

## Does R&D Activity Stimulated by Chile's FONDEF and FONTEC Programs Lead to Knowledge Spillovers?



Chile's FONDEF and FONTEC R&D grant programs both boost the productivity of direct beneficiaries, increasing total factor productivity (TFP) by around 4.2 percent.



However, spillover effects are contingent on program design. Only FONDEF-funded projects (requiring collaboration between firms and research centers) generate positive spillovers. FONTEC projects, which fund R&D within the firm, do not.



Spillover effects are nonlinear according to the share of firms within a sector-region receiving subsidies. Positive knowledge spillovers dominate when the share of treated firms is small. However, if the program supports a large share of a firm's rivals, spillovers decline as a result of a business-stealing effect.

### CONTEXT

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In the 2014 Development in the Americas report, [\*Rethinking Productive Development\*](#), we argued that productive development policies should be guided by the question, "Where's the failure?" Absent a clear market failure, policy interventions are not justified. The fundamental justification for R&D subsidies is the potential for R&D to generate knowledge spillovers. Yet, the vast majority of the literature on the impact of R&D subsidies on firm performance focuses on the effect on direct beneficiaries, completely missing the mark. By focusing on spillover effects in two very different programs in the same country, this study addresses this shortcoming and uncovers some of the features of R&D programs that are more likely to lead to positive spillovers.

### THE PROJECT

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We use fixed-effects techniques to estimate the direct and spillover effects on firm productivity of Chile's two R&D matching grant programs. One of them, FONTEC, focuses on intramural R&D—projects undertaken within the firm. The other, FONDEF, focuses on extramural R&D projects undertaken in collaboration with universities or technology institutes. We merge data from several waves of Chile's National Manufacturing Surveys with data on firm participation in these programs. To look at spillover effects, we measure the share of firms within each sector-region that have received treatment and see whether this proportion affects the productivity of non-treated firms.

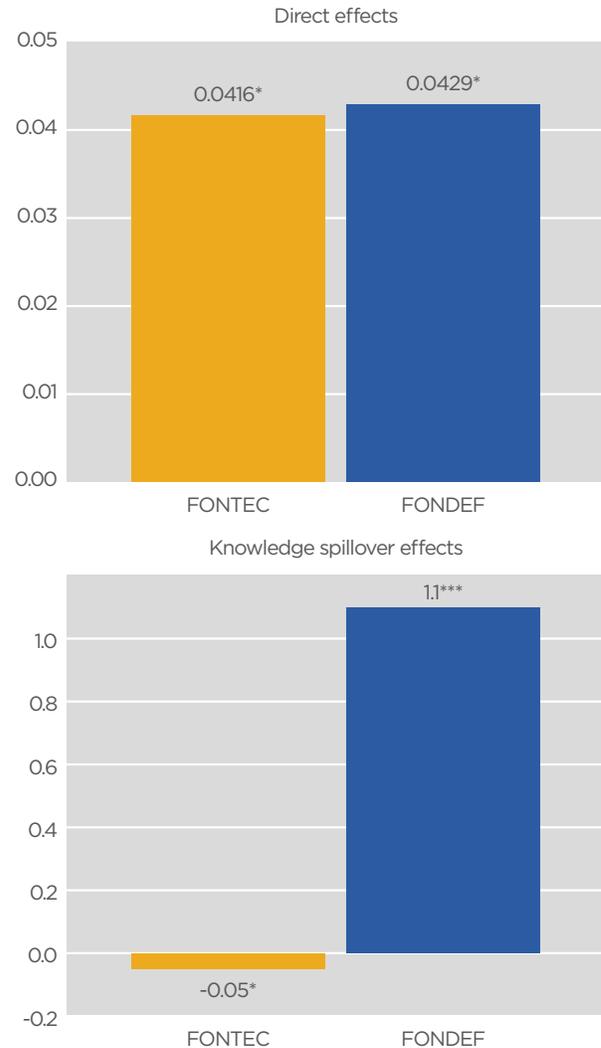
## RESULTS

Both FONDEF and FONTEC boost the productivity of direct beneficiaries by around 4.2 percent (see Figure). This result, however, is not enough to justify state intervention. If firms fully internalized the benefits of their investment, subsidies would not be necessary to elicit the optimal level of investment. Examining spillover effects is therefore crucial.

Spillover effects are contingent on program design. Only FONDEF-funded projects requiring collaboration with universities and technology institutes generate positive spillovers. An increase of 1 standard deviation in the share of treated firms in the same region and sector increases TFP of other firms by 1.1 percent (see Figure). These results are not surprising since: i) firms conducting intramural research may find it easier to protect the knowledge they generate, thus limiting diffusion, and ii) firms conducting research in collaboration with research centers may produce more generic, less specific knowledge that is more easily applicable outside the firm and thus more prone to generate spillovers.

Spillover effects are nonlinear according to the share of firms in the sector-region receiving treatment, leading to an inverted-U shaped relationship. When a firm receives a matching grant, it may have two different effects on other firms in the same sector and region. If there are knowledge spillovers, grants can increase the productivity of non-treated firms. But treated firms may also gain a competitive advantage, displacing demand from rival non-treated firms. Our results suggest that when the share of treated firms is small, the positive knowledge spillover effect dominates. As the share of supported firms increases, the business-stealing effect becomes more important.

## Spillover effect shown is impact of a one standard deviation increase in share of treated firms within the sector-region



\* denotes significance at 10% level; \*\*\* denotes significance at 1% level.

### Key Concept



### FIXED EFFECTS METHOD

Controls for unobservable or omitted factors that are constant over time and affect both the outcome of interest and the treatment (receive or not the subsidy).

### Key Concept



### KNOWLEDGE SPILLOVERS

Refer to the knowledge created by others that firms acquire without paying for it in a market transaction. They often result from employees' interactions and mobility.

## POLICY IMPLICATIONS

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1. First, the fact that an R&D subsidy increases productivity of direct beneficiaries is not enough to justify the subsidy. Interventions are needed to help overcome market failures which, in this case, consist of knowledge spillovers associated with R&D investments.
2. Second, at least in one of the programs, these positive knowledge spillovers are in fact present. Firms that invest in innovation do not always reap the full benefits of their investment. Therefore, matching grants should be used to promote knowledge creation and increase productivity.
3. Third, not all matching grants are created equal. Our results suggest that programs that stimulate collaborative R&D are more likely to generate spillovers than those stimulating R&D solely within the firm. Thus, innovation policy designs that encourage research collaboration between firms and universities or technological institutes should be preferred over those that subsidize intramural R&D.
4. Lastly, beyond some threshold, the intensity of the intervention becomes counterproductive, as business stealing effects dominate knowledge spillover effects. This suggests that it is better to spread matching grants across sectors and regions rather than focus all resources in specific sector-region pairs.

Key Concept



### R&D MATCHING GRANTS

Public subsidies that finance a share of the total costs of R&D projects, usually in the form of reimbursement of approved eligible expenditures.

## IDB RESEARCH ON R&D SUBSIDY PROGRAMS

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This research shows that countries should stimulate collaborative R&D, rather than R&D carried out within the firm. In the same spirit, these findings are the result of a collaborative effort between the Competitiveness, Technology and Innovation (CTI) division and the Research Department (RES) of the IDB, and the Development Effectiveness Division (DVF) of IDB Invest.



### FULL STUDY

[Crespi, G., L. Figal Garone, A. Maffioli, and E. Stein. 2019. "Innovation, Productivity, and Spillover Effects: Evidence from Chile."](#)

[Also published in \*World Development\*.](#)

## DEPARTMENT OF RESEARCH AND CHIEF ECONOMIST

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