristics of the program and the available data.

In this case, the treatment group consists of all companies that have received financing under the Innovative Entrepreneurship instrument in the 2009-2021 period. The control group, which will be used as a counterfactual, is made up of companies that did not receive support, but that share similar observable characteristics with the beneficiaries, that is 1) companies that began their activities in 2008 or later, when the program started to be implemented, and 2) had up to five employees in their starting year.

These companies are identified on the national EAI database, that is, those that make up the sample surveyed by the INE. The idea behind using companies of these characteristics is to have a control group of small companies that are similar in size to those created as a result of the subsidy granted by ANII, and that were created after the entrepreneurship support instrument started to be implemented.

It is important to note that, unlike other evaluations, in this case companies whose applications were rejected cannot be used as controls. This is because those applicants for the ANII subsidy are not companies but individuals who end up opening their business if their proposal is finally accepted. Thus, the companies in the control group are respondents of the EAI surveys that meet the criteria outlined above.

4.3. Econometric model

For the impact evaluation, the approach proposed by Liu, Wang and Xu (2022) was used, implemented in the statistical software R through the *fect* command. This methodology is part of the family of generalized difference-in-differences (DID) models and allows estimating heterogeneous treatment effects by cohort or treatment duration in unbalanced panels, including two-way fixed effects (TWFE) and allowing for interaction between them.

One of the main strengths of this methodology is its ability to correct common problems in impact evaluations, such as the presence of

unobservable factors that vary both over time and between units. In this way, this approach makes it possible to see whether the treatment affects different groups differently and at different times, without assuming a homogeneous impact for each of them. This is especially useful when heterogeneities in treatment exposure time are observed.

In addition, this methodology includes very useful diagnostic tools such as dynamic treatment effects graphs and statistical tests. These resources facilitate the evaluation of the validity of identification assumptions and ensure the reliability of their results.

Furthermore, this methodology solves the problem of negative weights inherent to conventional TWFE models. In practice, the treatment effect estimated using TWFE ends up being a weighted average of the effect of the different units over time. The problem is that when there is a staggered entry into treatment, the first observations often generate a negative weighting, which distorts the results by biasing them downwards. However, the methodology proposed by these authors solves this problem by treating the observations of the group that already received the treatment as if they were missing data. This prevents those who received treatment first from being used as controls for those who received it later, which eliminates negative weights” and therefore improves the validity of the results.

A key feature of the *fect* methodology is its focus on constructing counterfactual values for each treated unit. This makes it possible to estimate how each unit would have behaved in the absence of treatment, improving the accuracy of the estimates and avoiding the limitations of methods that only compare averages between groups.

In practice, the model used to calculate the counterfactual values was as follows:

$$Y(0)_{it} = \mu_i + \tau_t + \beta_1 capext_{it} + \beta_2 ANII\ support_i + \beta_3 age_{it} + \beta_4 non\ ANII\ support_{it} + \beta_5\ percentage\ of\ professionals_{it} + \lambda_{it} + \varepsilon_i$$

μ_i corresponds to the unobservable heterogeneity of each company which is constant over time; τ_t corresponds to shocks specific to each time period but common to all companies, *capext* is a binary variable that takes the value 1 if the company has foreign capital and 0 otherwise; *ANII support* represents the number of projects supported by the institution in addition to the instrument evaluated in this study; *age* corresponds to the age of the company or years since its establishment; *non ANII support* corresponds to the number of public subsidies received in addition to that of ANII; *percentage of professionals* controls for the proportion of professionals in the total number of employees; and λ_{it} is the inverse of the Mills ratio mentioned above.

Finally, the methodology used to estimate total factor productivity (TFP) at the company level is the one proposed by Olley and Pakes (1996) and implemented in STATA using the *prodest* command developed by Mollisi and Rigovati (2017). Since the variables necessary to calculate TFP were incorporated into the EAI in the 2016-2018 wave, the impact on this variable was estimated using the Propensity Score Matching (PSM) methodology.

4. 4. Descriptive statistics

Below are some basic descriptive statistics from the database used in the report.

This study draws on information from 393 companies in total: 210 in the control group and 183 in the treatment group. Table 1 shows the number of observations per group. Of the 1,833 observations, 841 correspond to the treatment group and 992 correspond to the control group. It is interesting to note that the treated and control companies have an average number of observations per period that is almost equal: 4. 6 and 4. 7 respectively.

Table 1: Number of observations per group and years of observation

Years of observation	Treatment (T)	Control (C)	Total
1	7	14	21
2	18	0	18
3	447	354	801
4	0	12	12
5	15	0	15
6	234	216	450
7	0	28	28
8	16	0	16
9	67	144	211
10	0	30	30
11	11	0	11
12	13	168	181
13	13	26	39
Total	841	992	1,833

Table 2 shows the distribution of the treated companies based on the year in which they received the subsidy. Companies that signed contracts with ANII in 2015, 2016 and 2017 provided the largest number of observations in the database.

Table 2: Number of observations of treated companies according to the year of entry into treatment

Year of entry into treatment	Number of observations
2008	23
2009	22
2010	35
2011	35
2012	44
2013	43
2014	34
2015	177
2016	154
2017	105
2018	50
2019	68
2020	37
2021	14
Total	841

Below are some basic descriptive statistics for the outcome variables used to measure the impact of ANII funding, along with the statistical power of each variable. The power calculation is essential, as it indicates the probability of finding a statistically significant impact given the mean and variance values in the outcome variables for the treatment group and control group, as well as a selected level of statistical significance, which in this case is 5%.

Table 3 shows that, for 9 of the 13 outcome variables analyzed, there is a 100% probability of detecting an impact of ANII financing, if such an impact actually exists. However, for 4 variables (Innovation in process, Innovation for the international market, Propensity to export and Sales revenue), the probability of finding the impact of the

Agency's subsidy is less than or equal to 65% even when it exists. This power level is lower than the commonly recommended threshold of 80%, which means that given the sample sizes and values presented in the table, impacts may not be found if they are of small or moderate magnitude.

Table 3: Main descriptive statistics and power calculations

	Observations		Statistical power	Mean		Standard deviation	
	T	C		T	C	T	C
Log. Investment in IA	841	992	100%	6.985	4.205	6.43	6.09
Log. Investment in R&D	841	992	100%	4.446	2.871	5.957	5.318
Performs R&D	841	992	100%	0.489	0.349	0.5	0.477
Innovative	841	992	100%	0.684	0.484	0.465	0.5
Innovative in products	841	992	100%	0.614	0.348	0.487	0.477
Innovative in processes	841	992	60%	0.244	0.201	0.43	0.401
Innovative in local market	841	992	100%	0.4	0.25	0.49	0.433
Innovative in international market	841	992	59%	0.185	0.147	0.389	0.354
Sells new products derived from innovation	841	992	100%	0.616	0.324	0.487	0.468
Propensity to export	841	992	54%	0.182	0.146	0.386	0.353
Log. Employment	841	992	100%	1.159	1.554	0.958	1.24
Log. Sales revenue	841	992	65%	9.067	10.252	6.678	6.901
Productivity	841	992	100%	8.615	10.387	5.941	5.312

5. Results

The results obtained during the impact evaluation for the different variables analyzed are presented below. For all variables, the average treatment effect for those treated (ATT) is reported for all variables. For those variables whose impact is statistically significant, graphs are included showing the impact as a function of the years of exposure to treatment.

5.1. Impact on investment effort in innovation activities

The start-ups supported by ANII leverage investment in innovation activities. This implies that subsidies achieves the desired effect of generating greater investment by companies (additionality or complementarity). Thus, if total investment in innovation is considered, the evidence suggests that beneficiary companies invest 195% more than non-beneficiary companies.

Table 4: Impact on investment effort in innovation activities

	Treatment effect (ATT)
Log Amount invested in R&D	0.677 (0.576)
Log Amount invested in IA	1.953*** (0.568)

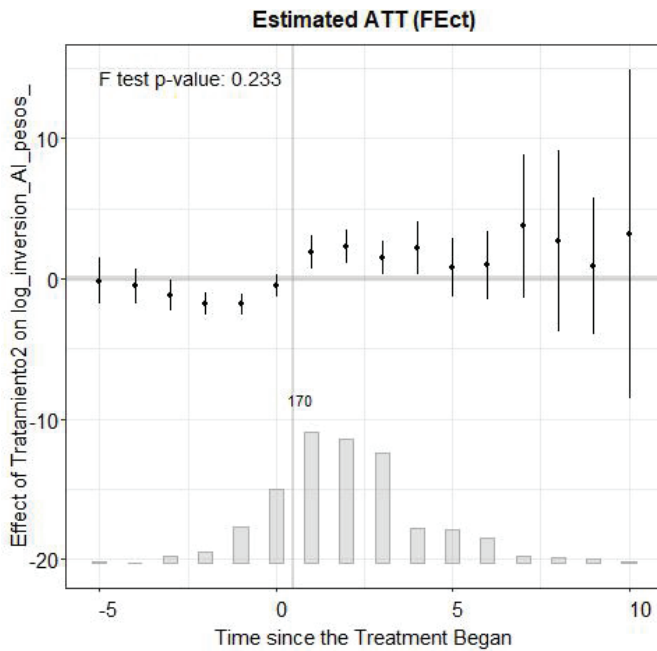
Note: Standard errors in parentheses. *Significant at 10%. **Significant at 5%. ***Significant at 1%.

Figure 3 shows the estimated average treatment effects according to the number of years since treatment entry, along with their confidence intervals. Also the p-value of the test assessing the joint significance of the ATTs for the pretreatment periods is included. This test is a particular version of the parallel trends assumption in which the null hypothesis is the absence of significant differences in the outcome variable between treated and controls in the pretreatment periods.

For the variable of investment in innovation activities, the F test confirms that it is greater than 0.05, which suggests that the null hypothesis that, as a whole, the ATTs for the pre-treatment periods are equal to 0 cannot be rejected, which means that there are parallel trends prior to entering the treatment for treated and control individuals.

Furthermore, it is evident that the impact is significant during the first four years from the start of treatment. This is evidenced by the fact that the estimated coefficients and their confidence intervals do not include the value zero. From the fifth year onwards, the coefficients lose statistical significance, which suggests that the effect disappears. These results show that the impacts of the ANII Innovative Entrepreneurship program on investments are significant and last twice the maximum time for project implementation (approximately two years).

Figure 3: Impact on investment effort in innovation activities by years of exposure to treatment.



5. 2. Impact on innovative behavior

The results indicate that beneficiary companies are 14 percentage points more likely to carry out innovation activities compared to non-beneficiary companies. Furthermore, ANII support has driven greater endogenous efforts in innovation, as treated firms are 8 percentage points more likely to carry out R&D than non-treated firms.

Table 5: Impact on innovative behavior

	Average treatment effect (ATT)
Performs R&D	0.084* (0.049)
Performs innovation activities	0.142*** (0.037)
Innovative in product	0.191*** (0.042)
Innovative in process	-0.002 (0.043)
Innovative in international market	-0.00002 (0.043)
Innovative in local market	0.122** (0.051)
Sells new products derived from innovation	0.254*** (0.046)

Note: Standard errors in parentheses. *Significant at 10%. **Significant at 5%. ***Significant at 1%.

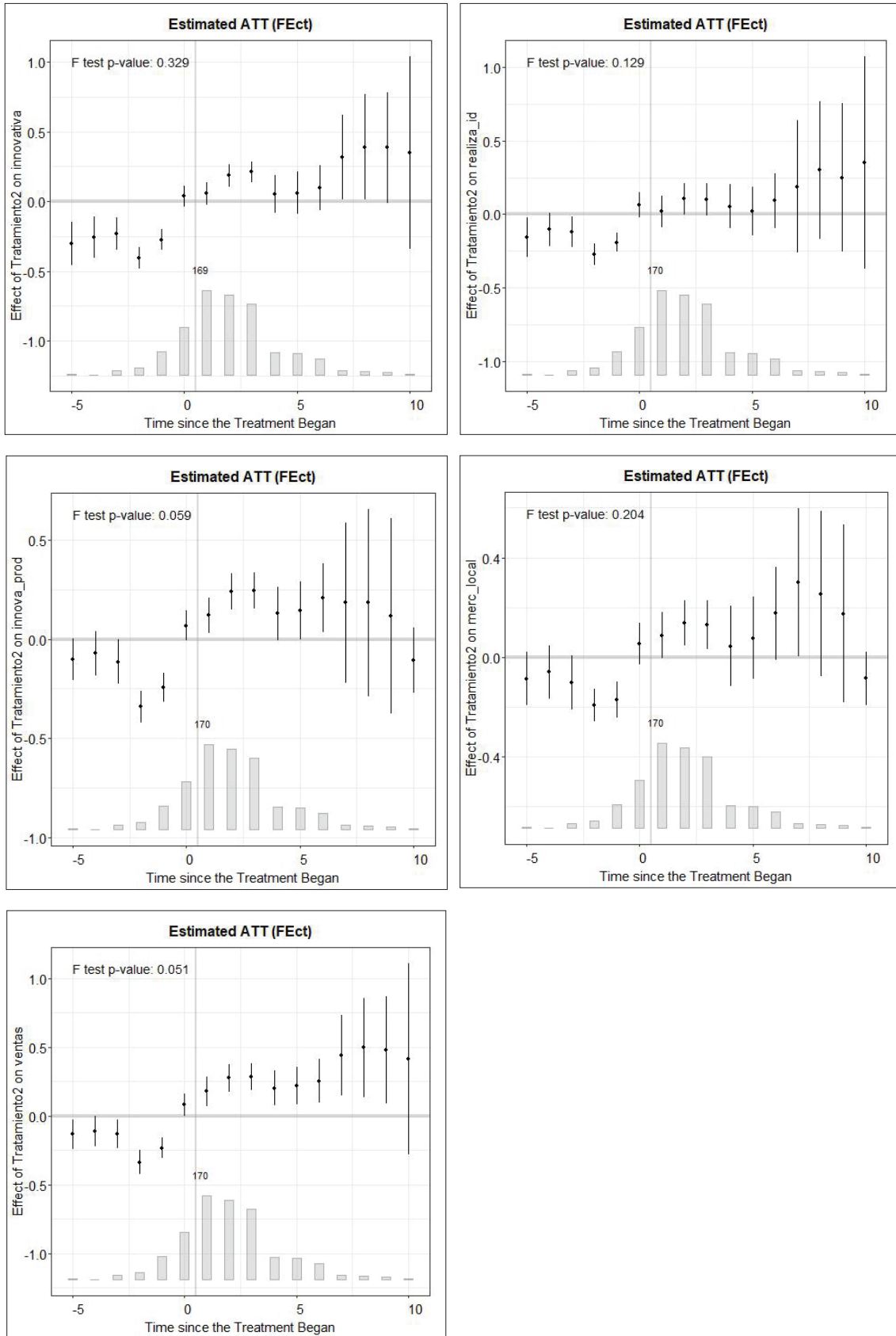
Regarding the type of innovation developed, beneficiary companies present a positive and significant effect of 19 percentage points on the probability of innovating in products and an effect of 25 percentage points on the generation of sales of novel products compared to the control group. In addition, companies that received support increased the probability of introducing innovations for the local market by 12 percentage points.

No significant impact is observed on process innovation or innovation of international scope, which could be related to the fact that the program's financing for this type of innovation and degree of novelty is very limited.

Figure 4 shows two key aspects: 1) for all outcome variables, the p-value of the F statistic is higher than 0.05, which indicates an absence of significant differences in the previous behavior of these variables before treatment; and 2) the effect of ANII funding extends beyond the duration of the project.

Innovation activities and R&D performance show a significant effect that persists for three years after receiving support and disappears thereafter. Similarly, innovations aimed at the local market show significant effects during the first three years, but the impact disappears from the fourth year onwards. Finally, as reflected in Figure 4, start-ups who innovate in products and generate sales derived from them show an impact that extends over a period of 9 years, which shows that ANII's financing generates persistent innovative behavior in the supported start-ups.

Figure 4: Impact on innovative behavior by years of exposure to treatment.



5. 3. Impact on economic performance

Regarding sales revenue and propensity to export, an analysis of statistical power showed that there was a low probability of finding an effect. This was indeed the case, since the estimated impact for these two variables is very small in relation to the dispersion (measured through standard deviation) and is not significant. Furthermore, no statistically significant impact was found for total factor productivity.

Table 6: Impact on economic performance

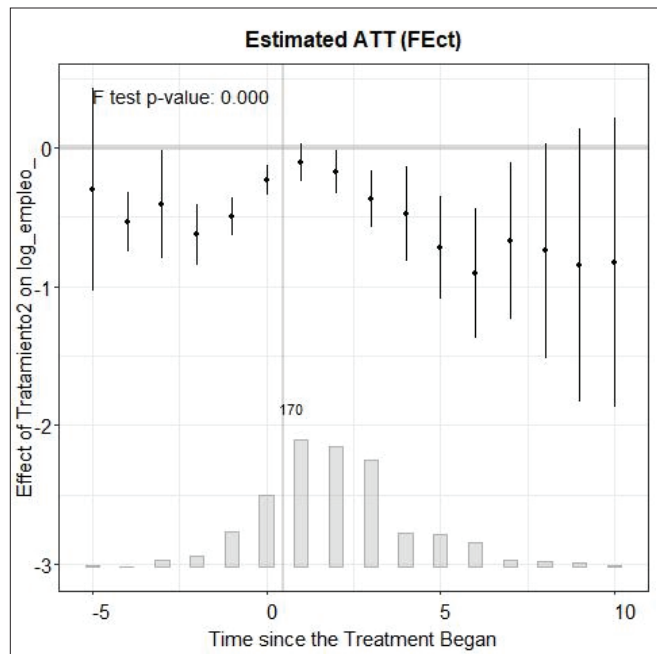
	Average treatment effect (ATT)
Log. Sales revenue	0. 839 (0. 503)
Propensity to export	0. 021 (0. 043)
Total factor productivity*	-0. 125 (0. 233)

Note: Standard errors in parentheses. *Significant at 10%. **Significant at 5%. ***Significant at 1%.

‡ Estimated by PSM using Kernel matching. The covariate balance test shows that there are no significant differences in the standardized means after matching.

Finally, for employment a significant impact is found, but as the F test determined that it does not comply with the assumption of parallel trends, the result cannot be considered valid.

Figure 5: Impact on employment by years of exposure to treatment



6. Discussion

The results presented confirm two of the three proposed hypotheses: ANII-supported companies invest more in innovation activities and show statistically significant differences in their innovative behavior compared to non-beneficiary companies. However, no evidence of significant effects was found on the economic performance variables.

These findings can be contextualized in light of existing literature, both for Latin America and for other regions of the world.

Research on the effects of public programs on investment in innovation, especially in innovative young start-ups or companies, is limited and mostly concentrated in European countries. In this sense, the positive and statistically significant results in total investment in innovation activities found in this study are consistent with those reported by Czarnitzki and Lopes-Bento (2014) for Germany. These authors found an effect coefficient for investment in R&D between 3. 3 and 2. 1, the latter value being very similar to that obtained in this study for investment in innovation activities. However, while these authors also identified a positive impact on R&D investment, this result was not replicated in the study.

Regarding the innovative performance of the beneficiary companies, the results coincide with various studies. Liu and Ramer (2016) found that regional public subsidies in Germany have a significant impact on new product introductions for both the firm and the market. Similarly, Radas et al. (2015) reported positive and significant effects of small business support programs in Croatia on the introduction of innovations and sales of new products. Guo et al. (2016) observed a positive impact of the Chinese fund Innofund on the innovation of small technology companies, with an effect of around 8 percentage points.

The absence of significant impact on the economic performance of beneficiary companies can be attributed to several factors. Firstly, the financial assistance from the Innovative Entrepreneurship program, while crucial for early-stage development, may be insufficient to fully address the obstacles to rapid economic scaling. Innovative start-ups frequently encounter considerable challenges in securing follow-on funding beyond initial seed capital, which is essential for aggressive market penetration or internationalization, especially in capital-intensive sectors (Himmelberg & Petersen, 1994; Hall & Lerner, 2010). Although the program effectively leverages private investment in innovation, the overall capital injected might remain modest compared to the investment required for aggressive market expansion, particularly for ventures competing in highly competitive global markets.

Secondly, the inherently high mortality rate of innovative start-ups, even those receiving public support, could dilute observable aggregate economic impacts. Statistics consistently demonstrate that a substantial percentage of start-ups fail within their initial years (Haltiwanger et al., 2013). While the program cultivates a higher propensity for innovation, not all innovative ventures will achieve commercial success or significant economic scale. The program's primary success may lie in enhancing the likelihood of innovation and survival, rather than guaranteeing immediate, large-scale economic returns across the entire cohort of supported firms.

Furthermore, the findings in this paper align with the mixed evidence reported in the Latin American literature. In Europe, Söderblom et al. (2015) observed an increase in sales for companies benefiting from the VINNOVA program in Sweden. Similarly, Auto and Ranniko

(2016) documented significant sales growth in supported start-ups in Finland, while Hottenrot and Lopes-Bento (2014) found this effect to be conditional on collaboration with international partners. In Latin America, Goñi (2019) and Lozada (2022) reported significant sales increases for start-ups participating in Start Up Peru. However, studies such as Butler (2016) for Buenos Aires *Emprende* and Verde (2016) for Start Up Chile did not find significant effects on sales revenue.

This study faces several limitations. The EAI survey data did not allow to measure the effects of the state subsidy on obtaining other sources of financing, such as bank loans or private venture investments. Future research could also explore the effects of knowledge spillover into the sectors where the beneficiary companies operate. Finally, it would be relevant to analyze the effects of the changes introduced to the program in 2021. Since the beneficiary start-ups of this new stage were not captured by this study, a comparative evaluation could provide valuable information on the impact of strategies targeting high-impact start-ups.

7. Conclusions

This study contributes to the debate on the role of the State in promoting innovative entrepreneurship in Latin America and reinforces the need to strengthen the culture of impact evaluation in the region. Through rigorous analysis of the effects of ANII's Innovative entrepreneurship program, compelling evidence was obtained on the impact of this type of initiatives.

The results indicate that financing provided by ANII significantly increases investment in innovation activities. Beneficiary companies increase their investment by 195% more than similar companies that are not supported, an effect that is maintained during the first four years, which doubles the maximum financing period. This finding highlights the importance of financial support in the early stages of the development of innovative start-ups.

In terms of innovative behavior, companies that receive financing show better performance in carrying out R&D activities, in product innovation, and in the sales of new products with a positive impact that persists for up to nine years. These companies are 14 percentage points more likely to innovate and 25 percentage points more likely to generate sales of new products. However, no significant effects are observed on process innovation or internationalization, suggesting areas of improvement for future interventions. Supplementary strategies may be required to drive innovation in these areas, such as training programs, specialist advice or incentives for international cooperation.

While no evidence was found of a significant effect of financing on overall economic performance, it is important to note that, from a theoretical point of view, the impact on innovation can generate long-term benefits, such as greater competitiveness, sustained growth and job creation. Future studies could delve deeper into the analysis of these aspects.

The relevance of this study lies in the integration of ANII administrative records with data from innovation surveys, which allowed to compile a large-scale longitudinal database that is the most comprehensive one used to date for this type of evaluation in the region. The application of a generalized difference-in-differences model, based on the methodology proposed by Liu, Wang, and Xu (2022), made it possible to address the particularities of a program to support innovative start-ups with a high mortality rate and to estimate the duration of the effect of financing.

In conclusion, this study provides robust evidence on the positive impact of ANII's Innovative Entrepreneurship support program. The findings have important implications for the design of public policies to promote innovation in Latin America, highlighting the importance of rigorous evaluation and financial support for innovative start-ups.

Conflict of Interests

The authors are members of the Evaluation and Monitoring unit within the National Agency for Research and Innovation (ANII), the agency responsible for the implementation of the Program assessed in this study. While affiliated with ANII, this evaluation was conducted with the aim of independent and objective assessment, and this declaration serves to ensure full transparency for the readership.

References

- Acs, ZJ, Audretsch, DB, Lehmann, EE, & Licht, G. (2017). National systems of innovation. *The Journal of Technology Transfer*, 42(5), 1230-1237. <https://doi.org/10.1007/s10961-017-9549-9>
- Aerts, K., & Czarnitzki, D. (2004). Using innovation survey data to evaluate R&D policy: The case of Belgium. *European Journal of Political Economy*, 20(4), 891-905. <https://doi.org/10.1016/j.ejpoleco.2004.03.007>
- Almus, M., & Czarnitzki, D. (2003). The effects of public R&D on subsidies firms' innovation activities: The case of Eastern Germany. *Journal of Business & Economic Statistics*, 21(2), 226-236. <https://doi.org/10.1198/073500103288618918>
- Audretsch, DB (1995). *Innovation and industry evolution*. MIT Press.
- Auto, E., & Ranniko, H. (2016). The impact of public funding on firm growth. *Journal of Business Venturing Insights*, 5, 50-56. <https://doi.org/10.1016/j.jbvi.2016.03.001>
- Barona, R., & Gómez, A. (2010). The importance of financing in innovative ventures. *Journal of Economics and Society*, 19(1), 45-62.
- Biancalani, F., & Czarnitzki, D. (2021). The impact of the Italian Start-Up Act on firm performance. *Small Business Economics*, 57(2), 801-820. <https://doi.org/10.1007/s11187-020-00374-6>
- Bukstein, D., Hernández, E., Monteiro, L., Peralta, M., Usher, X. and Vaz, M. (2017). Informe de evaluación de Impacto: instrumentos de promoción de la Innovación empresarial (Impact Evaluation Report: Instruments for Promoting Business Innovation). Montevideo: Agencia Nacional de Innovación e Investigación. Available at: <https://www.anii.org.uy/institucional/documentos-de-interes/4/informes-de-evaluacion/>

- Bukstein, D., Hernández, E., Monteiro, L., Peralta, M., Reyes, C. and Usher, X. (2020). Informe de evaluación del programa Emprendedores Innovadores 2020 (Evaluation Report of the 2020 Innovative Entrepreneurship Program). Montevideo: Agencia Nacional de Innovación e Investigación. Available at: <https://www.anii.org.uy/institucional/documentos-de-interes/4/informes-de-evaluacion/>
- Butler, K. (2016). Evaluating the Buenos Aires Emprende program: Lessons from a Latin American political experiment. *International Journal of Innovation*, 9(3), 295-313.
- Czarnitzki, D., & Lopes-Bento, C. (2014). Innovation subsidies: Does the funding source matter for innovation intensity and performance? *Empirical Economics*, 46(3), 889-913. <https://doi.org/10.1007/s00181-013-0696-1>
- Foreman-Peck, J. (2012). Effectiveness and efficiency of SME innovation policy. *Small Business Economics*, 39(2), 369-385. <https://doi.org/10.1007/s11187-010-9309-0>
- Fracica, A. (2009). Uncertainty in innovative ventures. *Journal of Economic Perspectives*, 23(4), 65-84.
- Goñi, L., & Reyes, J. (2019). Evaluating the impact of Start-Up Perú on sales growth. *Development Policy Review*, 37(4), 519-537. <https://doi.org/10.1111/dpr.12345>
- Guo, D., Guo, Y., & Jiang, K. (2016). Government-subsidized R&D and firm innovation: Evidence from China. *Research Policy*, 45(6), 1129-1144. <https://doi.org/10.1016/j.respol.2016.03.002>
- Hall, BH (2002). The financing of research and development. *Oxford Review of Economic Policy*, 18(1), 35-51. <https://doi.org/10.1093/oxrep/18.1.35>
- Hall, B. H., & Lerner, J. (2010). The financing of R&D and innovation. In BH Hall & N. Rosenberg (Eds.), *Handbook of the Economics of Innovation* (Vol. 1, pp. 609-639). Elsevier. [https://doi.org/10.1016/S0169-7218\(10\)01014-2](https://doi.org/10.1016/S0169-7218(10)01014-2)
- Hall, BH, Moncada-Paternò-Castello, P., Montresor, S., & Vezzani, A. (2016). Financing constraints, R&D investments and innovative performances: New empirical evidence at the firm level for Europe. *Economics of Innovation and New Technology*, 25(3), 183-196. <https://doi.org/10.1080/10438599.2015.1076194>
- Haltiwanger, J., Jarmin, R. S., & Miranda, J. (2013). Business dynamics statistics: An overview. In *NBER Chapters, Studies in Income and Wealth*, Vol. 73, pp. 1-28. National Bureau of Economic Research.
- Himmelberg, C. P., & Petersen, B. C. (1994). R&D and internal finance: A panel study of small firms in high-tech industries. *The Review of Economics and Statistics*, 76(1), 38-51. <https://doi.org/10.2307/2109824>
- Hottenrott, H., & Lopes-Bento, C. (2014). (International) R&D collaboration and SMEs: The effectiveness of targeted public R&D support schemes. *Research Policy*, 43(6), 1055-1066. <https://doi.org/10.1016/j.respol.2014.01.004>
- Kantis, H., & Federico, J. (2014). Emprendimientos dinámicos en América Latina (Dynamic Ventures in Latin America). *Ecosystems and sustainability*, 23(1), 45-68.
- Kolling, A. (2015). Public funding and firm-level productivity. *Empirical Economics*, 49(3), 969-993. <https://doi.org/10.1007/s00181-014-0890-7>
- Liu, S., & Ramer, R. (2016). Public funding and innovation in SMEs: Evidence from Germany. *Small Business Economics*, 47(3), 589-611. <https://doi.org/10.1007/s11187-015-9643-6>
- Liu, X., Wang, Y., & Xu, L. (2022). Evaluating public funding impacts using heterogeneous treatment models. *Journal of Policy Analysis and Management*, 41(4), 765-790. <https://doi.org/10.1002/pam.22301>
- Lozada, J. (2022). Evaluación de impacto de Start-Up Perú (Impact evaluation of Start-Up Peru). *Latin American Journal of Public Policies*, 15(2), 123-145.
- Organization for Economic Co-operation and Development (OECD). (2016). *Innovation-driven growth in regions*. OECD Publishing. <https://doi.org/10.1787/9789264261975-en>
- Radas, S., Anić, I. D., Tafro, A., & Wagner, V. (2015). The effects of public support schemes on small firms: Evidence from Croatia. *Research Policy*, 44(5), 1195-1206. <https://doi.org/10.1016/j.respol.2014.12.002>
- Söderblom, A., Samuelsson, M., Wiklund, J., & Sandberg, R. (2015). Public policy for high-growth entrepreneurs. *Small Business Economics*, 45(4), 747-767. <https://doi.org/10.1007/s11187-015-9657-0>
- Srhoj, S., Škrinjaric, B., & Radas, S. (2019a). Bidding against the odds? The impact evaluation of grants for young micro and small firms during the recession. *Small Business Economics*, 53(3), 727-744. <https://doi.org/10.1007/s11187-018-0065-0>
- Srhoj, S., Škrinjaric, B., & Radas, S. (2019b). Grants and firm performance: Evidence from Croatia. *Economic Systems*, 43(1), 1-14. <https://doi.org/10.1016/j.ecosys.2018.06.004>
- Verde, G. (2016). Evaluating the Start-Up Chile program: A cost-benefit analysis. *Emerging Markets Finance and Trade*, 52(3), 632-645. <https://doi.org/10.1080/1540496X.2015.1088152>

