# The impact of subsidizing early Young Innovative Companies on their access to capital market

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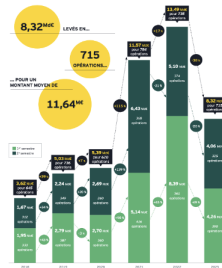
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# Young Innovative Companies have attracted a lot of attention ...

# ...Justified by their paradoxical position toward innovation

**The central role of the YICs**

**But with constrained R&D activities**

YICs essential to the innovation dynamic because **over-represented in the production of disruptive innovations** (Veugelers et al. 2010)

**Disruptive innovation**: innovation creating a new market or replacing the product previously dominant

Mainly explained by an incentive mechanism, **the replacement effect** (Baumol 2004)

**YICs face more barriers in their innovative activity:** liability of the newness, lack of financial means (Hall 2010, Grillitsch 2021)

**Limited access to the capital market:** lack of collateral, asymmetry of information (Hall 2010, Howell 2019)

**Widens the gap** between optimal private investment and the socially optimal investment

**Does subsidizing early Young Innovative Companies ease their access to the capital market, and if so, how?**

# Previous litterature

- **Impact Evaluation of subsidies to R&D** has mostly focused on testing the existence of an **additionality effect** mostly using a **quasi-experimental methodologies** (Dimos 2016) ... Even for YICs (Veugeler and Schneider 2010)... With some heterogeneity study (Czarniski and Delanote 2015)

- **Nascient and few litterature** on the **causal channels at play** and underlying the effect of the program (Howell 2017-2019, Söderblom, Samuelsson et al. 2015)

# Program Studied - Individual Aids from BPI

- Focus is placed on the **Individual Aids** distributed by the Public Investment Bank (BPI France)
  - Largest program for innovation support from BPI : €400 M and 2 600 supported firms ave.year
  - Not earmarked to YICs, but represent a substantial part of supported firms. In the period of interest (2010-2018), an estimated €506 M

- **Identifying YICs** among the supported firms - no unanimous definition - Review literature - 3 criteria
  - Firms treated in their three first years of existence
  - Undertaking R&D (GECIR)
  - Independent

# Strategy to answer our question

- One specificity of the program - Limited amount of distributed aids

|  | Min | 1st Qu | Median | Mean | 3rd Qu | Max |
|---|---|---|---|---|---|---|
| Subsidies | 1000 | 23900 | 30000 | 36411 | 35000 | 960000 |

Figure 1: Distribution of the subsidies size, source : BPI

- In that context two ways in which subsidies may incitate external investors to put money in the supported firms : a **Certification** or a **Prototypping** effect

- Two main steps for the strategy
  - **Step 1:** Checking the program's impact on access to the capital market through firms' level of equity and debt
  - **Step 2:** Disentangling between the potential two effects. Three indicators :
    1. Timing of the impact
    2. Effect of selection in the program before to receive funds (Certification)
    3. Effect of the increase in funds allocated to R&D thanks to public subsidy on capital raised (Prototyping)

# Methodology - Adapting the conventional matching DiD to fit the setting (1)

- **Main regression:**

  $log(Y_{i,t}) = \beta_1 D_i + \beta_2 1_{(t*T>0)} + \beta_3 D_i * 1(t * T > 0) + \beta_4 X_{(i,t)} + \lambda_i + \mu_t + e_{(i,t)}$

- Conventional Method adapted in two main ways
  - Use of a methodology adapted to **staggered treatment**, (Chaise-martin and d'Haultfoeuille, 2020)
  - Matching made thanks to **Coarsened Exact Matching (CEM)** and not a Propensity Score

# Results - Balance after matching with a CEM

| | CF | Treated | P-Value |
|---|---|---|---|
| **N** | 784 | 784 | |
| Total Asset | 215.58 | 228.98 | 0.371 |
| | (289.48) | (302.87) | |
| Work Force | 2.35 | 2.57 | 0.213 |
| | (3.50) | (3.38) | |
| Turnover | 156.81 | 135.01 | 0.356 |
| | (556.39) | (356.91) | |
| Added Value | 60.55 | 57.51 | 0.713 |
| | (166.77) | (160.27) | |
| Equity | 75.14 | 79.99 | 0.575 |
| | (168.95) | (172.18) | |
| Debt | 41.55 | 39.99 | 0.725 |
| | (94.30) | (80.41) | |
| Debt intensity | 3.03 | 2.55 | 0.525 |
| | (15.13) | (14.41) | |
| Gross R&D | 121.34 | 116.81 | 0.678 |
| | (149.58) | (152.18) | |
| Subsidy - Flow | 11.32 | 12.58 | 0.664 |
| | (38.29) | (39.73) | |
| Subsidy - Stock | 0.27 | 0.13 | 0.469 |
| | (4.89) | (1.80) | |
| Work force R&D | 1.94 | 2.14 | 0.232 |
| | (1.95) | (2.36) | |
| R&D intensity | 48300.19 | 43289.96 | 0.338 |
| | (78863.06) | (51984.16) | |
| Intangible Intensity | 22.08 | 22.70 | 0.864 |
| | (76.97) | (38.85) | |
| naf1 (%) | | | 1.000 |

**Matching variables:** Total Assets, Debt, Debt Int, crea-year, year, Sector; Min*-Subsidies, Turnover, Gross R&D

\* I match on financial characteristics. I also consider R&D characteristics but to the minimum. Firms having received subsidies are paired with firms that have received subsidies, and declaring R&D activities with firms declaring R&D activities (dummies).

# Results - Average impact on funds allocated to R&D

| | | Gross R&D (1) | | Gross R&D (2) | | Net R&D (3) | | Net R&D (4) |
|---|---|---|---|---|---|---|---|---|
| **CH Model** | 35% | 0.297 *** | 32% | 0.275 *** | 22% | 0.196 *** | 26% | 0.228 *** |
| | | (0.078) | | (0.077) | | (0.074) | | (0.085) |
| N | | 1937 | | 1563 | | 1666 | | 1557 |
| Switchers | | 636 | | 536 | | 562 | | 532 |
| | | | | | | | | |
| **TWFE Model** | 42% | 0.354 *** | 39% | 0.332 *** | 30% | 0.259 *** | 31% | 0.267 *** |
| | | (0.069) | | (0.072) | | (0.073) | | (0.075) |
| N | | 2952 | | 2465 | | 2529 | | 2456 |
| | | | | | | | | |
| **Control** | | | | Yes | | | | Yes |

Table 2: Impact of the program participation on funds allocated to
Gross R&D (left), Net R&D (right), short term tE[0,2]

**Regression:** $log(Y_{i,t}) = \beta_1 D_i + \beta_2 1_{(t*T>0)} + \beta_3 D_i * 1(t*T > 0) + \beta_4 X_{(i,t)} + \lambda_i + \mu_t + e_{(i,t)}$

**With:** $\beta_4 X_{(i,t)}$, the control variable, the subsidies cashed for the year

# Results - Average impact on the access to capital market

| | | Equity (1) | | Equity (2) | | Debt-Int (3) | | Debt-Int (4) | Debt-Ext (5) | Debt-Ext (6) |
|---|---|---|---|---|---|---|---|---|---|---|
| **CH Model** | 86% | 0.620 *** | 73% | 0.548 *** | 91% | 0.648 *** | 66% | 0.578 *** | 0.267 *** | 0.281 *** |
| | | (0.060) | | (0.094) | | (0.118) | | (0.174) | (0.024) | (0.054) |
| N | | 6147 | | 1880 | | 3536 | | 1278 | 2090 | 448 |
| Switchers | | 2159 | | 663 | | 1236 | | 457 | 432 | 105 |
| | | | | | | | | | | |
| **TWFE Model** | 77% | 0.571 *** | 60% | 0.473 *** | 79% | 0.582 *** | 55% | 0.441 *** | 0.313 *** | 0.259 *** |
| | | (0.065) | | (0.090) | | (0.113) | | (0.162) | (0.031) | (0.071) |
| N | | | | 2920 | | 4216 | | 2261 | 2195 | 836 |
| **Control** | | | | Yes | | | | Yes | | Yes |

Table 3: Impact of the program participation on access to Equity (left), Debt (right), short term tE[0,2]

**Regression:** $log(Y_{i,t}) = \beta_1 D_i + \beta_2 1_{(t*T>0)} + \beta_3 D_i * 1(t*T > 0) + \beta_4 X_{(i,t)} + \lambda_i + \mu_t + e_{(i,t)}$

**With:** $\beta_4 X_{(i,t)}$, the control variable, the subsidies cashed for the year

# Results - Timing Access to Capital Market
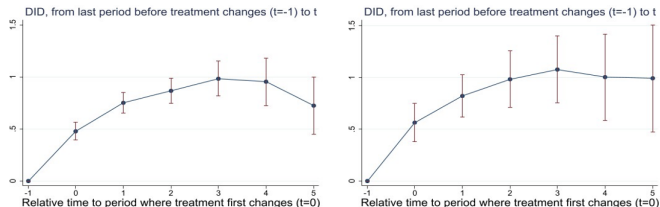


Figure 2: Dynamic Impact of the program participation on access to Equity (left), Debt (right), CH methodology

**Regression:** $log(Y_{i,t}) = \beta_1 D_i + \beta_2 1_{(t*T>0)} + \beta_3 D_i * 1(t * T > 0) + \lambda_i + \mu_t + e_{(i,t)}$

# Results - Certification Effect

| | Equity Vol (1) | Equity Vol (2) | Debt Vol (3) | Debt Vol (4) | Equity Prob (5) | Equity Prob (6) | Debt Prob (7) | Debt Prob (8) |
|---|---|---|---|---|---|---|---|---|
| | 0.497 *** | 0.322 | 0.450 * | 0.284 | 0.160 *** | 0.115 * | 0.168 *** | 0.115 * |
| | (0.143) | (0.199) | (0.230) | (1.459) | (0.061) | (0.060) | (0.062) | (0.069) |
| Switchers | 76 | | 50 | | 76 | | 75 | |
| N | 319 | 304 | 228 | 225 | 319 | 304 | 317 | 300 |
| | | | | | | | | |
| **CH** | Yes | | Yes | | Yes | | Yes | |
| **TWFE** | | Yes | | Yes | | Yes | | Yes |

Table 4: Certification Impact of the program participation on access to Equity and Debt

**Regression:** $log(Y_{i,t}) = \beta_1 D_i + \beta_2 1_{(t*T>0)} + \beta_3 D_i * 1(t * T > 0) + \lambda_i + \mu_t + e_{(i,t)}$

# Results - Prototyping effect

| | Equity Proba (1) | Equity Proba (2) | Equity Proba (3) | Equity Vol (4) | Equity Vol (5) | Equity Vol (6) | Debt Proba (7) | Debt Proba (8) | Debt Proba (9) | Debt Vol (10) | Debt Vol (11) | Debt Vol (12) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Subv t-1 | -0.002 | | | -0.001 | | | -0.002 | | | 0.003 | | |
| | (0.002) | | | (0.004) | | | (0.004) | | | (0.010) | | |
| Subv t-2 | -0.000 | | | -0.002 | | | 0.005 | | | 0.028 * | | |
| | (0.001) | | | (0.004) | | | (0.005) | | | (0.015) | | |
| Diff t-1 | | -0.000 | | | 0.002 | | | -0.000 | | | -0,001 | |
| | | (0.001) | | | (0.001) | | | (0.000) | | | (0,001) | |
| Diff t-2 | | 0.000 | | | 0.000 | | | 0.000 | | | 0,001 | |
| | | (0.000) | | | (0.002) | | | (0.000) | | | (0.000) | |
| Gross R&D t-1 | | | 0.000 | | | 0.000 | | | 0.003 * | | | 0.012*** |
| | | | (0.000) | | | (0.003) | | | (0.001) | | | (0.004) |
| Gross R&D t-2 | | | 0.001 | | | 0.003 | | | 0.001 | | | -0.001 |
| | | | (0.000) | | | (0.002) | | | (0.001) | | | (0.003) |
| N | 7256 | 7256 | 7535 | 7225 | 7503 | 7225 | 6158 | 6158 | 6150 | 3842 | 3842 | 3839 |

Table 5: Prototyping Effect, ten thousand euros, TWFE methodology

**Regression:** $log(Y_{i,t}) = \beta_1 D_i + \beta_2 1_{(t*T>0)} + \beta_3 D_i * 1(t*T>0)$
$+ \beta_4 D_i * 1(t*T>0)\Delta Pu.RD_{t-1} + \beta_5 D_i * 1(t*T>0)\Delta Pu.RD_{t-2} + \lambda_i + \mu_t + e_{(i,t)}$

**With:** $\Delta$ Pu.R&D - the increase of funds allocated to R&D thanks to public funds measured directly through, subvention cashed for a year (Subv), indirectly with the non-parametric difference-in-differences between perfect peers (Diff), or the total funds allocated to R&D (Gross R&D)

# Robustness Check

|              |      | Estimate | SE    | P-Value | LB    | UB    |
|--------------|------|----------|-------|---------|-------|-------|
| **Gross R&D** | Main | 0.297    | 0.078 | 0.000   | 0.144 | 0.450 |
|              | Rob  | 0.453    | 0.132 | 0.000   | 0.195 | 0.712 |
| **SC**       | Main | 0.620    | 0.059 | 0.000   | 0.503 | 0.737 |
|              | Rob  | 0.557    | 0.091 | 0.000   | 0.378 | 0.737 |
| **Debt**     | Main | 0.648    | 0.118 | 0.000   | 0.417 | 0.880 |
|              | Rob  | 0.642    | 0.147 | 0.000   | 0.354 | 0.929 |

Table 6: Robustness check, CH methodology, short term tE[0,2]

The new matching is done on the R&D characteristics, controlling from the financial characteristics at the minimum. 498 new peers are created. Out of them 347 of the counterfactual firms are new and where not included in the first matching

# Conclusion

**Results**

- The program has an **impact on the access to the capital market** both in terms of equity and debt- The main **channel at play is a certification effect**
- The impact is larger after the big take off of outstanding funds in the Venture Capital Segment (2014-2015). Therefore, **the capacity of the Venture Capital market seems to be an important driver** to determine the size of the impact

**Implication**

- The importance of a certification effect could be a direct argument against the adoption of a "spray and pray" strategy as it risks devaluing the BPI label

# Appendix - Other Data used

- **BPI:** State Aids received by firms in the AI program, source: BPI France

- **FARE:** Firm's Balance sheet; source: Tax authority

- **GECIR:** Firm's R&D expenses, R&D tax credit forms; source: Tax authority

- **LIFI:** Financial connection and group ownership, cross-referenced with GECIR to identify independent firms; source : National Institute for Statistics, France

# Appendix - Timing R&D
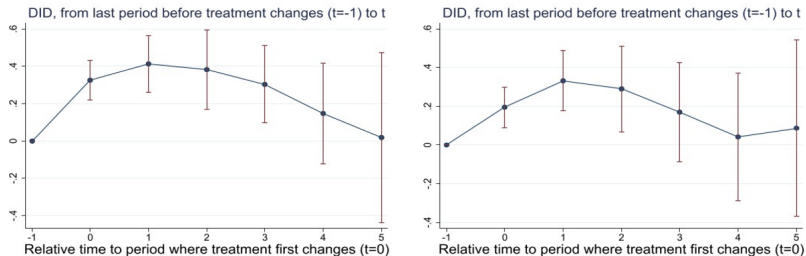


Figure 3: Dynamic Impact of the program participation on funds allocated to Gross R&D (left), Net R&D (right), CH methodology

# Appendix - Average impact in volume

| | Gross R&D | Equity | Debt |
|---|---|---|---|
| | (1) | (2) | (3) |
| **CH Model** | 15.340 | 72.38 *** | 48.42 *** |
| | (13.95) | (24.10) | (17.31) |
| N | 2372 | 6147 | 6155 |
| Switchers | 796 | 2159 | 2163 |
| **TWFE Model** | 20.92482 | 71.22 *** | 52.35 *** |
| | 14.0681 | (0.21) | (0.14) |
| N | 3416 | 5896 | 5903 |

Table 7: Average impact of the program participation, short term tE[0,2]

# Appendix - Dynamic impact in volume

| | Gross R&D (1) | Gross R&D (2) | Equity (3) | Equity (4) | Debt (5) | Debt (6) |
|---|---|---|---|---|---|---|
| 0 | 30.59 *** | 22.14 ** | 26.19 ** | 28.95 * | 23.68 *** | 17.06 |
| | (8.78) | (9.55) | (11.21) | (15.82) | (7.71) | (13.69) |
| 1 | 37.50 ** | 38.51 *** | 73.43 *** | 92.01 *** | 48.67 *** | 44.18 * |
| | (16.38) | (13.99) | (25.52) | (31.53) | (16.41) | (25.26) |
| 2 | 39.61 | 41.95 ** | 114.98 *** | 147.78 *** | 68.27 * | 70.53 |
| | (24.82) | (19.67) | (41.79) | (52.60) | (38.84) | (48.50) |
| 3 | 60.53 ** | 37.86 | 291.75 * | 301.12 ** | 183.92 ** | 178.65 ** |
| | (25.38) | (23.65) | (155.90) | (136.39) | (74.64) | (75.33) |
| 4 | 30.45 | 23.12 | 233.93 *** | 267.37 *** | 172.27 ** | 192.21 ** |
| | (31.87) | (30.55) | (76.77) | (75.44) | (78.40) | (81.04) |
| 5 | 32.05 | 12.22 | 239.31 ** | 287.25 *** | 151.15 | 240.95 ** |
| | (52.10) | (37.91) | (98.20) | (94.01) | (187.95) | (112.36) |
| CH | Yes | | Yes | | Yes | |
| TWFE | | Yes | | Yes | | Yes |

Table 8: Dynamic impact of the program participation

# Appendix - Heterogeneity of impact by period (1)

|            | Min   | 1st Qu | Median | Mean   | 3rd Qu | Max     |
|------------|-------|--------|--------|--------|--------|---------|
| **2010-2014** | 5 500 | 25 000 | 30 000 | 35 776 | 40 000 | 300 000 |
| **2015-2018** | 1 500 | 25 000 | 30 000 | 29 956 | 30 000 | 100 000 |

Table 9: Distribution of the Subsidies granted by period

|              | Gross R&D (2010-2014) | Gross R&D (2015-2018) | Equity (2010-2014) | Equity (2015-2018) | Debt (2010-2014) | Debt (2015-2018) |
|--------------|-----------------------|-----------------------|--------------------|--------------------|------------------|------------------|
| **CH Model** | 0.287 *** | 0.309 ** | 0.471 *** | 0.745 *** | 0.419 *** | 0.795 *** |
|              | (0.084)   | (0.146)  | (0.070)   | (0.103)   | (0.147)   | (0.162)   |
| N            | 1327      | 524      | 3034      | 2891      | 1863      | 1541      |
| 5 Switchers  | 475       | 161      | 1086      | 1073      | 668       | 568       |
|              |           |          |           |           |           |           |
| **TWFE Model** | 0.348 *** | 0.368 *** | 0.442 *** | 0.703 *** | 0.504 *** | 0.773 *** |
|              | (0.079)   | (0.141)  | (0.076)   | (0.105)   | (0.141)   | (0.173)   |
| N            | 1873      | 1079     | 2972      | 2924      | 2200      | 2016      |

Table 10: A larger impact in the second period, short term tE[0,2]

# Appendix - Heterogeneity of impact by period (2)

|  | Equity Vol (1) | Debt Vol (2) | Equity Prob (3) | Debt Prob (4) |
|---|---|---|---|---|
| Treatment | 0.261 *** | -0.204 | 0.108*** | 0.152 *** |
|  | (0.0769) | (0.279) | (0.027) | (0.058) |
| Venture Capital | 0.000192 *** |  | 0.000018 |  |
|  | (0.000047) |  | 0.000014 |  |
| Private Debt |  | 0.0011 *** |  | 0.0001 |
|  |  | (0.0004) |  | (0.0001) |
| N | 5896 | 4216 | 5234 | 4923 |

Table 11: Interaction Treatment outstanding funds on Capital Market, short term tE[0,2]