# Entrepreneurial Finance and the Effects of Restrictions on Government R&D Subsidies*

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**Abstract**

Entrepreneurial ventures often face liquidity constraints. While governments have intervened with programs subsidizing R&D projects, these programs may have their effectiveness undermined by the restrictions they impose on subsidy recipients. We study the impact on venture outcomes of one important restriction, namely, the prohibition on transferring know-how away from a given geographic area. Using novel data on Israeli startups and evaluating a policy change that relaxed this restriction, we find that the policy change increased the likelihood of applying for a subsidy for startups most likely to have been affected by the restriction. We also show that R&D subsidies had a significant positive effect on startup survival, the ability to attract external investment, and innovation, but only for recipients applying for subsidies after the restriction was relaxed.

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# 1 Introduction

One of the most important challenges facing entrepreneurial ventures is access to capital at socially optimal prices (Hall and Lerner, 2010). This is because of the knowledge externalities they generate and the fact that these ventures typically undertake intangible investments whose value cannot be easily assessed by potential investors (Baum *et al.*, 2000). To address these market failures, policy makers have frequently advocated the use of R&D subsidy programs (Howell, 2017). A number of studies have assessed the effect of receiving subsidies on venture outcomes, but the evidence is mixed (Lerner, 1999; Wallsten, 2000). One reason for this inconclusive evidence is that the existing literature has dedicated scant attention to the fact that R&D subsidies often come with multiple restrictions that governments impose on recipients to ensure that their goals are attained. These restrictions can generate heterogeneous effects of R&D subsidy programs on venture outcomes, varied even among startups with similar characteristics.

This paper examines the effect of an important restriction, namely, the prohibition on transferring subsidized know-how outside a given geographic area. As an example of this restriction, the U.S. Small Business Innovation Research (SBIR) grant program insists that "R&D work (financed with SBIR funds) must be performed in the United States".[1] At the state level, the Texas Emerging Technology Fund requires that "at least eighty-five percent of the Company's employees and eighty-five percent of the Company's independent contractors shall be individuals whose principal place of residence is located in the State of Texas".[2] Similar provisions are imposed in the U.S. by states like New York and Maryland[3] and in countries like Israel, South Korea, Australia, and New Zealand.

The motivation for restricting the external transfer of know-how is to prevent the technological spillovers generated from R&D subsidies from being appropriated by external agents. This motivation is especially salient for small countries and states within federally-organized countries, where firms have an incentive to reach out to larger external markets. To understand the effect of this restriction on the effectiveness of R&D subsidy programs, we address the following questions: How does restricting the external transfer of know-how affect the startups' decision to apply for a subsidy? Does the effect vary across startups? And, how does the restriction ultimately influence the impact of R&D subsidies on venture outcomes?

To answer these questions, we exploit data on 2,304 Israeli startups that were founded during 1990-2014.

[1] Refer to https://www.sbir.gov/sites/default/files/sbir_pd_with_1-8-14_amendments_2-24-14.pdf, page 16.

[2] Refer to the Texas Emerging Technology Fund, at http://governor.state.tx.us/ecodev/etf, Award Agreement, page 13.

[3] Refer to http://esd.ny.gov/nystar/CentersforAdvTechnolgy.asp and http://tedco.md/program/technology-commercialization-fund-tcf/.

This empirical context is meaningful for two reasons. First, the Israeli government has a variety of programs to support its firms, including startups. Second, many of these programs have been copied by several other economies (Lach, 2002).[4] The program that we examine consists of R&D subsidies offered by the Israeli Office of the Chief Scientist (OCS) at the Ministry of Industry and Trade. The OCS awards subsidies for R&D projects to Israeli firms, including startups, which are required to match the amount received by the OCS. If their projects are commercially viable, grant recipients must pay back the initial amount, usually in the form of royalties (Trajtenberg, 2000). This repayment scheme implies that the grant is *de facto* a low interest rate loan conditional on the success of the project.[5] As we detail later, the OCS imposes restrictions on the external transfer of the know-how generated from the subsidies and penalties when these restrictions are violated. These restrictions and the related penalties are a cause of concern in Israel and abroad, as evidenced by the abundance of websites warning Israeli firms as well as non-Israeli investors about the costs of undertaking R&D projects with government subsidies.[6]

To evaluate the effect of the R&D subsidy restrictions on the decision of startups to apply for government support, we exploit a policy change introduced by the OCS in 2006. Before 2006, the OCS prohibited any external transfer of know-how generated from the R&D subsidies. However, in March 2005, the OCS amended the existing R&D law after recognizing that it may have been hampering innovation and, ultimately, economic growth. The amendment became effective as of January 2006, since when the external transfer of subsidized know-how has been permitted under the condition that a redemption fee is paid. The essence of this reform is synthesized in a 2006 article published by the *Globes*, a respected Israeli financial newspaper. The article states that: "*The overall impact of the changes to the R&D Law is likely to be very great indeed. The obstacles which the R&D Law placed in the way of Israeli high-tech companies in the area of know-how transfer . . . abroad made it extremely difficult for such companies to operate in a global technology market. The restrictions made those companies already in receipt of OCS funding unattractive to potential foreign investors. . . .. The removal of the restrictions should have the opposite effect.*"[7]

Our empirical approach is to compare the probability that a startup applies for a government subsidy

[4] See, for instance, Canada, Singapore, New Zealand, South Korea, Taiwan, and Australia.

[5] Subsidy programs in other countries have a similar repayment scheme. See, for instance, the conditional grants provided by the Ontario government in Canada (http://www.mentorworks.ca/blog/government-funding/ontario-small-business-grants-new-investment-projects) and those awarded by the French Banque Publique d'Investissement (http://www.bpifrance.fr), the Finnish Funding Agency for Innovation (https://www.tekes.fi/en/funding/startup/research-development-piloting), and the Spanish Centre for Development and Industrial Technology (https://www.cdti.es).

[6] See, for instance, https://www.theventurealley.com/wp-content/uploads/sites/5/2013/08/OCS-Israel.pdf.

[7] http://www.globes.co.il/en/article-1000129681.

depending on whether the expected year of the startup's first application occurs before or after the policy change. Our identification strategy rests on the assumption that the policy change does not correlate with pre-existing trends in the probability of applying for a subsidy. To ensure the validity of this strategy, we control for heterogeneous time trends that vary with the sector in which the startups operate, their start year, and the date of their expected initial subsidy application. Our initial findings show that, following the reform, the likelihood that startups would apply for a subsidy increased, although the increase is not significantly different from zero. We then distinguish startups according to their ability to attract private funds, proxying this characteristic with an indicator variable identifying startups that had raised private funds at inception. Startups likely to be attractive to private investors should be the most affected by the policy reform, given their high opportunity costs of seeking government support. We find that, following the implementation of the Israeli reform, the likelihood of applying for a subsidy significantly increased for startups with initial private funds, but this was not the case for those lacking private funding at inception. Results from our preferred model specification show that, prior to the reform, startups with initial private funds were 22 percentage points less likely to apply for a government R&D subsidy than were startups without such funds. After the reform, startups with initial private funding became as likely as startups without such funding to apply for a subsidy. Reassuringly, we do not observe significant pre-existing trends in the probability of applying for a subsidy. A possible concern is that the Israeli policy reform may have been introduced in response to the bursting of the dot-com bubble, which negatively impacted the Israeli economy in 2001-2002 (Cohen *et al.*, 2010). To address this concern, we re-estimate our equations in separate subsamples of information and communication technology (ICT) startups, relative to which the policy reform may be endogenous, and non-ICT startups that were not directly affected by the burst of the bubble. The results are consistent across subsamples.

Did R&D subsidies post-reform simply substitute for private capital, or did they stimulate innovation? We infer the effect of reducing the restriction on the external transfer of know-how on the startups' private effort by analyzing the change in performance of subsidized and non-subsidized applicants after the reform. Suppose that the main effect of the policy reform was to induce applications from startups that are on average more attractive to private investors than pre-reform applicants, but due to the reform now seek government support because it has become relatively cheaper. In that case, we should observe post-reform applicants, *including non-subsidized applicants*, outperforming pre-reform applicants. If there were no difference in performance between post- and pre-reform non-subsidized applicants, the evidence would be inconsistent

with the policy reform predominantly enticing startups that would have undertaken R&D projects with private funds, but found government subsidies relatively more attractive. This reasoning, of course, relies on the assumption that the Israeli government did not meaningfully change its selection criteria concurrently with the policy reform.

Our results show that prior to the reform there was no significant difference in performance between subsidized and non-subsidized applicants. After the policy reform, the probability of a startup surviving, its likelihood of attracting external funds, and its innovation output increased only for subsidized applicants but not for non-subsidized ones. As a result, the gap in venture performance between subsidized and non-subsidized applicants in the post-reform period is significantly larger than the one in the pre-reform period. These findings are not driven by variations in the applicants' acceptance rate after the reform. They are also not driven by the government changing its selection criteria with the reform and disproportionately admitting startups with greater private funds. To address the concern that these results may be biased because of omitted factors, we estimate two-step Heckman selection models that treat the assignment of an R&D subsidy as endogenous and include a selection correction term in the structural equation of venture outcomes. By accounting for the endogeneity of government funding, our findings remain unchanged.

This evidence suggests that those startups that applied for government support as a result of the reduced restriction on the external transfer of subsidized know-how were no more inclined to substitute private with public funds than were pre-reform applicants. Additionally, it suggests that the policy reform increased the startups' marginal value from exerting effort in a subsidized project and, concurrently, private effort. Taken together, our findings indicate that restrictions on the external transfer of subsidized know-how made subsidies less effective in promoting innovation.

This paper builds on the literature evaluating R&D subsidy programs. The existing results are mixed. Lerner (1999) and Audretsch *et al.* (2002), for instance, find a positive effect of grants awarded by the SBIR program on startups' R&D spending and growth. In contrast, Wallsten (2000) provides evidence that SBIR grants displace private R&D spending as they are awarded to companies whose R&D projects could have been financed with non-government funds. Analyzing alternative subsidy programs in the U.S., Feldman and Kelley (2006) confirm the finding by Wallsten (2000), while Zhao and Ziedonis (2012) and Howell (2016) provide evidence that state grants enhance a startup's commercial viability.[8] We advance this

[8]Outside of the U.S., Lach (2002) examines the impact of Israeli government subsidies on small firms and finds that these subsidies encourage private R&D spending. Using European data on large and small firms, Busom (2000), Gonzalez *et al.* (2005), Almus and Czarnitzki (2003), and Bronzini and Iachini (2014) also assess the effect of government subsidies on firm R&D spending.

literature by examining the effects of R&D subsidy restrictions. As we show, these restrictions may lead to heterogeneous effects that can reconcile the mixed findings in the literature. The study closest to ours is Dechezleprêtre *et al.* (2016). They analyze the effect of R&D tax incentives by exploiting a U.K. policy reform that raised the size threshold under which firms can access the more generous tax regime for small enterprises. They find a subsequent increase in firm innovation and conclude that the policy change induced firms with high-quality R&D projects to apply. In contrast, we analyze a different type of R&D subsidy, conditional R&D grants, and a different kind of subsidy restriction. In addition, we consider the effect of R&D subsidies on the outcomes of entrepreneurial ventures. Importantly, we have access to information regarding all three relevant subsamples of firms: applicants that were granted an R&D subsidy, applicants that were not awarded a subsidy, and non-applicants. Therefore, we provide a more nuanced analysis of the mechanisms through which the reform impacted venture outcomes.

## 2 Conceptual framework

In this section, we develop a simple model that will guide our empirical analysis. A startup's payoff from a subsidized R&D project is described by the following function:

$$\Pi = V(E, \frac{G}{K}) - \frac{1}{2}E^2 - \rho(\theta) \tag{1}$$

$V(E, \frac{G}{K})$ is the value accruing to a startup from pursuing the subsidized R&D project. It is strictly concave in the startup's own R&D effort $E \in [0, \overline{E}]$ and the subsidy $G \in [0, \overline{G}]$. That is, $V_E(E, \frac{G}{K}) > 0$, $V_G(E, \frac{G}{K}) > 0$ and $V_{EE}(E, \frac{G}{K}) < 0$, $V_{GG}(E, \frac{G}{K}) < 0$. Subsidies often come with restrictions in their use. In our context, these restrictions reduce the private value that startup founders derive from the subsidized project. The parameter $K \geq 1$ measures the level of the restrictions on the use of a subsidy. We divide $G$ by $K$, so that the larger $K$ is, the smaller the effective subsidy $\frac{G}{K}$ becomes. The cost of exerting private effort is $\frac{1}{2}E^2$. The term $\rho(\theta)$ measures the opportunity cost of pursuing a project with government subsidies. It represents the value startup founders derive from undertaking a project without the subsidy. We assume that $\rho(\theta)$ is strictly increasing in the startup's ability, $\theta \in [0, \overline{\theta}]$, to finance the project with private funds. The parameter $\theta$ could be positively related to the quality of a startup, provided that capital markets are efficient and, thus, investors can discern good from poor quality ventures. $\theta$ could also depend on how attractive a given R&D project is to private investors for reasons unrelated to quality. For instance, startups developing technologies for the external market may be more attractive to private investors given that the external market is larger than the internal one in the case of small economies.

A startup must first decide whether or not to apply for a subsidy. Without loss of insight, we assume that if the startup applies for a subsidy, it is granted one. If the startup opts for a subsidy, it must then choose the amount of its own R&D effort to allocate to the project. The government determines the subsidy amount $G$, which we assume does not vary across projects. The model is easily solved as follows. The first order condition is:

$$V_E(E, \frac{G}{K}) - E = 0 \tag{2}$$

The second order condition for a maximum is verified given that $V_{EE}(E, \frac{G}{K}) < 0$. Applying for a subsidy is profitable if $V(E^*, \frac{G}{K}) - \frac{1}{2}(E^*)^2 \geq \rho(\theta)$, where $E^*$ is the value of $E$ that maximizes a startup's payoff. Notice that a reduction in the restrictions on the use of subsidized funds, $K$, by increasing $V(E^*, \frac{G}{K})$, enhances the likelihood that a startup opts for a subsidy. Additionally, such a reduction enhances the marginal applicant's level of ability to attract private funds. In fact, the ability level for the marginal applicant is $\theta = \rho^{-1}(V(E^*, \frac{G}{K}) - \frac{1}{2}E^{*2})$ and thus decreasing in $K$.

The relationship between a startup's level of R&D effort and the subsidy amount is derived as:

$$\frac{dE^*}{dG} = -\frac{V_{EG}(E^*, \frac{G}{K})}{V_{EE}(E^*, \frac{G}{K}) - 1} \tag{3}$$

Given that $V_{EE}(E^*, \frac{G}{K}) < 0$, the sign of $\frac{dE^*}{dG}$ depends on the sign of $V_{EG}(E^*, \frac{G}{K})$. A government subsidy stimulates private effort *if and only if* $E$ and $G$ are strict complements in the project's value ($V_{EG}(E^*, \frac{G}{K}) > 0$). For instance, this is the case of government subsidies that generate spillovers such as upgrading founders' knowledge and skills. Notice that when $V_{EG}(E^*, \frac{G}{K}) > 0$, a decrease in $K$ increases a startup's marginal value from exerting private effort in a subsidized project, and as a result, induces the startup to exert more effort.

To summarize, a reduction in $K$ will:

1. Increase the likelihood that startups apply for government R&D subsidies.

2. Induce applications from startups with a higher ability to attract private funds.

3. Enhance the effect of a subsidy on a startup's private effort, provided that $E$ and $G$ are complements.

In the following sections, we present our empirical results in light of these predictions.

# 3 Institutional setting

Since the late 1960s, the Israeli government has implemented a number of policies to support industrial R&D. For the purpose of this study, we follow Trajtenberg (2000, 2005) and identify two related milestones.

The first is the creation of the OCS in 1968 with the scope of subsidizing R&D projects developed by private Israeli firms. The second is the 1985 Law for the Encouragement of Industrial R&D (R&D Law). As stated in Trajtenberg (2000), the goal of this law was to "develop science-based, export-oriented industries, which will promote employment and improve the balance of payment." To achieve these goals, the R&D Law has encompassed a system of financial incentives managed by the OCS.

The largest of these incentives are subsidies that the OCS disburses to support Israeli firms' R&D activities. Each year the OCS sets a budget for R&D projects to which firms can apply. In doing so, it adopts a "neutrality approach" in the sense that it does not target any specific sector or technology. Once firms have applied for government support, a research committee, chaired by the Chief Scientist, reviews the proposals and decides if and what percentage of each proposal should be subsidized. In making its selections, the research committee considers the following criteria: *i*) the level of a proposed product's inventiveness and uniqueness; *ii*) the market needs and the contribution of a given project to the Israeli economy; and *iii*) the firm's ability to pursue the proposed project. Subsidized firms must match government funds from other sources. Proposals that could bring substantial improvements to existing products or processes receive the largest fraction of the proposed R&D budget. The majority of startups receive a subsidy corresponding to 50% of their approved budget. The subsidized firm commits to paying back the initial amount, typically in the form of royalties, but the annual payback cannot account for more than a small percentage of the firm's sales. This repayment scheme implies that, in the case of a successful project, the subsidy is a loan offered by the OCS at a low interest rate, while in the case of an unsuccessful project, the OCS amount becomes a grant *sensu stricto*.

One of the Israeli government's concerns is that economic agents outside of Israel may appropriate the rewards of OCS subsidies if the subsidized firms transfer their know-how externally. Prior to 2006, the OCS prohibited any external transfer of know-how. Exceptions could be made, but they were rare and decided on a case-by-case basis. Additionally, starting in 1995, the external transfer of know-how became a criminal offense. According to Cohen *et al.* (2010), this technology transfer prohibition prevented OCS-supported startups from achieving an exit given that, in the majority of cases, the exits would involve acquisitions by external investors. In March 2005, policy makers modified the existing law in fear that the initial provisions would act as barriers to external investment. The amendment, which became effective as of January 2006, allowed the external transfer of know-how generated from the R&D subsidies under the condition that a redemption fee is paid. Specifically, if a firm transfers the know-how generated from an R&D subsidy

externally, the firm must repay the greater of the following two options: *i*) the amount equal to the sale price of the know-how multiplied by the percentage of the firm projects' budget financed by the OCS; *ii*) the total amount of the subsidy, plus annual interest, minus the royalty already paid to the OCS. This payment scheme becomes more onerous if the subsidized firm transfers the know-how as a part of an external acquisition.[9]

# 4 Data

We assembled a detailed sample of 2,304 Israeli startups using data from the Israel Venture Capital Research Center (IVC). The IVC specializes in monitoring Israel's high-tech industry and collects extensive information about the population of Israeli startups. From the IVC dataset, we initially selected all of the Israeli startups that, as of September 2014, had an exit event, either successful (IPO or acquisitions) or unsuccessful (having ceased operations), and for which we had access to complete information. We complemented this set of 1,643 startups with an additional sample of 661 startups that the IVC labels as "seeking capital." To build this latter sample, we randomly selected 1,000 startups in the "seeking capital" category and retained the ones for which we had information regarding their founders and financing rounds.

The distribution of the 2,304 startups across sectors is as follows: 376 operate in communications, 355 in internet, 518 in IT and software, 208 in hardware, 110 in semiconductors, 174 in cleantech, 273 in life sciences, and 290 in medical devices. This distribution reflects Israel's comparative advantage in ICT.

As of 2016, the average age of a startup was 14 years. The average amount raised per startup, across all financing rounds, was $10 million (median: $1.45 million). Forty percent of the startups received funds from external investors (mostly venture capitalists and private equity firms), of which U.S. investors financed 79%. Regarding exits, 142 startups went public via an IPO, 561 were acquired, and 940 had ceased operations. External companies, 85% of which were from the U.S., acquired a total of 418 Israeli startups. Of the 661 startups labeled by the IVC as "seeking capital", 79% either did not raise any financing at all or did not receive any funds in the five years following their latest round.

We complemented our dataset with information on U.S. patents granted to our sample startups. We matched the company and founder names from our list to "assignee" information available from the Thomson-Reuters patent database. This database is particularly valuable for our study because it also includes information on reassignments. To measure startup patent production, we used patent application dates, which reflect as much as possible the timing of a new technology produced by a startup. By counting only patents

[9] For details regarding the penalties, refer to http://meitar.com/181064.

that were ultimately granted from such applications, we consider only valuable technologies. In our sample, 10% of the startups had applied for a patent at inception.

Of the total sample, 907 startups applied for an OCS subsidy. Of those that applied at least once, 28% never received a subsidy. The total number of applications observed in our sample is 3,483, of which 72% were awarded subsidies. This percentage is very close to the one observed for the entire population of Israeli applicants: Trajtenberg (2000) reports that the acceptance rate for OCS subsidies is approximately 70%. The average amount provided per subsidy is $300,000, and the median value is $240,000. Half of the subsidized projects were assigned 50% of the agreed-upon R&D budget. In considering the startups' initial subsidy, the share of projects supported at 50% increases to 60%.

The average age at which startups apply for their first R&D subsidy is two years and the median age is one year. Regarding the distribution of subsidized startups by sector we observe the following: 15% of them were in communications, 3% in internet, 21% in IT and software, 12% in hardware, 8% in semiconductors, 8% in cleantech, 16% in life sciences, and 17% in medical devices. This distribution is similar to the one observed for the entire population of Israeli companies, including startups.[10]

Table 1 reports descriptive statistics distinguishing between subsidized startups, startups that applied for subsidies but were denied, and startups that never applied for a subsidy. Time-varying aspects are measured at inception. As shown, startups operating in the fields of semiconductors, life sciences, medical devices, and computer hardware are overrepresented among applicants of R&D subsidies compared to non-applicants, while internet startups are underrepresented. Meanwhile, startups located in the Center district are overrepresented among applicants, while the ones in Tel Aviv appear underrepresented.

The average amount of funds startups raised from private sources is $0.7 million for applicants to R&D subsidies and $0.8 million for non-applicants. Among the applicants, we do not observe any significant difference between subsidized and non-subsidized startups in the amount of funding they raised at inception. When examining the characteristics of investors, applicants were as likely as non-applicants to attract external investment during the founding year. Among the applicants, non-subsidized applicants were more likely to attract external investors. Regarding exits, as of September 2014, applicants were as likely as non-applicants to have experienced a successful exit (either an IPO or an acquisition). However, applicants were less likely to be acquired by external companies and there is no significant difference between subsidized and non-subsidized applicants.

[10] Information can be found at http://www.moital.gov.il/CmsTamat/Rsrc/MadaanEnglish/MadaanEnglish.html.

⟨ Insert Table 1 about here ⟩

# 5 Restrictions to R&D subsidies and startups' decision to apply for a subsidy

In this section, we examine the effect government R&D subsidy restrictions have on application decisions. For this purpose, we analyze the Israeli policy reform introduced in 2006 aimed at reducing restrictions on the external transfer of subsidized know-how.

## 5.1 Empirical methodology

We start by determining the effect of the Israeli reform on the likelihood that a startup applies for government support. Let $Apply_i$ be an indicator that equals 1 if a startup $i$ applied for a government subsidy and zero otherwise. We then estimate the following linear probability model:

$$Apply_i = \alpha_0 + \alpha_1 Post\ amendment\ to\ R\&D\ Law_i + \alpha_2 \mathbf{X}_i + \alpha_3 \mathbf{P}_i + \gamma_i + \tau_i + \varepsilon_i \quad (4)$$

where $Post\ amendment\ to\ R\&D\ Law_i$ is an indicator for whether a startup's expected first application for an R&D subsidy occurred after 2005. The expected year of a first application for startups in the communications, internet, semiconductors, cleantech, medical devices, and hardware sectors, is the year following inception. Instead, startups in the software and life sciences sectors would apply on average two years after their inception. These cutoffs correspond to the median time it takes a startup from a given sector to apply for its first R&D subsidy. We uniformly apply this cutoff to startups that did and did not apply for a subsidy. The rationale is to assess how the Israeli policy reform affected the decision of startups to apply for a subsidy at around the time they were expected to make such a decision.

The vector $\mathbf{X}_i$ contains a number of controls for relevant characteristics of a startup. Time-varying aspects are measured during a startup's founding year. We begin by controlling for whether startups received private funds at inception, which is our proxy for a startup's ability to attract funds from the capital market.[11] Additionally, we proxy a startup's technology aspects with an indicator for whether the startup applied for U.S. patents at inception. We also include an indicator for whether a startup develops university inventions. This indicator controls for whether a startup's technology is science-based, given that science-based startups require relatively larger investments to bring their technologies to the market (Jensen *et al.*, 2003). Further-

[11] Since a large percentage of startups did not receive any funding at inception (57%) and 70% of the startups received less that $0.1 million we prefer to use the indicator for whether a startup had received private funds at inception rather than the amount of funds raised.

more, we include an indicator for whether a startup was located in a company-sponsored accelerator and use it as a proxy for the formal and informal links between the startup and established companies. We control for whether a startup was founded in a government incubator because startups that receive support from such incubators are subject to similar restrictions regarding the external transfer of know-how. Additionally, discussions with Israeli policy makers revealed that incubator startups tend to deal with more basic technologies than those outside of an incubator. Finally, we control for the number of startup founders and use it as a proxy for the depth and heterogeneity of founders' experience (Eisenhardt and Schoonhoven, 1990). $\gamma_i$ and $\tau_i$ in equation (4) refer to location and sector fixed effects, respectively. Specifically, we control for the districts in which startups are located (North, Haifa, Center, Tel Aviv, Jerusalem, and South) and for the following sectors: communication, information technology and software, internet, semiconductors, hardware, cleantech, life sciences, and medical devices.

To ensure that the effects we estimate with equation (4) are not confounded by pre-existing trends in the dependent variable of interest, the vector $\mathbf{P}_i$ includes a number of important controls that are worth describing in detail. In particular, the amount of U.S. venture capital (in constant U.S. dollars), by sector, controls for the availability of external capital. The total amount (in constant Israeli shekels) of Israeli venture capital and OCS funds control for the availability of internal capital. All these variables are measured during the year of a startup's expected first subsidy application. Additionally, we include the share of internet and life science ventures that were initiated during a startup's founding year to control for trends in sectors where Israel either has an expertise (internet) or is investing to develop one (life sciences). Given the differential cost it requires to set up internet and life science startups, it is more likely for the latter than for the former to undertake projects that require government subsidies. We also control for the Israeli GDP growth during the year of its expected first subsidy application. We interact the Israeli GDP growth with sector dummies, to account for differential trends across sectors.[12] Summary statistics for some of the variables of interest are presented in Table 1.

As discussed in the conceptual framework, relaxing the restriction on the external transfer of subsidized know-how should induce startups with a higher ability to attract private funds to apply. To test this prediction, we modify equation (4) and introduce an interaction term between the Israeli policy change indicator, *Post amendment to R&D Law*, and the indicator for whether a startup had received funds at inception, which

[12]The results do not change if we replace the Israeli GDP growth with the GDP growth in the U.S.A., where many Israeli firms establish their subsidiaries.

is our proxy for the ability to attract funds from the capital market. The modified equation (4) is:

$$\begin{aligned} Apply_i &= \beta_0 + \beta_1 \textit{Post amendment to R\&D Law}_i + \beta_2 \textit{Post amendment to R\&D Law}_i \textit{ x Received } funds \\ &\quad + \beta_3 \mathbf{X}_i + \beta_4 \mathbf{P}_i + \gamma_i + \tau_i + \varepsilon_i \end{aligned} \tag{5}$$

For our prediction to hold, the coefficient $\beta_2$ of the interaction between *Post amendment to R&D Law* and *Received funds* should be positive. To ensure that the indicator *Received funds* is predetermined relative to the policy reform, we will focus on those startups that were founded up until 2006.

## 5.2 Results

The results from estimating equation (4) are displayed in columns I, III, V, and VII of Table 2, while the results from estimating equation (5) are reported in the remaining columns. Standard errors are clustered around sector and the year in which a startup was established. In columns I and II, we examine the entire sample of startups. In columns III and IV, we consider those startups that were founded through 2006. In columns V and VI, we further refine the sample and remove those startups that applied for their first subsidy after two years from inception. In this way, we compare startups with homogenous rationales for seeking government support. Finally, in columns VII and VIII, we also remove those startups founded prior to 1997. By considering startups that were initiated just before or after the Israeli policy reform, we reduce the risk that potential unobserved trends may drive our findings.

We initially focus on the estimation of equation (4). Across the different sample definitions, we observe a strong negative correlation between having raised private funds at inception and the likelihood of applying for a government R&D subsidy. For instance, in column I, we report that startups with initial private funds are 13 percentage points less likely to apply for a subsidy than startups without such funds. The effect increases to 18 percentage points when we consider startups that were founded during 1997-2006, excluding the ones that applied after two years from inception.

We now turn to the effects of the Israeli policy reform on the likelihood that startups apply for a subsidy. As reported in column I, startups that are expected to apply for their first R&D subsidy after the policy change are 4 percentage points more likely to actually apply for such a subsidy relative to startups whose expected first subsidy application occurs before the policy reform. However, the effect is not significantly different from zero. The effect increases to 10 percentage points when we restrict the sample to startups founded through 2006, but remains insignificantly different from zero (column III). We continue to find similar effects when we further refine the sample and remove those startups that applied for their first sub-

sidy after two years from their launching, and when we also remove those startups founded prior to 1997 (columns V and VII).

Next, we assess whether the Israeli policy reform had a differential effect on startups that did, and did not, raise private funds at inception. Having raised funds is our measure of a startup's ability to attract private funding. According to the predictions of our theoretical model, reducing the restriction on the external transfer of subsidized know-how should increase the applicants' level of ability to attract private funds. Hence, we would expect the Israeli policy reform to predominantly affect the decision to apply for a subsidy made by startups with initial private funds. To verify this conjecture, we estimate equation (5), which relates the probability of applying for a government R&D subsidy to the Israeli policy reform indicator, whether a startup had raised private funds at inception, the interaction between these two variables, and controls. The results are reported in columns II, IV, VI, and VIII of Table 2. In line with the predictions of our model, we observe that, following the Israeli policy reform, the likelihood of applying for a government subsidy significantly increased for startups with initial private funds relative to startups without such funds. For instance, the coefficients reported in column VIII indicate that, following the reform, startups with private funds became 14 percentage points more likely to apply for government R&D subsidies than startups without such funding. Prior to the reform, startups with private funds were 22 percentage points less likely to apply for a subsidy than firms without private funds. However, after the reform, startups with private funding became as likely as startups without private support to apply for government subsidies ($p$-value: 0.11). In Table A1, we estimate a more flexible specification of equation (5), replacing the policy reform indicator with indicators for the years in which the startups are expected to apply for their first subsidy. We interact these indicators with our measure for whether startups had raised private funds at inception (*Received funds*). We report the results for our preferred specification, where we restrict the sample to startups established during 1997-2006, excluding the ones that applied for a subsidy more than two years after inception. The results from this table are synthesized in Figure 1, which plots the coefficients for the years in which startups are expected to apply for their first subsidy interacted with the *Received funds* indicator, along with the associated 95 percent confidence intervals. The results of this exercise underscore our main finding that, following the implementation of the Israeli policy reform, startups with initial private funds experienced an increase in the likelihood of applying for a subsidy relative to startups without such funds. The $F$ statistic on the coefficients for the interactions between *Received funds* and the post-reform year indicators is 2.52 ($p$-value: 0.06). Reassuringly, we observe no significant pre-reform trends. The $F$

statistic on the coefficients for the interactions between *Received funds* and the pre-reform year indicators is 1.54 ($p$-value: 0.18).

The results on the controls provide several insights. Across the different sample specifications, the availability of external capital is negatively correlated with the likelihood of applying for an R&D subsidy, while the availability of OCS funds is positively correlated. Startups located in a company-sponsored accelerator are more likely to apply for government support. These startups should be strongly rooted in the Israeli market given their ties with Israeli companies or external companies with subsidiaries in Israel. Moreover, startup applicants are predominantly located outside of the Tel Aviv district, which is typically considered the center of Israeli startup activities. Finally, applicants mostly operate in life sciences, a sector in which liquidity constraint problems tend to be most critical.

A possible concern with the results presented so far is that the Israeli policy reform may have been introduced in response to the bursting of the dot-com bubble that severely affected the Israeli economy during 2001-2002. In this case, failing to control for the appropriate trends would imply that the effect of the policy reform indicator on the likelihood of a startup applying for a subsidy is upward biased. While in our regressions we control for sector-specific time trends, in Panels A and B of Table A2, we present the results from estimating equations (4) and (5) in separate subsamples of ICT and non-ICT startups. The reason is that the effects of the policy reform on non-ICT startups should be uncorrelated or less correlated with the bursting of the dot-com bubble.[13] For brevity, we only present those models that restrict the sample to startups founded through 2006. Reassuringly, we find similar patterns across the two sectors. For instance, when we consider the sample of ICT startups that were founded during 1997-2006, excluding the ones that applied for their first subsidy two years after inception (column VI of Panel A), we find that pre-reform startups with initial private funds were 13 percentage points less likely to apply for government R&D subsidies relative to pre-reform startups without such funds. After the reform, ICT startups with initial funds became as likely as ICT startups which did not have such funding to apply for government subsidies. When we examine the sample of non-ICT startups, we observe that pre-reform startups with initial private financial support were 29 percentage points less likely to apply for government R&D subsidies relative to pre-reform startups without such support (column VI of Panel B). After the reform, non-ICT startups with initial funds became as likely as non-ICT startups without such funds to seek government support.

As a last note, it could be that reducing the restriction on the external transfer of know-how may have

[13] ICT startups include startups operating in the telecommunications, software, and internet sectors.

encouraged the formation of new ventures. Before the policy reform, individuals may not have found it profitable to start a venture because the generated value would not have been enough to compensate for their opportunity cost of becoming entrepreneurs. In analyses available upon request, we attempted to verify this hypothesis by generating a count of startups founded in a given year/sector/district. We then modeled this count as a function of district, founding year, and sector fixed effects. Additionally, we controlled for trends varying at the founding year-district and founding year-sector levels. The resulting estimates do not reveal any significant effect of the policy reform on the number of newly created startups. This analysis should be taken with caution given the limited number of observations and the fact that we cannot exploit any temporal variation in the implementation of the Israeli policy reform. Nevertheless, it provides an indication that the reform did not induce startups to enter the market because of the new rules on the external transfer of know-how.

⟨ Insert Table 2 about here ⟩

# 6 Restrictions to R&D subsidies and venture outcomes

As previously discussed, reducing the restriction on the external transfer of subsidized know-how induced applications from startups that were able to raise private funds at inception. In this section, we assess how relaxing this restriction affects the impact of receiving a subsidy on venture outcomes.

## 6.1 Empirical methodology

Startups with a greater ability to attract private funds may apply for government support in the post-reform period in order to substitute private funds with cheaper government subsidies. Alternatively, they may apply because the reduction in the restrictions on the external transfer of subsidized know-how may have increased the startups' marginal value from investing private effort in a subsidized project. Before the reform, these startups may have been able to pursue only R&D projects of small scope or a limited number of projects by relying on private funds. To assess the effect of reducing the subsidy restriction on the startups' private R&D effort and, concurrently, venture outcomes, the ideal strategy would be to estimate an instrumental variable model whereby receiving a subsidy and the interaction between receiving a subsidy and applying to the subsidy program after the policy reform are treated as endogenous. Unfortunately, we do not have enough strong instruments that would allow us to identify the system of equations defining such a model. Notwithstanding this limitation, we still can provide meaningful evidence that allows us to infer the effect

of the Israeli policy reform on venture outcomes.

We begin by analyzing the change in performance of subsidized and non-subsidized applicants after the policy reform. Let us suppose that the main effect of the policy reform was to induce applications from startups that are more attractive to private investors than pre-reform applicants, but seek government support because it has now become relatively cheaper. Then, we should observe post-reform applicants, *including non-subsidized applicants*, outperforming pre-reform applicants. If we were to observe that there is no difference in performance between post- and pre-reform non-subsidized applicants, then this evidence would be inconsistent with the policy reform predominantly enticing startups that could have undertaken R&D projects with private funds, but found government subsidies comparatively more attractive. These conjectures rely on the assumption that the Israeli government did not change its selection criteria with the policy reform, for instance, by increasing the rate of acceptance to the subsidy program or disproportionately admitting applicants with greater private funds. Thus, our empirical analysis must assess whether the government selection criteria changed coincident with the Israeli policy reform.

We examine the subsample of applicants to the Israeli R&D subsidy program and, within this subsample, evaluate a startup's survival, its ability to attract external investment, and its patent production. We define a startup as having survived if it went through an IPO or acquisition or if it raised funds in the five years from the first subsidy application. Because restrictions on the external transfer of know-how cause an increase in the opportunity costs for external investors, we employ an additional indicator for whether a startup was acquired by an external company or if it raised external capital during the five-year time window following its first application. Finally, since the Israeli government is focused on stimulating innovation, we examine the number of U.S. granted patents applied for by a startup during the same time window specified for the other outcomes. To avoid the influence of outliers, we discretize the startups' patent count and generate an indicator that is equal to zero if a startup did not apply for any patent, one if it applied for one patent, and two if it applied for more than one patent.[14] These venture outcomes are taken to be a function of observables as follows:

$$\begin{aligned} Y_i &= \delta_0 + \delta_1 \textit{Post amendment to R\&D Law}_i + \delta_2 \textit{R\&D subsidy}_i + \\ &\quad \delta_3 \textit{Post amendment to R\&D Law}_i \textit{ x R\&D subsidy}_i + \delta_4 \mathbf{X}_i + \delta_5 \mathbf{M}_i + \delta_6 \mathbf{P}_i + \gamma_i + \tau_i + \varphi_i + \varepsilon_i \quad (6) \end{aligned}$$

where $Y_i$ is either of our venture outcomes. We consider applications that were filed before 2010 to

[14]The two-patent cutoff corresponds to the 90th percentile of the patent distribution. Results remain qualitatively invariant if we instead use an indicator for whether the number of granted patents applied for after the first subsidy is greater than zero.

provide a window of five years (from 2010 to 2014) to evaluate venture outcomes.[15] In doing so, the sample of applicants decreases from 907 to 791. Considering applications that were filed before 2012 and assessing venture outcomes over a window of three years leaves our results qualitatively unchanged. *Post amendment to R&D Law* is an indicator for whether a startup's first subsidy application occurred after the amendment of the Israeli R&D Law. *R&D subsidy* is an indicator that equals 1 if an applicant was awarded an R&D subsidy and zero otherwise.[16] We focus on a startup's first application because the effect of the Israeli policy change should be especially relevant for first-time applicants. The reason is that applicants to follow-on subsidies are bounded by the restriction regime of the first subsidy at least for the portion of know-how that is produced with the initial subsidy.

According to the reasoning above, if we were to find that $\delta_1$ is positive and significantly different from zero, this evidence would be consistent with the Israeli policy reform inducing applications from startups that could have undertaken projects with private funds, but found R&D subsidies relatively more attractive. If we were to find that $\delta_1$ is insignificantly different from zero and $\delta_3$ is positive and significant, it would be possible that the Israeli policy reform *i*) did not disproportionately induce applications from startups with an intent to substitute private with public funds and *ii*) increased the marginal value that startups derive from exerting effort in a subsidized project and, thus, private effort. Clearly, these predictions rely on the assumption that the Israeli government did not meaningfully modify its criteria for accepting applicants in the R&D subsidy program concurrently with the policy reform.

The vector $\mathbf{X}_i$ contains a similar set of regressors to the ones we used in equations (4) and (5). Specifically, we control for the number of a startup's founders, the startup's age at application, and an indicator for whether a startup developed university inventions. Additionally, we include an indicator for whether a startup was founded in a government-sponsored incubator, and another one for whether it spent time in a company-sponsored accelerator. $\mathbf{M}_i$ includes the amount of private funds a startup raised up until its first subsidy application and an indicator for whether a startup received external investment during the same period. It also includes an indicator variable for whether a startup obtained Binational Industrial Research and Development (BIRD) grants prior to seeking government support and one for whether a startup experienced positive sales during the same period.[17] Finally, $\mathbf{M}_i$ includes the number of U.S. granted patents that a

[15] Most of our data on startups' outcomes and their financing rounds were collected at the end of 2014.

[16] In this paper, we do not examine the subsidy amount that a startup receives the first time it applies for a subsidy because the vast majority of startups are granted 50% of the agreed-upon R&D budget in their first application.

[17] We did not control for these startup characteristics in equations (4) and (5), because very few startups had obtained BIRD grants at inception or had experienced positive sales.

startup applied for prior to its first subsidy request. We control for district ($\gamma_i$), sector ($\tau_i$), and founding year ($\varphi_i$) fixed effects. $\mathbf{P}_i$ encompasses the Israeli GDP growth during the time in which a startup was founded and during the year of its first subsidy application interacted with sector indicators. Summary statistics on venture outcomes are reported in Table 3.

⟨ Table 3 about here ⟩

To complete our analysis, we assess whether the acceptance rate of the R&D subsidy program changed with the policy reform. For this purpose, we estimate the likelihood that an applicant is awarded a subsidy as a function of the policy reform indicator and controls. The equation we estimate is:

$$\begin{aligned} \textit{R\&D Subsidy}_i &= \psi_0 + \psi_1 \textit{Post amendment to R\&D Law}_i + \psi_2 \mathbf{X}_i + \psi_3 \mathbf{M}_i + \psi_4 \mathbf{P}_i + \\ &\quad \gamma_i + \tau_i + \varphi_i + \varepsilon_i \end{aligned} \tag{7}$$

where the vectors $\mathbf{X}_i$, $\mathbf{M}_i$, and $\mathbf{P}_i$ contain the same controls as those listed in equation (6). To evaluate whether, following the policy reform, the government changed its selection criteria and disproportionately admitted applicants with greater private funds, we modify equation (7) by introducing an interaction term between the policy reform indicator and the amount of private funds a startup raised through its first subsidy application.

A limitation of the empirical strategy described thus far is that, despite the fact that we control for a large number of applicants' characteristics in equations (6) and (7), there may still be some unobservable factors that could determine both receiving government funds and venture outcomes. Moreover, the potential bias from omitting these factors may vary depending on whether startups applied for a subsidy before or after the implementation of the Israeli policy reform. To address this concern as much as we can, we follow Busom (2000) and Hussinger (2008) and estimate a two-step Heckman selection model that treats the assignment of a subsidy as endogenous and includes a selection correction in the structural equation on venture outcomes. We first estimate this model for those startups that filed a subsidy application *both* before and after the Israeli policy reform. In so doing, we implicitly assume that the potential bias from omitting relevant variables does not vary with the Israeli policy reform. We then estimate the Heckman selection model in separate subsamples of pre- and post-reform applicants allowing for the possibility that the extent of the bias may vary with the policy reform.

It is difficult to find exclusion restrictions in our dataset. We modify equation (7) and model the probability that an applicant is awarded a subsidy as a function of the size of the R&D budget first-time applicants

submitted to the OCS as well as all the other controls listed in equation (7). The R&D budget size is available for 88% of total applicants and 87% of the applicants submitting their first subsidy request prior to 2010. Discussions with OCS officials revealed that startups with larger proposed R&D budgets are more to likely to be subsidized. As we show in the next subsection, the size of a startup's proposed R&D budget does not appear to be significantly correlated with any of the venture outcomes. To the extent that the startups' amount of private funds and their number of patents filed prior to applying for a subsidy capture the startups' R&D expenditure, R&D budget proposals could be interpreted a statement of what startups would like to accomplish in the future. However, success ultimately depends on whether startups are in fact granted a subsidy, and, thus, *ceteris paribus* the size of such proposals could affect the propensity of the OCS to subsidize a given project without impacting venture outcomes, necessarily. However, to rule out the possibility that the size of a startup's R&D budget is correlated with unobserved startup characteristics, we introduce on the right-hand side of equation (6) (and also of equation (7)) an indicator for whether an applicant is above the median of the proposed R&D budget size distribution and another indicator for whether the applicant is in the last percentile of the same distribution. The cutoffs for the median and last percentile are computed at the sector and application year levels.

### 6.2 Results

Table 4 reports the estimation of equation (6) for the performance outcomes of startup applicants. In columns I-IV of this table, we examine a startup's likelihood of survival; in columns V-VIII its likelihood of attracting external investment; and in columns IX-XII its patent output. In columns I, II, V, VI, IX, and X, we refrain from controlling for factors that may be correlated with a startup's ability to attract private funds as their inclusion may confound the effect of the policy reform on venture outcomes (these are controls in the matrix **M** of equation (6)). We add these controls in the remaining columns. Standard errors are clustered around sector and founding year.

In columns I, III, V, VII, IX, XI, we introduce the policy reform indicator (*Post amendment to R&D Law*) and the indicator for whether a startup was granted an R&D subsidy (*R&D subsidy*). None of the indicators' coefficients are significantly different from zero. In columns II, IV, VI, VIII, X, and XII, we add the interaction between *Post amendment to R&D Law* and *R&D subsidy*. Its coefficient is positive and significantly different from zero, regardless of the venture outcome analyzed and the controls utilized. Conversely, the coefficients for *Post amendment to R&D Law* and *R&D subsidy* continue to be insignificantly different from

zero. Tests on the hypothesis that $\delta_1$ and $\delta_3$ in equation 6 sum to zero indicate that the positive effect of the interaction between *Post amendment to R&D Law* and *R&D subsidy* is driven by the fact that post-reform subsidized startups tend to outperform pre-reform subsidized startups.[18] Altogether, these results indicate that, following the Israeli policy reform, venture outcomes improved for subsidized applicants but not for non-subsidized ones.

⟨ Table 4 about here ⟩

It is possible that the results obtained from estimating equation (6) are driven by the fact that the Israeli government changed its selection criteria following the policy reform. For instance, it could be that the acceptance rate increased after the policy reform given the startups' higher ability to attract private funds. Consequently, non-subsidized applicants after the reform may not have such a higher ability compared to non-subsidized applicants in the pre-reform period. We verify this possibility by estimating equation (7) for the probability that a startup is awarded a subsidy. The results are reported in Table 5. In columns I and II, we consider the entire sample of applicants. In columns III and IV, the sample is truncated in 2009 to reproduce the sample size used to estimate equation (6). The results reported in columns I and III show that, all else equal, startups applying after the policy reform are no more likely to obtain a subsidy than startups that applied before the reform. In columns II and IV of the same table, we add the interaction between the policy reform indicator and the amount of private funds received by a startup prior to applying. The coefficient of the interaction is not significantly different from zero regardless of the sample definition. This suggests that there are no significant differences in the way that a startup's pre-application amount of private funds affects the likelihood of obtaining an R&D subsidy in the post- relative to the pre-policy reform period. Results reported in Table A3 show that there are no significant differences in the way almost all the other startup characteristics we control for affect the likelihood of obtaining an R&D subsidy in the post- relative to the pre-policy reform period.

In Tables A4 and A5, we report the results from assessing *i*) venture outcomes and *ii*) the probability that applicants are awarded a subsidy in separate subsamples of ICT and non-ICT startups. This is an important robustness check. As we suggested earlier, the Israeli policy reform may have been introduced in response to the bursting of the dot-com bubble. Failing to properly control for the effects of the dot-com bubble's burst may result in a downward biased estimate of the Israeli policy reform's impact on venture outcomes, in

[18] The corresponding *p*-values are reported at the bottom of Table 4

the case of ICT startups. Moreover, it would also bias the effect of the policy reform on the likelihood that a startup is granted a subsidy (although the direction of the bias is not *a priori* clear in this case). Reassuringly, the results are consistent across subsamples, although they are more robust in the case of non-ICT startups.

⟨ Table 5 about here ⟩

As previously stated, despite the fact that we control for a large number of applicants' characteristics in equation (6), there may be some unobservable factors that could determine both receiving government funds and venture outcomes. To address this concern, we estimate the two-step Heckman selection model described in the preciding subsection. We initially estimate this model for startups that applied for a subsidy both before and after the implementation of the Israeli policy reform, thus, implicitly assuming that the potential bias from omitting relevant variables does not differ with the Israeli policy reform. For this purpose, we modify the selection equation (equation (7)) and add the logarithm for the size of a startup's proposed R&D budget. This measure is available for 87% of the applicants submitting their first subsidy request prior to 2010. To address the concern that the size of a startup's proposed R&D budget is correlated with unobserved startup characteristics, we control in equation (6) (and also in equation (7)) for whether an applicant is above the median of the proposed R&D budget size distribution and for whether the applicant is in the last percentile of the same distribution. These indicators are denoted as *Proposed R&D budget 50* and *Proposed R&D budget 90*. The cutoffs for the median and last percentile are computed at the sector and application year levels. The results are reported in Table 6.

In columns I and II, we present the estimation results for the likelihood that a startup is awarded a subsidy. In column I, we include the continuous measure for a startup's proposed R&D budget size. In column II, we add the indicators *Proposed R&D budget 50* and *Proposed R&D budget 90*. Confirming the conjectures of OCS officials, we find that startups with larger proposed R&D budgets are more likely to be awarded a subsidy (column I). Once we add the discrete indicators in column II, the effect of the continuous measure of a startup's proposed budget size declines, but remains highly significant.

In columns III to V, we report the results from estimating equation (6) for venture outcomes having controlled for the logarithm of the size of a startup's proposed R&D budget and the indicators *Proposed R&D budget 50* and *Proposed R&D budget 90*. The coefficient of the continuous measure for the size of a startup's proposed R&D budget is insignificantly different from zero, regardless of the venture outcome we examine. *Proposed R&D budget 50* has a positive and significant effect on a startup's patent output. We continue

to find that post-reform applicants that were not awarded a subsidy do not outperform non-subsidized pre-reform applicants. Additionally, we continue to observe that receiving a subsidy has a positive effect on venture outcomes only after the implementation of the Israeli policy reform. This effect is driven by post-reform subsidized startups outperforming subsidized startups in the pre-reform period.

In columns VI to VIII, we report the results from estimating equation (6) for venture outcomes having controlled for the indicators *Proposed R&D budget 50* and *Proposed R&D budget 90* and added the selection correction term. Across venture outcomes, the coefficient of the inverse of the Mill's ratio is not significantly different from zero, suggesting that the hypothesis of no selection bias cannot be rejected. As shown in column VI, the effect of receiving a subsidy post-reform is 21 percentage points larger than the effect of receiving such a subsidy in the pre-reform period. The effect of receiving a subsidy in the pre-reform period is not significantly different from zero. Post-reform subsidized startups are 14 percentage points more likely to remain active than pre-reform subsidized startups ($p$-value: 0.14), while post-reform applicants that were denied a subsidy are as likely to remain active as non-subsidized startups in the pre-reform period. Regarding the controls, we find that a startup's predetermined amount of non-government funds and the number of founders are positively correlated with a startup's survival. Conversely, the age of a startup at its first subsidy application is negatively correlated with its survival rate. The results on these controls are qualitatively the same as those presented in Table 4 for the total sample of startup applicants that filed a subsidy application prior to 2010. In column VII, we report the results for the likelihood that a startup attracts external investment. The effect of receiving a subsidy post-reform on the likelihood of attracting external investment is 22 percentage points larger than the effect of receiving such a subsidy in the pre-reform period. Again, receiving a subsidy in the pre-reform period does not improve a startup's likelihood of attracting external investment. Post-reform subsidized startups are 19 percentage points more likely to attract external investment than pre-reform subsidized startups ($p$-value: 0.01), while post-reform applicants that were denied a subsidy are as likely to attract external investment as non-subsidized startups in the pre-reform period. Expectedly, having obtained external funds prior to applying for a subsidy is positively correlated with the subsequent likelihood of receiving such funds. The results for a startup's patent output, which are reported in column VIII, are consistent with the ones for the other venture outcomes. The effect of receiving a subsidy pre-reform is not significantly different from zero. Subsidized startups in the post-reform period produce more patents than subsidized startups in the pre-reform period ($p$-value: 0.06), while non-subsidized applicants in the post-reform period produce as many patents as non-subsidized applicants

in the pre-reform period. As expected, there is a positive and significant correlation between the number of granted patents that a startup applied for prior to its first subsidy application and the patent output produced after that application.

⟨ Table 6 about here ⟩

To address the concern that omitted variable bias may vary depending on whether startups applied for a subsidy before or after the implementation of the Israeli policy reform, we estimate the Heckman selection model above in separate subsamples of pre- and post-reform applicants. We re-estimate the selection equation in each subsample of pre-reform and post-reform applicants. Because the subsample of post-reform applicants that filed a subsidy application before 2010 is made of 199 observations only, we estimate the selection equation for the entire set of post-reform applicants and not just for those that applied prior to 2010. Post-reform applicants that filed an application after 2009 should be plausibly affected by post-reform omitted factors in a similar way as post-reform applicants that filed an application before 2010. The results are displayed in Table 7. For the sake of brevity we only report the coefficients for the regressors of interest. In Panel A, we show the results for pre-reform applicants. As shown in columns I and II, the continuous measure for the size of a startup's proposed R&D budget continues to be a strong positive predictor of the probability that a startups is awarded a subsidy, regardless of whether we add the discrete indicators *Proposed R&D budget 50* and *Proposed R&D budget 90*. As reported in columns III to VIII, the effect of receiving a subsidy in the pre-reform period continues to be insignificantly different from zero, regardless of whether or not we add to the venture outcome equations the selection correction term. Additionally, the coefficients of the inverse of the Mill's ratio continue to be insignificantly different from zero. In Panel B, we report the results for post-reform applicants. The continuous measure for the size of a startup's proposed R&D budget is positively related to the probability that a startups is awarded a subsidy and the effect is significant at the 5% confidence level, regardless of the selection equation specification (columns I and II). In line with our earlier findings, results reported in columns III to VIII show that receiving a subsidy in the post-reform period positively affects venture outcomes. Finally, the coefficients of the inverse of the Mill's ratio reported in columns VI to VIII continue to be insignificantly different from zero.

⟨ Table 7 about here ⟩

Taken together, these results provide an indication that those startups, which applied for government

funding as a result of the reduction in the restriction on the external transfer of know-how, were not disproportionately inclined to substitute private funds with government subsidies relative to pre-reform applicants. Moreover, the results suggest that the policy reform increased startups' marginal value from exerting effort on a subsidized project and, concurrently, private effort.

# 7 Concluding remarks

This paper analyzes government R&D subsidies, an important funding source for entrepreneurial ventures, and emphasizes the effects that restrictions on technology transfer have on the startups' decision to apply for government support and their performance.

Examining a novel dataset of Israeli startups, we find that relaxing this restriction increased the likelihood of applying for a subsidy for startups with an ability to attract private funds that, prior to the reform, would have found it unprofitable to pursue subsidized projects. We also provide evidence that those startups that applied for subsidies as a result of the loosening of the restriction were not disproportionately more inclined to substitute private funds with government subsidies than pre-reform applicants. Finally, we show that R&D subsidies enhanced firm survival rates, the likelihood of attracting external investment, and innovation, but only for recipients applying for government support after the restriction was relaxed. This suggests that the policy reform increased startups' marginal value from exerting effort in a subsidized project and, concurrently, private effort.

These findings have important implications for policy makers as well as for entrepreneurs. For policy makers, this analysis indicates that imposing restrictions on the use of R&D subsidies makes these subsidies less effective and ultimately prevent policy makers from attaining their goal of encouraging local innovation. Particularly for small open economies that are concerned with spurring innovation and ensuring that technological spillovers are kept local, accompanying R&D subsidies with tax credits for firms maintaining their R&D facilities locally may be more effective than imposing restrictions on the external transfer of subsidized know-how. In addition, policy makers in these countries could invest in improving the innovation capacity of local universities and established firms with whom startups could collaborate. By doing so, they would increase these startups' costs of transferring their R&D facilities externally. Finally, for entrepreneurs, our findings point to the importance of understanding how restrictions on R&D subsidies affect their profits. Entrepreneurs that have outside options may refrain from applying for R&D subsidies whose restrictions could significantly reduce their degrees of freedom and ultimately make them unprofitable.

These conclusions come with some caveats, which open venues for future research. First, we have assessed the the effects of the Israeli policy reform by adopting a deductive approach and estimated selection models to account for the endogeneity of receiving an R&D subsidy. An alternative approach would have been to estimate an instrumental variable model where receiving a subsidy and receiving a subsidy post-reform are treated as endogenous variables. Second, in considering the generalizability of our analysis to other small economies, it is important to mention that Israel has comparatively strong technology sectors and, as a result, a developed network of investors. Startups located in small economies lacking such comparative advantages may have no option but to apply for government R&D subsidies. The social costs of restricting the external transfer of subsidized know-how may be larger for these economies. Third, we have analyzed a specific type of subsidy, the so-called "conditional grants." As we mentioned earlier, the characteristic of these grants is that their recipients must pay back the initial amount provided that the subsidized projects become commercially viable. This repayment scheme may penalize startups with commercially viable projects. Some of these startups could find it unprofitable to seek government support even after the restrictions on the external transfer of know-how are relaxed. However, our primary interest lies in those marginal decisions that startups make as a specific consequence of changes in the restrictions to government R&D subsidies. For completeness, future studies may extend our analysis to different types of subsidies.

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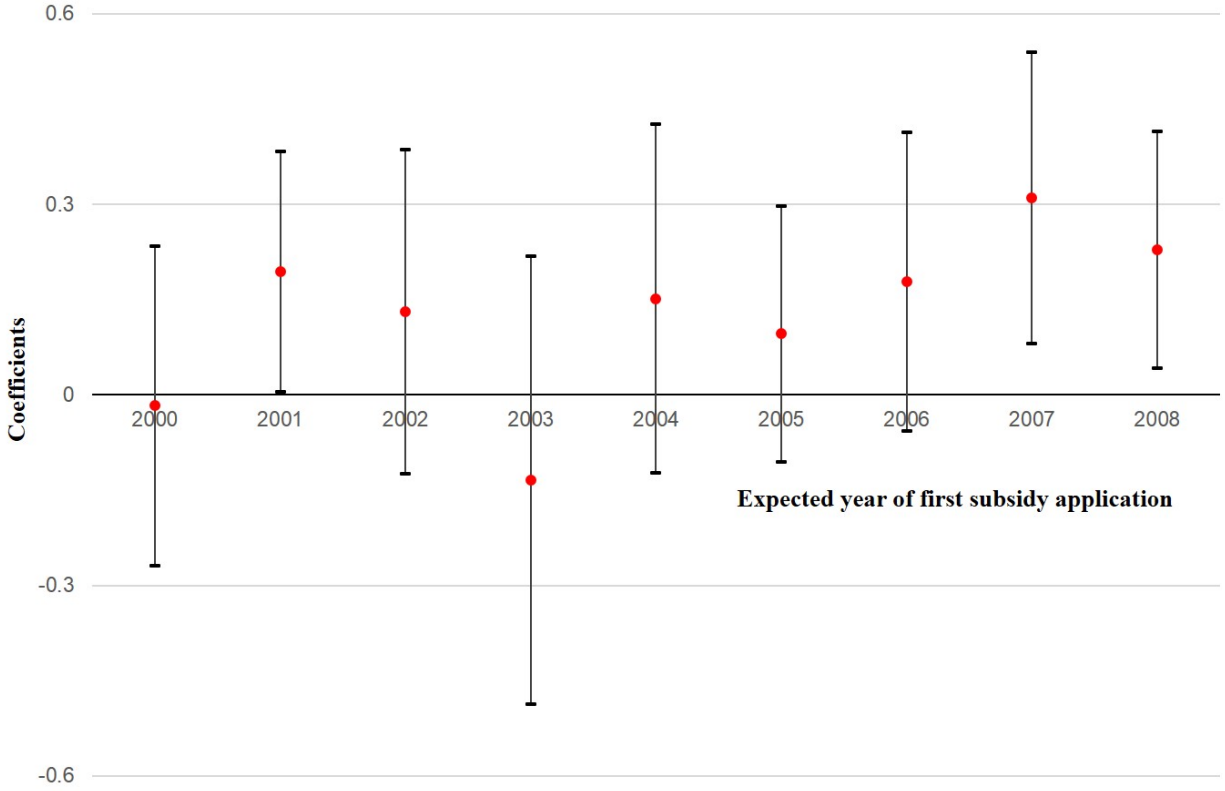


**Figure 1**. This figure represents the coefficients on the interactions between the years of the startups' expected first subsidy application and the indicator for whether the startups had raised private funds at inception. These coefficients are obtained from the model estimated in Table A1. The Israeli policy reform was implemented starting from 2006. Vertical lines are 95 percent confidence intervals for the coefficients. The $F$ statistic for the pre-reform coefficients is 1.54, while the $F$ statistic for the post-reform coefficients is 2.52.

Table 1. Summary statistics

| | Subsidized startups I | | Non-subsidized applicants II | | Non-applicants III | | *T*-test diff. means I vs. II | *T*-test diff. means I vs. III | *T*-test diff. means II vs. III |
|---|---|---|---|---|---|---|---|---|---|
| | Mean | S.D. | Mean | S.D. | Mean | S.D. | *p*-value | *p*-value | *p*-value |
| Experienced an exit (IPO/Acquisition) | 0.33 | 0.47 | 0.29 | 0.46 | 0.29 | 0.46 | 0.22 | 0.07 | 0.93 |
| Acquired by an external company | 0.15 | 0.35 | 0.16 | 0.36 | 0.20 | 0.40 | 0.69 | 0.00 | 0.10 |
| Amount of funds received ($ mill.) | 0.70 | 2.51 | 0.64 | 1.54 | 0.81 | 5.69 | 0.72 | 0.63 | 0.63 |
| Received funds from external investors | 0.17 | 0.38 | 0.22 | 0.42 | 0.19 | 0.39 | 0.09 | 0.53 | 0.15 |
| University spinoff | 0.15 | 0.35 | 0.15 | 0.36 | 0.10 | 0.29 | 0.80 | 0.00 | 0.00 |
| Government incubator | 0.21 | 0.41 | 0.16 | 0.36 | 0.18 | 0.38 | 0.06 | 0.07 | 0.39 |
| Company accelerator | 0.06 | 0.23 | 0.04 | 0.19 | 0.05 | 0.21 | 0.22 | 0.36 | 0.46 |
| N. granted patents | 0.41 | 2.26 | 0.48 | 2.34 | 0.35 | 1.95 | 0.71 | 0.54 | 0.37 |
| N. founders | 2.04 | 1.06 | 1.98 | 1.09 | 2.01 | 1.09 | 0.48 | 0.62 | 0.69 |
| North | 0.11 | 0.32 | 0.10 | 0.30 | 0.08 | 0.27 | 0.64 | 0.01 | 0.22 |
| South | 0.04 | 0.20 | 0.05 | 0.21 | 0.04 | 0.20 | 0.69 | 0.95 | 0.64 |
| Haifa | 0.10 | 0.30 | 0.08 | 0.28 | 0.09 | 0.28 | 0.40 | 0.24 | 0.90 |
| Center | 0.38 | 0.49 | 0.37 | 0.48 | 0.23 | 0.42 | 0.64 | 0.00 | 0.00 |
| Jerusalem | 0.07 | 0.26 | 0.06 | 0.24 | 0.07 | 0.26 | 0.58 | 0.92 | 0.60 |
| Tel Aviv | 0.29 | 0.45 | 0.34 | 0.47 | 0.49 | 0.50 | 0.14 | 0.00 | 0.00 |
| Communications | 0.15 | 0.36 | 0.15 | 0.36 | 0.17 | 0.38 | 0.99 | 0.35 | 0.53 |
| Internet | 0.03 | 0.16 | 0.12 | 0.33 | 0.22 | 0.41 | 0.00 | 0.00 | 0.00 |
| IT Software | 0.21 | 0.41 | 0.23 | 0.42 | 0.23 | 0.42 | 0.46 | 0.30 | 0.95 |
| Hardware | 0.11 | 0.32 | 0.10 | 0.30 | 0.08 | 0.27 | 0.59 | 0.00 | 0.17 |
| Semiconductors | 0.08 | 0.27 | 0.03 | 0.17 | 0.04 | 0.19 | 0.00 | 0.00 | 0.73 |
| Life Sciences | 0.16 | 0.37 | 0.13 | 0.34 | 0.09 | 0.29 | 0.26 | 0.00 | 0.06 |
| Medical Devices | 0.17 | 0.37 | 0.14 | 0.35 | 0.10 | 0.30 | 0.33 | 0.00 | 0.07 |
| Cleantech | 0.08 | 0.28 | 0.08 | 0.28 | 0.07 | 0.26 | 0.94 | 0.26 | 0.48 |
| Observations | 653 | | 254 | | 1397 | | | | |

*Notes*: This table reports descriptive statistics distinguishing between subsidized startups, startups that applied for an R&D subsidy but were never awarded one, and startups that never applied for a subsidy. The abbreviation *N.* stands for 'Number of." Time-varying aspects are measured at inception. *Government incubator* is an indicator for whether a startup was founded in a government-sponsored incubator. *Company accelerator* is a dummy for whether a startup had spent time in a company-sponsored accelerator. We report *p*-values for the *t*-tests of the difference in means between the characteristics of: i) subsidized applicants and non-subsidized applicants (I vs. II), ii) subsidized applicants and non-applicants (I vs. III); iii) non-subsidized applicants and non-applicants (II vs. III).

Table 2. Effects of the Israeli policy reform on startups' propensity to apply for government R&D subsidies

| | All startups | | Founded through 2006 | | Removing applications filed after 2 yrs. from start | | Founded during 1997 through 2006 | |
|---|---|---|---|---|---|---|---|---|
| | (I) | (II) | (III) | (IV) | (V) | (VI) | (VII) | (VIII) |
| Post amendment to R&D Law | 0.040 | -0.007 | 0.102 | 0.059 | 0.051 | -0.019 | 0.092 | 0.031 |
| | (0.054) | (0.055) | (0.077) | (0.077) | (0.067) | (0.070) | (0.089) | (0.088) |
| Received funds | -0.127*** | -0.176*** | -0.154*** | -0.177*** | -0.203*** | -0.241*** | -0.178*** | -0.216*** |
| | (0.021) | (0.031) | (0.027) | (0.033) | (0.030) | (0.035) | (0.032) | (0.039) |
| Post amendment to R&D Law x | | 0.113*** | | 0.100* | | 0.164*** | | 0.141** |
| Received funds | | (0.040) | | (0.051) | | (0.057) | | (0.060) |
| University spinoff | 0.029 | 0.031 | 0.043 | 0.043 | 0.023 | 0.022 | 0.028 | 0.026 |
| | (0.031) | (0.031) | (0.036) | (0.036) | (0.039) | (0.038) | (0.042) | (0.042) |
| Government incubator | -0.034 | -0.033 | -0.008 | -0.008 | 0.068* | 0.069* | 0.067 | 0.065 |
| | (0.032) | (0.032) | (0.037) | (0.037) | (0.040) | (0.040) | (0.047) | (0.047) |
| Company accelerator | 0.121*** | 0.110*** | 0.169*** | 0.164*** | 0.219*** | 0.214*** | 0.233*** | 0.227*** |
| | (0.037) | (0.038) | (0.061) | (0.061) | (0.068) | (0.068) | (0.080) | (0.081) |
| Granted patent | 0.037 | 0.045 | 0.040 | 0.044 | 0.079* | 0.085** | 0.072 | 0.078 |
| | (0.036) | (0.036) | (0.041) | (0.041) | (0.042) | (0.042) | (0.044) | (0.045) |
| N. founders (log) | 0.075** | 0.073** | 0.045 | 0.045 | 0.023 | 0.023 | 0.032 | 0.032 |
| | (0.030) | (0.030) | (0.037) | (0.037) | (0.034) | (0.034) | (0.038) | (0.038) |
| Availability of internal capital (log) | 0.035 | 0.037 | -0.028 | -0.029 | -0.075 | -0.076 | -0.050 | -0.050 |
| | (0.052) | (0.052) | (0.069) | (0.068) | (0.082) | (0.081) | (0.105) | (0.104) |
| Availability of external capital (log) | -0.049** | -0.049** | -0.058** | -0.057** | -0.081*** | -0.078*** | -0.057 | -0.054 |
| | (0.022) | (0.021) | (0.024) | (0.025) | (0.028) | (0.028) | (0.036) | (0.036) |
| Availability of OCS funds (log) | 0.102* | 0.112* | 0.197*** | 0.200*** | 0.280*** | 0.284*** | 0.319*** | 0.323*** |
| | (0.061) | (0.060) | (0.071) | (0.071) | (0.079) | (0.078) | (0.105) | (0.106) |
| Constant | -1.243 | -1.429 | -3.124** | -3.185** | -4.708*** | -4.799*** | -5.719** | -5.783** |
| | (1.205) | (1.184) | (1.419) | (1.410) | (1.560) | (1.552) | (2.211) | (2.229) |
| Sector FE | YES | YES | YES | YES | YES | YES | YES | YES |
| Region FE | YES | YES | YES | YES | YES | YES | YES | YES |
| Trends | YES | YES | YES | YES | YES | YES | YES | YES |
| Observations | 2,304 | 2,304 | 1,757 | 1,757 | 1,488 | 1,488 | 1,237 | 1,237 |
| R-squared | 0.151 | 0.154 | 0.116 | 0.118 | 0.140 | 0.145 | 0.131 | 0.135 |

*Notes*: This table reports the estimations of equations (4) and (5) for the likelihood that a startup applies for an R&D subsidy. In columns I and II, the results are for the entire sample of startups; in columns III and IV the results are for startups founded through 2006; in columns V and VI for startups founded through 2006, excluding applications filed after two years from a startup's inception; in columns VII and VIII for startups founded during 1997 through 2006, excluding applications filed after two years from a startup's inception. We control for (but do not report) the interaction between the Israeli GDP growth during a startup's expected first subsidy request year and sector FE, the share of internet and the share of life sciences startups founded in the same year as a given startup. Standard errors (in parentheses) are clustered around sector and inception year. ***, **, and *: significance at the 1%, 5%, and 10% levels.

Table 3. Summary statistics on venture outcomes for the sample of R&D subsidy applicants

| | Startups whose first application was accepted | | Startups whose first application was rejected | | $T$-test of the difference in means |
|---|---|---|---|---|---|
| | Mean | S.D | Mean | S.D | $p$-value |
| Survived | 0.54 | 0.50 | 0.47 | 0.50 | 0.046 |
| Attracted external investment | 0.36 | 0.48 | 0.31 | 0.46 | 0.101 |
| Patent output | 0.57 | 0.83 | 0.47 | 0.78 | 0.071 |
| Observations | 427 | | 364 | | |

*Notes*: This table reports descriptive statistics distinguishing between first-time applicants according to whether or not they were awarded an R&D subsidy. We truncate the sample in 2009 to provide sufficient time to evaluate venture outcomes. Consequently, the sample of applicants is made of 791 rather than 907 observations. *Survived* is an indicator for whether a startup went through an IPO or acquisition or if it raised funds in the five years from the first subsidy application. *Attracted external investment* is an indicator for whether a startup was acquired by an external company or if it raised external capital during the five-year time window following its first application. *Patent output* is an indicator that is equal to zero if a startup did not apply for any U.S. granted patent in the five years following its first subsidy application, one if it applied for one patent, and two if it applied for more than one patent.

Table 4. Effects of the Israeli policy reform on venture outcomes

| | Survival | | | | Attracting external investment | | | | Patent output | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (I) | (II) | (III) | (IV) | (V) | (VI) | (VII) | (VIII) | (IX) | (X) | (XI) | (XII) |
| Post amendment | 0.042 | -0.075 | 0.079 | -0.016 | 0.012 | -0.129 | 0.044 | -0.074 | 0.011 | -0.149 | 0.102 | -0.042 |
| to R&D Law | (0.075) | (0.083) | (0.074) | (0.083) | (0.076) | (0.089) | (0.059) | (0.074) | (0.136) | (0.125) | (0.115) | (0.104) |
| R&D subsidy | 0.050 | -0.014 | 0.037 | -0.015 | 0.029 | -0.048 | 0.013 | -0.051 | 0.096 | 0.008 | 0.057 | -0.021 |
| | (0.036) | (0.048) | (0.037) | (0.050) | (0.039) | (0.052) | (0.039) | (0.050) | (0.059) | (0.069) | (0.054) | (0.062) |
| R&D subsidy x Post | | 0.225*** | | 0.181** | | 0.268*** | | 0.224*** | | 0.309** | | 0.275** |
| amendment to R&D Law | | (0.085) | | (0.082) | | (0.077) | | (0.075) | | (0.155) | | (0.120) |
| University spinoff | 0.030 | 0.029 | 0.007 | 0.007 | -0.009 | -0.009 | -0.032 | -0.031 | 0.043 | 0.042 | -0.050 | -0.050 |
| | (0.057) | (0.057) | (0.054) | (0.054) | (0.045) | (0.043) | (0.043) | (0.042) | (0.091) | (0.091) | (0.093) | (0.093) |
| Government incubator | -0.065 | -0.079* | -0.033 | -0.046 | -0.038 | -0.056 | -0.021 | -0.037 | -0.092 | -0.113 | -0.053 | -0.073 |
| | (0.043) | (0.044) | (0.045) | (0.045) | (0.043) | (0.045) | (0.042) | (0.044) | (0.077) | (0.077) | (0.072) | (0.071) |
| Company accelerator | 0.032 | 0.011 | 0.085 | 0.066 | -0.037 | -0.062 | -0.001 | -0.024 | -0.439*** | -0.468*** | -0.354*** | -0.381*** |
| | (0.078) | (0.076) | (0.078) | (0.076) | (0.080) | (0.082) | (0.078) | (0.079) | (0.099) | (0.097) | (0.098) | (0.096) |
| Age at first application (log) | -0.101*** | -0.101*** | -0.175*** | -0.171*** | -0.046 | -0.046 | -0.122*** | -0.118*** | -0.116** | -0.116** | -0.239*** | -0.234*** |
| | (0.035) | (0.035) | (0.039) | (0.039) | (0.033) | (0.033) | (0.034) | (0.034) | (0.054) | (0.054) | (0.051) | (0.049) |
| N. founders (log) | 0.145*** | 0.144*** | 0.130*** | 0.130*** | 0.165*** | 0.165*** | 0.147*** | 0.147*** | 0.146** | 0.145** | 0.065 | 0.064 |
| | (0.036) | (0.036) | (0.037) | (0.037) | (0.033) | (0.032) | (0.032) | (0.031) | (0.060) | (0.060) | (0.056) | (0.056) |
| Amount funds received (log) | | | 0.139*** | 0.134*** | | | 0.106*** | 0.101*** | | | 0.150*** | 0.144*** |
| | | | (0.029) | (0.029) | | | (0.029) | (0.028) | | | (0.043) | (0.042) |
| Received external invest. | | | -0.004 | -0.007 | | | 0.140** | 0.136** | | | -0.022 | -0.027 |
| | | | (0.061) | (0.059) | | | (0.056) | (0.055) | | | (0.074) | (0.073) |
| Received BIRD grant | | | 0.058 | 0.063 | | | -0.106 | -0.100 | | | 0.331 | 0.338* |
| | | | (0.114) | (0.109) | | | (0.139) | (0.136) | | | (0.205) | (0.204) |
| N. granted patents (log) | | | -0.032 | -0.031 | | | 0.007 | 0.009 | | | 0.526*** | 0.528*** |
| | | | (0.038) | (0.038) | | | (0.029) | (0.029) | | | (0.062) | (0.063) |
| Experienced positive sales | | | -0.117 | -0.117 | | | -0.203*** | -0.202*** | | | -0.375*** | -0.374*** |
| | | | (0.077) | (0.076) | | | (0.077) | (0.076) | | | (0.110) | (0.111) |
| Constant | 0.599*** | 0.649*** | 0.470** | 0.515** | 0.207 | 0.260 | 0.160 | 0.215 | 0.413 | 0.482 | 0.139 | 0.207 |
| | (0.207) | (0.209) | (0.200) | (0.202) | (0.202) | (0.198) | (0.180) | (0.179) | (0.348) | (0.351) | (0.343) | (0.347) |
| Start year FE | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Sector FE | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Region FE | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Trends | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Observations | 791 | 791 | 791 | 791 | 791 | 791 | 791 | 791 | 791 | 791 | 791 | 791 |
| R-squared | 0.117 | 0.126 | 0.157 | 0.162 | 0.128 | 0.142 | 0.179 | 0.189 | 0.150 | 0.157 | 0.323 | 0.328 |
| $p$-values for $H0$: $\delta_1 + \delta_3 = 0$ (eq. (6)) | | 0.15 | | 0.05 | | 0.08 | | 0.02 | | 0.20 | | 0.10 |

*Notes*: This table reports the estimation of equation (6). We limit the sample to startup applicants. We truncate the sample in 2009 to provide sufficient time to evaluate venture outcomes. Consequently, the sample is made of 791 rather than 907 applicants. In columns I-IV, the dependent variable is an indicator for whether a startup survives after its first subsidy application. In columns V-VIII, the dependent variable is an indicator for whether a startup attracts external investment after its first subsidy application. In columns IX-XII, the outcome variable is an indicator that is equal to zero if a startup did not apply for any U.S. granted patent in the five years following its first subsidy application, one if it applied for one patent, and two if it applied for more than one patent. We control for the interaction between the Israeli GDP at a startup's inception and sector FE, as well as the interaction between the Israeli GDP at a startup's first application and sector FE. At the end of the table, the $p$-values are for the test of the null hypothesis that post-reform subsidized applicants are as performing as pre-reform subsidized applicants. Standard errors (in parentheses) are clustered around sector and inception year. ***, **, and *: significance at the 1%, 5%, and 10% levels.

Table 5. Likelihood that a startup applicant is granted an R&D subsidy

| | All first-time applications | | First-time applications filed before 2010 | |
|---|---|---|---|---|
| | (I) | (II) | (III) | (IV) |
| Post amendment to R&D Law | 0.042 | 0.005 | 0.031 | -0.040 |
| | (0.073) | (0.087) | (0.080) | (0.095) |
| Amount funds received (log) | 0.039 | 0.025 | 0.044 | 0.022 |
| | (0.027) | (0.031) | (0.028) | (0.032) |
| Post amendment to R&D Law x | | 0.030 | | 0.062 |
| Amount funds received (log) | | (0.036) | | (0.040) |
| University spinoff | -0.035 | -0.038 | -0.025 | -0.030 |
| | (0.052) | (0.052) | (0.052) | (0.051) |
| Government incubator | -0.191*** | -0.193*** | -0.200*** | -0.203*** |
| | (0.046) | (0.046) | (0.046) | (0.046) |
| Company accelerator | -0.042 | -0.045 | -0.059 | -0.061 |
| | (0.088) | (0.088) | (0.088) | (0.088) |
| Age at first application (log) | -0.050 | -0.043 | -0.027 | -0.014 |
| | (0.034) | (0.036) | (0.036) | (0.037) |
| N. founders (log) | -0.006 | -0.007 | 0.015 | 0.017 |
| | (0.032) | (0.032) | (0.032) | (0.033) |
| Received external investment | -0.003 | -0.004 | -0.006 | -0.006 |
| | (0.050) | (0.050) | (0.056) | (0.056) |
| Received BIRD grant | 0.047 | 0.046 | 0.051 | 0.052 |
| | (0.135) | (0.134) | (0.143) | (0.141) |
| N. granted patents (log) | 0.019 | 0.019 | 0.011 | 0.011 |
| | (0.026) | (0.026) | (0.026) | (0.026) |
| Experienced positive sales | -0.082 | -0.091 | -0.145* | -0.160** |
| | (0.070) | (0.072) | (0.074) | (0.075) |
| Constant | 0.504** | 0.515** | 0.420* | 0.432* |
| | (0.228) | (0.223) | (0.236) | (0.229) |
| Start year FE | YES | YES | YES | YES |
| Sector FE | YES | YES | YES | YES |
| Region FE | YES | YES | YES | YES |
| Trends | YES | YES | YES | YES |
| Observations | 907 | 907 | 791 | 791 |
| R-squared | 0.133 | 0.134 | 0.153 | 0.156 |

*Notes*: This table reports the estimation of the probability that a startup applicant is granted an R&D subsidy (equation (7) in the text). In columns I and II, we consider the entire sample of first-time applicants. In columns III and IV, we truncate the sample in 2009 to replicate the same sample definition as in Table 4. We control for the interaction between the Israeli GDP at a startup's inception and sector FE, as well as the interaction between the Israeli GDP at a startup's first application and sector FE. Standard errors (in parentheses) are clustered around sector and inception year. ***, **, and *: significance at the 1%, 5%, and 10% levels.

Table 6. Effects of the Israeli policy reform on venture outcomes: Addressing selection concerns

| | Receiving a subsidy | | Venture outcomes | | | Venture outcomes: Accounting for the endogeneity of public funding | | |
|---|---|---|---|---|---|---|---|---|
| | | | Survival | Attracting external investment | Patent output | Survival | Attracting external investment | Patent output |
| | (I) | (II) | (III) | (IV) | (V) | (VI) | (VII) | (VIII) |
| R&D subsidy | | | -0.050 | -0.032 | 0.002 | -0.049 | -0.033 | 0.002 |
| | | | (0.054) | (0.055) | (0.076) | (0.054) | (0.056) | (0.076) |
| Post amendment to R&D Law | 0.023 | 0.012 | -0.069 | -0.035 | 0.037 | -0.066 | -0.039 | 0.040 |
| | (0.085) | (0.083) | (0.092) | (0.077) | (0.093) | (0.092) | (0.078) | (0.093) |
| R&D subsidy x | | | 0.209** | 0.223*** | 0.224* | 0.210** | 0.226*** | 0.223* |
| Post amendment to R&D Law | | | (0.091) | (0.081) | (0.124) | (0.092) | (0.082) | (0.124) |
| Proposed R&D budget (log) | 0.061*** | 0.044*** | 0.001 | 0.016 | -0.014 | | | |
| | (0.017) | (0.016) | (0.019) | (0.015) | (0.035) | | | |
| Proposed R&D budget 50 | | 0.148*** | 0.010 | 0.011 | 0.224*** | 0.018 | -0.054 | 0.258* |
| | | (0.046) | (0.061) | (0.051) | (0.079) | (0.084) | (0.076) | (0.133) |
| Proposed R&D budget 90 | | 0.062 | 0.076 | 0.027 | 0.114 | 0.081 | -0.003 | 0.126 |
| | | (0.058) | (0.052) | (0.050) | (0.079) | (0.060) | (0.059) | (0.099) |
| University spinoff | -0.033 | -0.030 | 0.021 | -0.054 | -0.021 | 0.021 | -0.040 | -0.029 |
| | (0.060) | (0.060) | (0.058) | (0.043) | (0.094) | (0.057) | (0.044) | (0.096) |
| Government incubator | -0.040 | -0.037 | 0.021 | -0.050 | -0.144* | 0.017 | -0.032 | -0.152* |
| | (0.054) | (0.051) | (0.059) | (0.049) | (0.082) | (0.060) | (0.052) | (0.089) |
| Company accelerator | -0.012 | -0.011 | 0.113 | -0.054 | -0.372*** | 0.114 | -0.046 | -0.375*** |
| | (0.093) | (0.090) | (0.083) | (0.082) | (0.101) | (0.083) | (0.083) | (0.101) |
| Age at first application (log) | -0.063* | -0.048 | -0.188*** | -0.121*** | -0.209*** | -0.190*** | -0.102*** | -0.221*** |
| | (0.037) | (0.037) | (0.044) | (0.036) | (0.056) | (0.047) | (0.037) | (0.057) |
| N. founders (log) | 0.020 | 0.016 | 0.149*** | 0.159*** | 0.029 | 0.149*** | 0.152*** | 0.033 |
| | (0.034) | (0.034) | (0.038) | (0.033) | (0.061) | (0.037) | (0.033) | (0.061) |
| Amount funds received (log) | 0.024 | 0.008 | 0.123*** | 0.088*** | 0.102** | 0.124*** | 0.084*** | 0.104** |
| | (0.030) | (0.031) | (0.030) | (0.030) | (0.046) | (0.030) | (0.030) | (0.047) |
| Received external investment | -0.005 | 0.001 | 0.014 | 0.157*** | -0.022 | 0.013 | 0.155*** | -0.022 |
| | (0.063) | (0.063) | (0.063) | (0.057) | (0.081) | (0.063) | (0.057) | (0.081) |
| Received BIRD grant | 0.145 | 0.139 | 0.078 | -0.139 | 0.608** | 0.086 | -0.188 | 0.636** |
| | (0.146) | (0.147) | (0.134) | (0.161) | (0.237) | (0.140) | (0.162) | (0.251) |
| N. granted patents (log) | 0.012 | 0.013 | -0.042 | 0.006 | 0.532*** | -0.041 | 0.000 | 0.535*** |
| | (0.030) | (0.030) | (0.039) | (0.029) | (0.060) | (0.040) | (0.029) | (0.061) |
| Experienced positive sales | -0.032 | -0.031 | -0.061 | -0.149* | -0.322*** | -0.064 | -0.137 | -0.328*** |
| | (0.079) | (0.079) | (0.078) | (0.083) | (0.101) | (0.077) | (0.083) | (0.105) |
| Inverse Mill's ratio | | | | | | 0.078 | -0.880 | 0.510 |
| | | | | | | (0.624) | (0.607) | (1.287) |
| Constant | -0.237 | -0.018 | 0.223 | -0.077 | 0.418 | 0.234 | 0.579* | -0.026 |
| | (0.358) | (0.334) | (0.340) | (0.271) | (0.540) | (0.373) | (0.348) | (0.771) |
| FE & Trends | YES | YES | YES | YES | YES | YES | YES | YES |
| Observations | 685 | 685 | 685 | 685 | 685 | 685 | 685 | 685 |
| R-squared | 0.147 | 0.159 | 0.178 | 0.228 | 0.359 | 0.177 | 0.227 | 0.359 |
| $p$-values for *H0*: $\delta_1 + \delta_3 = 0$ (eq. (6)) | | | 0.14 | 0.00 | 0.06 | 0.14 | 0.01 | 0.06 |

*Notes*: In column I, the likelihood of that a startup is granted an R&D subsidy is modeled as a function of the size of a startup's proposed R&D budget and the controls listed in equation (7). In column II, we add the indicators for whether startups are above the median of the proposed R&D budget size distribution (*Proposed R&D budget 50*) and for whether they are in the last percentile of the same distribution (*Proposed R&D budget 90*). In columns III to VIII, we examine venture outcomes. In columns III-V, we control for the continuous measure of the size of a startup's proposed R&D budget, the indicators *Proposed R&D budget 50* and *Proposed R&D budget 90*, and the other regressors listed in equation (6). In columns VI-VIII, we add the selection correction term. The startups' proposed R&D budget is available for 685 of the 791 applicants that filed their first application before 2010. Standard errors (in parentheses) are clustered around sector and inception year. ***, **, and *: significance at the 1%, 5%, and 10% levels.

Table 7. Effects of the Israeli policy reform on venture outcomes: Addressing selection concerns in separate samples of of pre- and post reform applicants

| **PANEL A: Pre-Reform Applicants** | Receiving a subsidy | | Venture outcomes | | | Venture outcomes: Accounting for the endogeneity of public funding | | |
|---|---|---|---|---|---|---|---|---|
| | | | Survival | Attracting external investment | Patent output | Survival | Attracting external investment | Patent output |
| | (I) | (II) | (III) | (IV) | (V) | (VI) | (VII) | (VIII) |
| R&D subsidy | | | -0.060 | -0.041 | 0.016 | -0.058 | -0.041 | 0.017 |
| | | | (0.057) | (0.058) | (0.082) | (0.057) | (0.058) | (0.082) |
| Proposed R&D budget (log) | 0.062*** | 0.051*** | 0.005 | 0.021 | -0.002 | | | |
| | (0.020) | (0.019) | (0.022) | (0.019) | (0.044) | | | |
| Proposed R&D budget 50 | | 0.061 | -0.005 | 0.008 | 0.086 | 0.001 | -0.018 | 0.090 |
| | | (0.050) | (0.062) | (0.061) | (0.080) | (0.071) | (0.068) | (0.096) |
| Proposed R&D budget 90 | | 0.076 | 0.066 | 0.150 | 0.062 | 0.064 | 0.105 | 0.062 |
| | | (0.151) | (0.171) | (0.143) | (0.243) | (0.175) | (0.147) | (0.253) |
| Inverse Mill's ratio | | | | | | 0.008 | -0.907 | 0.106 |
| | | | | | | (0.657) | (0.641) | (1.399) |
| Controls | YES | YES | YES | YES | YES | YES | YES | YES |
| FE & Trends | YES | YES | YES | YES | YES | YES | YES | YES |
| Observations | 486 | 486 | 486 | 486 | 486 | 486 | 486 | 486 |
| R-squared | 0.195 | 0.197 | 0.152 | 0.218 | 0.322 | 0.151 | 0.216 | 0.3222 |
| **PANEL B: Post-Reform Applicants** | Receiving a subsidy | | Venture outcomes | | | Venture outcomes:Accounting for the endogeneity of public funding | | |
| | | | Survival | Attracting external investment | Patent output | Survival | Attracting external investment | Patent output |
| | (I) | (II) | (III) | (IV) | (V) | (VI) | (VII) | (VIII) |
| R&D subsidy | | | 0.153* | 0.217*** | 0.197* | 0.167** | 0.234*** | 0.207* |
| | | | (0.078) | (0.062) | (0.112) | (0.081) | (0.066) | (0.111) |
| Proposed R&D budget (log) | 0.054** | 0.038** | -0.065 | -0.036 | -0.119 | | | |
| | (0.021) | (0.019) | (0.067) | (0.069) | (0.084) | | | |
| Proposed R&D budget 50 | | 0.098 | 0.222** | 0.008 | 0.369*** | 0.209* | 0.009 | 0.297* |
| | | (0.069) | (0.091) | (0.075) | (0.135) | (0.106) | (0.093) | (0.158) |
| Proposed R&D budget 90 | | 0.077 | -0.202 | -0.306 | 0.304 | -0.231 | -0.309 | 0.203 |
| | | (0.230) | (0.287) | (0.216) | (0.457) | (0.258) | (0.195) | (0.446) |
| Inverse Mill's ratio | | | | | | 0.618 | 0.414 | 0.225 |
| | | | | | | (1.176) | (1.125) | (1.540) |
| Controls | YES | YES | YES | YES | YES | YES | YES | YES |
| FE & Trends | YES | YES | YES | YES | YES | YES | YES | YES |
| Observations | 315 | 315 | 199 | 199 | 199 | 199 | 199 | 199 |
| R-squared | 0.187 | 0.193 | 0.379 | 0.479 | 0.543 | 0.358 | 0.438 | 0.520 |

*Notes*: In column I, the likelihood that a startup is granted an R&D subsidy is modeled as a function of the continuous measure for the size of a startup's proposed R&D budget and the controls listed in equation (7). In column II, we add an indicator for whether startups are above the median of the proposed R&D budget size distribution (*Proposed R&D budget 50*) and one for whether they are in the last percentile of the same distribution (*Proposed R&D budget 90*). In columns III to VIII, we examine venture outcomes. Specifically, in columns III-V, we control for the continuous measure of the size of a startup's proposed R&D budget, the discrete indicators *Proposed R&D budget 50* and *Proposed R&D budget 90*, as well as the regressors listed in equation (6). In columns VI-VIII, we add the selection correction term to *Proposed R&D budget 50*, *Proposed R&D budget 90*, and the regressors listed in equation (6). The startups' proposed R&D budget is available for 685 of the 791 applicants that filed their first application before 2010. Because the subsample of post-reform applicants that filed a subsidy application prior to 2010 is made of 199 observations only, we estimate the selection equation for the entire set of post-reform applicants and not just for those that applied prior to 2010. Standard errors (in parentheses) are clustered around sector and inception year. ***, **, and *: significance at the 1%, 5%, and 10% levels.

Table A1. Effects of the Israeli policy reform on startups' propensity to apply for government R&D subsidies

| | Likelihood of applying for an R&D subsidy |
|---|---|
| Y 2000 x Received funds | -0.017 |
| | (0.126) |
| Y 2001 x Received funds | 0.195** |
| | (0.095) |
| Y 2002 x Received funds | 0.131 |
| | (0.128) |
| Y 2003 x Received funds | -0.134 |
| | (0.177) |
| Y 2004 x Received funds | 0.152 |
| | (0.138) |
| Y 2005 x Received funds | 0.096 |
| | (0.101) |
| Y 2006 x Received funds | 0.179 |
| | (0.118) |
| Y 2007 x Received funds | 0.310*** |
| | (0.115) |
| Y 2008 x Received funds | 0.228** |
| | (0.094) |
| Y 1999 | 0.087 |
| | (0.137) |
| Y 2000 | 0.083 |
| | (0.141) |
| Y 2001 | -0.080 |
| | (0.131) |
| Y 2002 | 0.139 |
| | (0.167) |
| Y 2003 | 0.231 |
| | (0.180) |
| Y 2004 | 0.000 |
| | (0.190) |
| Y 2005 | 0.006 |
| | (0.183) |
| Y 2006 | 0.005 |
| | (0.141) |
| Y 2007 | -0.025 |
| | (0.212) |
| Y 2008 | 0.037 |
| | (0.290) |
| Received funds | -0.303*** |
| | (0.086) |
| Controls | YES |
| Sector & Region FEs | YES |
| Observations | 1,237 |
| R-squared | 0.150 |

*Notes*: We report the coefficients on the years of the startups' expected first subsidy application and the interactions between these year indicators and the *Received funds* variable using the same sample definition as in column VIII of Table 2. *Received funds* is an indicator for whether startups had received private funds at inception. Since there are very few sample startups with initial funds that were expected to apply for their first subsidy in 1998 and 1999, we combine them together. The $F$ statistic on the pre-reform year coefficients is 1.47 ($p$-value: 0.19). The $F$ statistic on the coefficients for the interactions between *Received funds* and the pre-reform year indicators is 1.54 ($p$-value: 0.18). The $F$ statistic on the coefficients for the interactions between *Received funds* and the post-reform year indicators is 2.52 ($p$-value: 0.06). The $F$ statistic on the coefficients for the post-reform year indicators is 0.09 ($p$-value: 0.96). Controls and fixed effects are listed in the text. Standard errors (in parentheses) are clustered around sector and inception year. ***, **, and *: significance at the 1%, 5%, and 10% levels.

Table A2. Effects of the Israeli policy reform on startups' propensity to apply for government R&D subsidies: ICT and non-ICT startups

| **PANEL A: ICT Startups** | Founded through 2006 | | Removing applications filed after 2 yrs. from start | | Founded during 1997 through 2006 | |
|---|---|---|---|---|---|---|
| | (I) | (II) | (III) | (IV) | (V) | (VI) |
| Post amendment to R&D | -0.016 | -0.022 | -0.010 | -0.063 | 0.134 | 0.094 |
| | (0.096) | (0.098) | (0.080) | (0.087) | (0.128) | (0.128) |
| Received funds | -0.084** | -0.088* | -0.115*** | -0.154*** | -0.091** | -0.127** |
| | (0.034) | (0.044) | (0.039) | (0.048) | (0.038) | (0.049) |
| Post amendment to R&D | | 0.017 | | 0.142** | | 0.118* |
| Law x Received funds | | (0.066) | | (0.069) | | (0.070) |
| Controls | YES | YES | YES | YES | YES | YES |
| Sector FE | YES | YES | YES | YES | YES | YES |
| Region FE | YES | YES | YES | YES | YES | YES |
| Trends | YES | YES | YES | YES | YES | YES |
| Observations | 898 | 898 | 786 | 786 | 686 | 686 |
| R-squared | 0.118 | 0.118 | 0.136 | 0.140 | 0.134 | 0.137 |

| **PANEL B: Non-ICT Startups** | Founded through 2006 | | Removing applications filed after 2 yrs. from start | | Founded during 1997 through 2006 | |
|---|---|---|---|---|---|---|
| | (I) | (II) | (III) | (IV) | (V) | (VI) |
| Post amendment to R&D | 0.223* | 0.128 | 0.090 | 0.004 | 0.245 | 0.102 |
| | (0.125) | (0.118) | (0.126) | (0.126) | (0.171) | (0.160) |
| Received funds | -0.221*** | -0.257*** | -0.288*** | -0.321*** | -0.225*** | -0.288*** |
| | (0.035) | (0.040) | (0.038) | (0.041) | (0.042) | (0.049) |
| Post amendment to R&D | | 0.179** | | 0.172* | | 0.256** |
| Law x Received funds | | (0.081) | | (0.097) | | (0.098) |
| Controls | YES | YES | YES | YES | YES | YES |
| Sector FE | YES | YES | YES | YES | YES | YES |
| Region FE | YES | YES | YES | YES | YES | YES |
| Trends | YES | YES | YES | YES | YES | YES |
| Observations | 859 | 859 | 702 | 702 | 551 | 551 |
| R-squared | 0.107 | 0.111 | 0.141 | 0.146 | 0.119 | 0.130 |

*Notes*: This table reports the estimation of equations (4) and (5). We estimate linear probability models for the likelihood that a startup applies for an R&D subsidy, distinguishing between ICT startups (Panel A) and non-ICT startups (Panel B). ICT startups include startups operating in telecommunications, software, and the internet sectors. Columns I and II report results from restricting the sample to startups founded through 2006. Columns III and IV report results for startups founded through 2006, excluding applications filed after two years from a startup's start year. Finally, columns V and VI report results for startups founded during 1997 through 2006, excluding applications filed after two years from a startup's start year. Controls, trends, and fixed effects are the same as those listed in Table 2. Standard errors (in parentheses) are clustered around sector and inception year. ***, **, and *: significance at the 1%, 5%, and 10% levels.

Table A3. Likelihood that a startup applicant is granted an R&D subsidy

| | All first-time applications | First-time applications filed before 2010 |
|---|---|---|
| Post amendment to R&D Law | 0.109 | -0.027 |
| | (0.183) | (0.214) |
| Amount funds received (log) | 0.023 | 0.021 |
| | (0.034) | (0.035) |
| Amount funds received (log) x Post amendment to R&D Law | 0.017 | 0.057 |
| | (0.054) | (0.058) |
| University spinoff | -0.044 | -0.041 |
| | (0.062) | (0.062) |
| University spinoff x Post amendment to R&D Law | -0.017 | 0.001 |
| | (0.119) | (0.128) |
| Government incubator | -0.281*** | -0.282*** |
| | (0.048) | (0.049) |
| Government incubator x Post amendment to R&D Law | 0.296*** | 0.337** |
| | (0.109) | (0.131) |
| Company accelerator | -0.232** | -0.236** |
| | (0.100) | (0.099) |
| Company accelerator x Post amendment to R&D Law | 0.372** | 0.426** |
| | (0.147) | (0.177) |
| Age at first application (log) | -0.016 | -0.007 |
| | (0.042) | (0.042) |
| Age at first application (log) x Post amendment to R&D Law | -0.068 | -0.019 |
| | (0.076) | (0.102) |
| N. founders (log) | 0.017 | 0.020 |
| | (0.042) | (0.043) |
| N. founders (log) x Post amendment to R&D Law | -0.049 | 0.002 |
| | (0.074) | (0.082) |
| Received external investment | -0.032 | -0.030 |
| | (0.076) | (0.078) |
| Received external investment x Post amendment to R&D Law | 0.065 | 0.081 |
| | (0.109) | (0.122) |
| Received BIRD grant | 0.084 | 0.070 |
| | (0.156) | (0.153) |
| Received BIRD grant x Post amendment to R&D Law | -0.063 | -0.046 |
| | (0.311) | (0.449) |
| N. granted patents (log) | 0.016 | 0.015 |
| | (0.033) | (0.033) |
| N. granted patents (log) x Post amendment to R&D Law | -0.024 | -0.063 |
| | (0.062) | (0.062) |
| Experienced positive sales | -0.226* | -0.223* |
| | (0.129) | (0.129) |
| Experienced positive sales x Post amendment to R&D Law | 0.265 | 0.161 |
| | (0.167) | (0.171) |
| Constant | 0.489** | 0.427* |
| | (0.215) | (0.229) |
| Start year/Sector/Region FEs | YES | YES |
| Sector FE x Post amendment to R&D Law | YES | YES |
| Region FE x Post amendment to R&D Law | YES | YES |
| Trends | YES | YES |
| Observations | 907 | 791 |
| R-squared | 0.167 | 0.194 |

*Notes*: Standard errors (in parentheses) are clustered around sector and inception year. ***, **, and *: significance at the 1%, 5%, and 10% levels.

Table A4. Effects of the Israeli policy reform on venture outcomes - ICT and non-ICT startups

| **PANEL A: ICT Startups** | Survival | | | | Attracting external investment | | | | Patent output | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (I) | (II) | (III) | (IV) | (V) | (VI) | (VII) | (VIII) | (IX) | (X) | (XI) | (XII) |
| Post amendment to R&D Law | -0.030 | -0.108 | 0.018 | -0.059 | -0.033 | -0.116 | 0.003 | -0.088 | 0.017 | -0.053 | 0.089 | 0.010 |
| | (0.125) | (0.131) | (0.117) | (0.128) | (0.121) | (0.138) | (0.092) | (0.121) | (0.114) | (0.120) | (0.137) | (0.139) |
| R&D subsidy | 0.076 | 0.027 | 0.068 | 0.020 | 0.064 | 0.008 | 0.052 | -0.005 | 0.093 | 0.049 | 0.072 | 0.022 |
| | (0.062) | (0.077) | (0.060) | (0.077) | (0.071) | (0.098) | (0.068) | (0.092) | (0.089) | (0.110) | (0.082) | (0.106) |
| R&D subsidy x | | 0.166 | | 0.161 | | 0.186 | | 0.192 | | 0.149 | | 0.166 |
| Post amendment to R&D Law | | (0.116) | | (0.119) | | (0.128) | | (0.121) | | (0.187) | | (0.159) |
| Controls in $X_i$ | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Controls in $M_i$ | | | YES | YES | | | YES | YES | | | YES | YES |
| Start year FE | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Sector FE | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Region FE | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Trends | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Observations | 339 | 339 | 339 | 339 | 339 | 339 | 339 | 339 | 339 | 339 | 339 | 339 |
| R-squared | 0.165 | 0.170 | 0.205 | 0.209 | 0.155 | 0.160 | 0.216 | 0.223 | 0.161 | 0.163 | 0.350 | 0.352 |

| **PANEL B: Non-ICT Startups** | Survival | | | | Attracting external investment | | | | Patent output | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (I) | (II) | (III) | (IV) | (V) | (VI) | (VII) | (VIII) | (IX) | (X) | (XI) | (XII) |
| Post amendment to R&D Law | 0.088 | -0.070 | 0.112 | -0.021 | -0.023 | -0.205 | -0.018 | -0.177 | -0.015 | -0.286 | 0.100 | -0.132 |
| | (0.102) | (0.118) | (0.104) | (0.123) | (0.097) | (0.110) | (0.077) | (0.091) | (0.218) | (0.192) | (0.172) | (0.162) |
| R&D subsidy | 0.033 | -0.048 | 0.024 | -0.043 | 0.012 | -0.078 | 0.011 | -0.070 | 0.111 | -0.029 | 0.082 | -0.036 |
| | (0.052) | (0.071) | (0.055) | (0.074) | (0.047) | (0.062) | (0.048) | (0.059) | (0.085) | (0.096) | (0.076) | (0.079) |
| R&D subsidy x | | 0.290** | | 0.241* | | 0.322*** | | 0.289*** | | 0.496** | | 0.421** |
| Post amendment to R&D Law | | (0.123) | | (0.122) | | (0.090) | | (0.091) | | (0.235) | | (0.181) |
| Controls in $X_i$ | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Controls in $M_i$ | | | YES | YES | | | YES | YES | | | YES | YES |
| Start year FE | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Sector FE | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Region FE | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Trends | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Observations | 452 | 452 | 452 | 452 | 452 | 452 | 452 | 452 | 452 | 452 | 452 | 452 |
| R-squared | 0.142 | 0.156 | 0.181 | 0.190 | 0.182 | 0.202 | 0.224 | 0.240 | 0.168 | 0.182 | 0.335 | 0.345 |

*Notes*: This table reports the estimation of equation (6). We truncate the sample in 2009 to provide sufficient time to evaluate venture outcomes. In columns I-IV, we estimate linear probability models for the likelihood that a startup survives after its first subsidy application. In columns V-VIII, we estimate linear probability models for the likelihood that a startup attracts external investment after its first subsidy application. In columns IX-XII, the outcome variable is an indicator that is equal to zero if a startup did not apply for any U.S. granted patent in the five years following its first subsidy application, one if it applied for one patent, and two if it applied for more than one patent. The list of controls encompassed in the vectors $X_i$ and $M_i$ is provided in the text. We control for the interaction between the Israeli GDP at a startup's inception and sector FE, as well as the interaction between the Israeli GDP at a startup's first application and sector FE. Standard errors (in parentheses) are clustered around sector and inception year. ***, **, and *: significance at the 1%, 5%, and 10% levels.

Table A5. Likelihood that a startup applicant is granted an R&D subsidy: ICT and non-ICT startups

| | ICT Startups | | | | Non-ICT Startups | | | |
|---|---|---|---|---|---|---|---|---|
| | All first-time applications | | First-time applications filed before 2010 | | All first-time applications | | First-time applications filed before 2010 | |
| | (I) | (II) | (III) | (IV) | (V) | (VI) | (VII) | (VIII) |
| Post amendment to R&D Law | 0.096 | 0.081 | 0.064 | 0.001 | 0.050 | -0.016 | 0.056 | -0.029 |
| | (0.116) | (0.143) | (0.135) | (0.162) | (0.091) | (0.110) | (0.108) | (0.120) |
| Funds received (log) | 0.050 | 0.045 | 0.056 | 0.042 | 0.036 | 0.008 | 0.028 | -0.002 |
| | (0.039) | (0.043) | (0.043) | (0.044) | (0.037) | (0.043) | (0.039) | (0.048) |
| Post amendment to R&D Law x | | 0.013 | | 0.060 | | 0.053 | | 0.072 |
| Amount funds received (log) | | (0.049) | | (0.057) | | (0.048) | | (0.053) |
| University spinoff | 0.210*** | 0.212*** | 0.217*** | 0.229*** | -0.086 | -0.091 | -0.084 | -0.092 |
| | (0.065) | (0.067) | (0.062) | (0.067) | (0.062) | (0.062) | (0.060) | (0.061) |
| Government incubator | -0.179** | -0.180** | -0.178** | -0.181** | -0.145*** | -0.150*** | -0.155*** | -0.159*** |
| | (0.089) | (0.089) | (0.087) | (0.087) | (0.055) | (0.055) | (0.058) | (0.058) |
| Company accelerator | -0.367** | -0.368** | -0.286 | -0.285 | 0.058 | 0.053 | -0.005 | -0.007 |
| | (0.159) | (0.160) | (0.199) | (0.204) | (0.091) | (0.091) | (0.094) | (0.094) |
| Age at first application (log) | -0.149** | -0.146** | -0.124* | -0.114* | 0.027 | 0.042 | 0.050 | 0.068 |
| | (0.057) | (0.059) | (0.064) | (0.065) | (0.044) | (0.047) | (0.042) | (0.043) |
| N. founders (log) | -0.014 | -0.014 | -0.002 | -0.001 | -0.002 | -0.002 | 0.027 | 0.029 |
| | (0.049) | (0.049) | (0.047) | (0.047) | (0.044) | (0.045) | (0.047) | (0.048) |
| Received external investment | -0.082 | -0.082 | -0.061 | -0.063 | 0.020 | 0.020 | 0.014 | 0.012 |
| | (0.071) | (0.071) | (0.081) | (0.082) | (0.072) | (0.072) | (0.079) | (0.078) |
| Received BIRD grant | 0.009 | 0.010 | -0.003 | -0.002 | 0.213 | 0.206 | 0.269 | 0.273 |
| | (0.171) | (0.172) | (0.169) | (0.168) | (0.239) | (0.237) | (0.283) | (0.275) |
| N. granted patents (log) | 0.000 | -0.000 | -0.002 | -0.006 | 0.004 | 0.005 | -0.003 | -0.000 |
| | (0.036) | (0.036) | (0.036) | (0.038) | (0.038) | (0.038) | (0.041) | (0.042) |
| Experienced positive sales | -0.137 | -0.143 | -0.168 | -0.196* | 0.025 | 0.010 | -0.014 | -0.021 |
| | (0.089) | (0.092) | (0.102) | (0.104) | (0.114) | (0.117) | (0.141) | (0.136) |
| Constant | 0.704*** | 0.709*** | 0.618** | 0.627*** | 0.416 | 0.432 | 0.220 | 0.226 |
| | (0.235) | (0.235) | (0.239) | (0.234) | (0.305) | (0.305) | (0.343) | (0.342) |
| Start year FE | YES | YES | YES | YES | YES | YES | YES | YES |
| Sector FE | YES | YES | YES | YES | YES | YES | YES | YES |
| Region FE | YES | YES | YES | YES | YES | YES | YES | YES |
| Trends | YES | YES | YES | YES | YES | YES | YES | YES |
| Observations | 383 | 383 | 339 | 339 | 524 | 524 | 452 | 452 |
| R-squared | 0.220 | 0.220 | 0.205 | 0.208 | 0.157 | 0.159 | 0.188 | 0.191 |

*Notes*: This table reports the estimation of the probability that a startup applicant is granted an R&D subsidy (equation (7) in the text). In columns I-IV, we report the results for ICT startups. In columns V-VIII, we report the results for non-ICT startups. In columns I and II, we consider the entire sample of ICT startups. Similarly, in columns V and VI, we consider the entire sample of non-ICT startups. In columns III and IV as well as in columns VII and VIII, we truncate the sample in 2009. We control for the interaction between the Israeli GDP at a startup's inception and sector FE, as well as the interaction between the Israeli GDP at a startup's first application and sector FE. Standard errors (in parentheses) are clustered around sector and inception year. ***, **, and *: significance at the 1%, 5%, and 10% levels.