KU LEUVEN

R&D tax incentives: econometric evaluation of their impact

Dirk Czarnitzki

- Dept. of Managerial Economics, Strategy and Innovation, KU Leuven, Belgium
- Head of Innovation Survey Group, ECOOM at KU Leuven
- Research Associate, ZEW Mannheim, Germany

Some observations

- Innovation and R&D have been and continue to be high on the list of political priorities in the EU
- EU Members (and also other OECD countries) maintain a whole portfolio of policy instruments to incent R&D and innovation in the business sector.
  - Financing public universities and research organizations
  - Patent system and other intellectual property rights
  - Allowing R&D collaboration among firms (exempted from anti-trust legislation)
  - Public Innovation Procurement
  - R&D grants (also loans)
  - R&D tax credits and related measures
  - Public loan guarantees
  - Others, typically smaller initiatives, such as innovation vouchers, public VC and/or mezzanine capital.

KU LEUVEN

Some observations

- These policies either
  - improve the appropriability conditions of R&D
    - Patents and other IPRs
  - or reduce the cost of R&D
    - R&D grants, tax incentives, R&D collaboration
  - or aim at making firms' R&D more productive
    - Knowledge production by the public sector, innovation vouchers, R&D collaboration

Past evidence on R&D tax credits

- Hall/van Reenen (2000) surveyed studies on R&D tax credits
- Conclusion:
  1 dollar R&D tax credit stimulates a dollar of R&D
- However, methods are questionable:
  - mostly scholars used a „user cost of R&D“
  - Different tax breaks result in variation in user cost of R&D at the firm, industry and/or country level
  - Scholars applied regression analysis using variation in that user cost of R&D to identify the effect of tax treatment.

Recent example: Brown et al. (2017)

- Calculate tax treatment of R&D based on McFetridge and Warda (1983)
  - $B_{i,t} = (1 - A_{i,t}) / (1 - T_{i,t})$
  - T : corporate income tax rate
  - A : combined net present value of all reductions to tax liabilities resulting from a 1 dollar investment in R&D.
  - B-index: present value of before-tax income needed to generate to cover the cost an additional 1 dollar R&D. The lower the B-index, the more generous the tax treatment.
  - „R&D tax credits“ = 1 - B

Brown et al. (2017)

- Study is done at the industry level using multiple countries
  - Panel regressions using R&D as dependent variable.
- The authors compare the effect of tax treatments of R&D to other policy variables, such as
  - Accounting standards
  - IP protection
- They conclude that
  - Stronger accounting standards → +
  - Stronger creditor rights → -
  - Stronger IP protection → +
  - More generous R&D tax treatment → only + in non-hi-tech sectors!!!!!

KU LEUVEN

Brown et al. (2017)

- Problems:
  - Measure of R&D tax credits is estimated
  - suffers most likely from (severe) measure error
  - (this also applies to all other explanatory var‘s, such as IP protection).
- All other policy variables might be positively correlated with R&D tax treatment (incl. similar trends)
  ➔ questionable whether coefficients are correctly identified

Further observations on policy evaluation practice

- Evidence-based policy has become more popular over the last decades
  - This calls for an active evaluation culture
- The 2014 EU revision of state-aid rules includes not only obligations to evaluate major government policies, but also to make ex-ante evaluation plans before larger new policy schemes are implemented.
- Among other methods, econometric techniques allowing counterfactual impact evaluations have gained a lot of attraction in the last two decades.
  - The EC (2014) published guidelines for evaluations incl. methods to be used.

Further observations on policy evaluation practice

- In contrast to macro-level studies, it is preferred to conduct micro-econometric evaluations at the firm-level.
- Focus on one specific scheme
  - Paying attention to details of the policy program under scrutiny
  - Using detailed data on treated firms incl. their specific treatments (tax relief, subsidy amount in Euros, etc.)

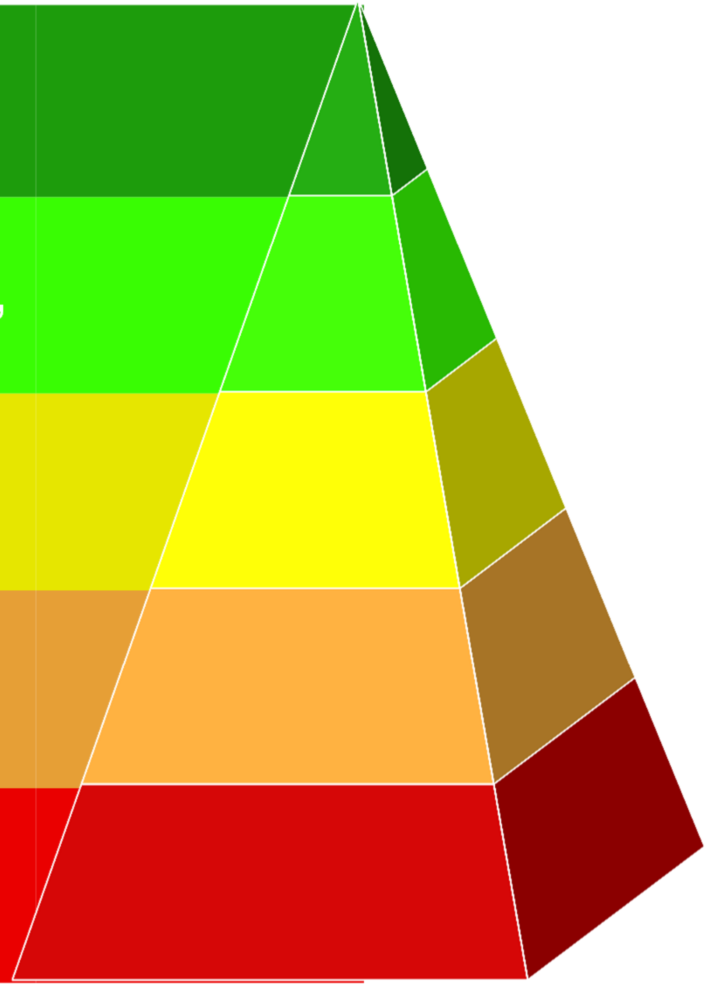
Methods for treatment effects estimation

- During the last decade, mircoeconometric *„counterfactual impact evaluations“* have become an important tool in the area of public (enterprise) support policies.

- It became popular to use methods, such as
  - Matching estimators
  - (Conditional) Difference-in-Difference regressions
  - Instrumental variable regressions
  - More recently: Regression Discontinuity Designs
  - randomized control trials
  - „quasi-natural“ experiments

(Modified) Scientific Maryland Scale

- **5** Randomized control trials, ‘natural experiments‘, no selective sample attrition
- **4** Instrumental variable techniques or RDD, proper balancing (OLS, matching), attrition discussed but not addressed
- **3** Difference-in-Differences, balancing (OLS, matching), but uncontrolled differences likely remain
- **2** ‘Before and after‘ comparisons, or a comparison group but without balancing of covariates
- **1** Correlation analysis, no control group, no attempt at establishing a counterfactual



Methods

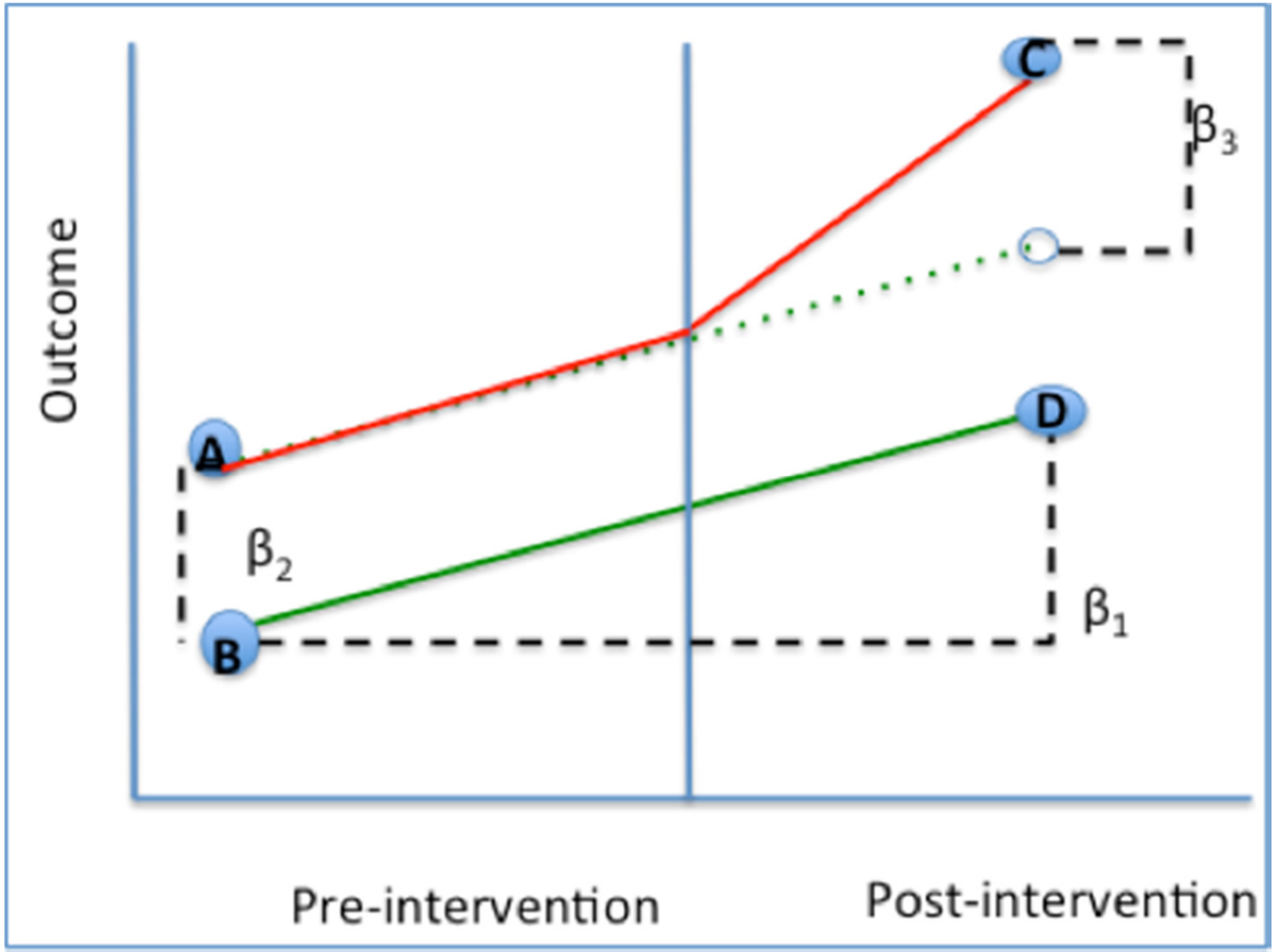
- Most studies reach nowadays level 3 of the modified Maryland scale.
- Most popular in the recent past: Matching estimators
  - For each subsidzed firm, find a very similar firm that has not been subsidized, and compare their R&D spending, or other appropriate variable of interest.
  - Very frequently done for R&D grant schemes
  - Problem: what is the appropriate control group in which „twins“ are searched?
  - Rejected applicants? Firms that never applied?
  - Problem in tax credits studies: all firms are eligible. Firms that do not claim benefits are maybe „special“?

KU LEUVEN

Other popular method

- Difference-in-difference:
  - Trace firms over time and compare treated firms before and after program participation with firms that never participated.
  - Again: what is the appropriate control group?
  - Improved version: „Conditional difference-in-difference“ combines matching and diff-in-diff.
  - Remaining problem: all „reasonable firms“ might participate.

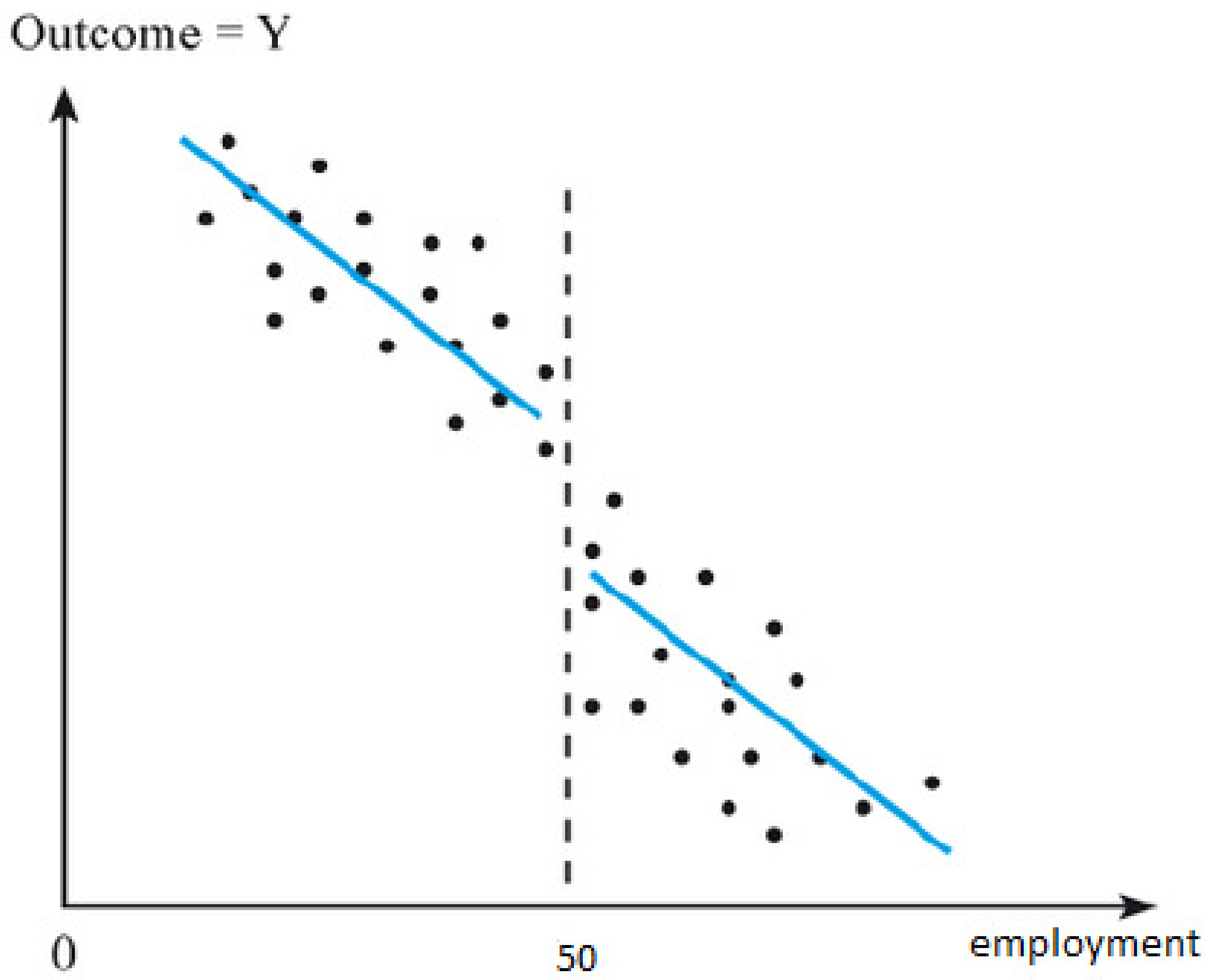
Difference-in-Difference



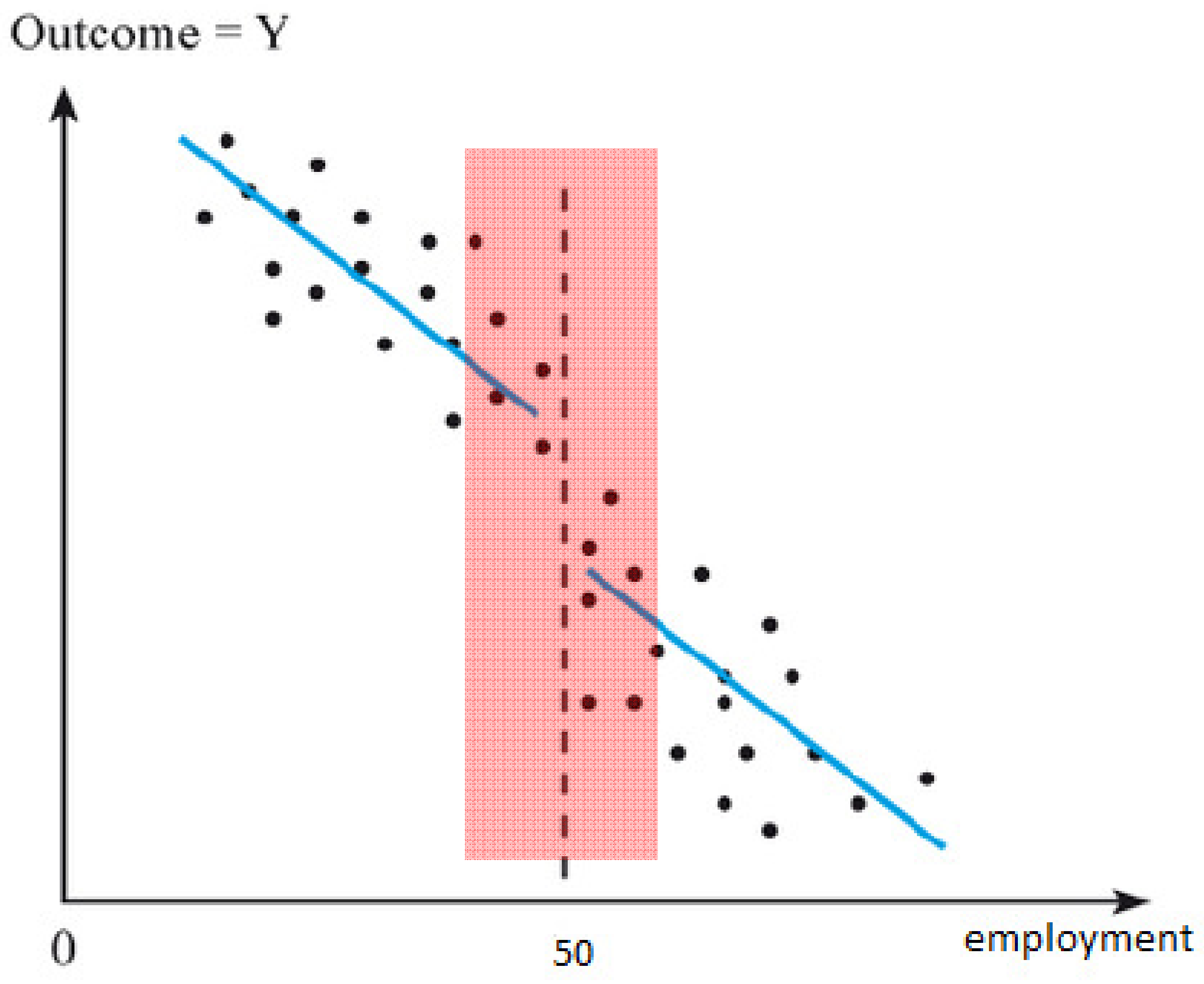
Control group problem

- Given the problem of what is the appropriate control group, scholars have more recently favored so-called “regression discontinuity designs”
- Exploit exogenous variation in treatment around a threshold value:
- Examples:
  - small firms receive 30% higher tax credits than medium and large firms
  - caps for maximum accountable R&D in tax credit scheme
- Ideally: use changes in these thresholds!

KU LEUVEN



Outcome = Y
0
50
employment


Outcome = Y
0
50
employment

Example: Dechezleprêtre et al. (2016)

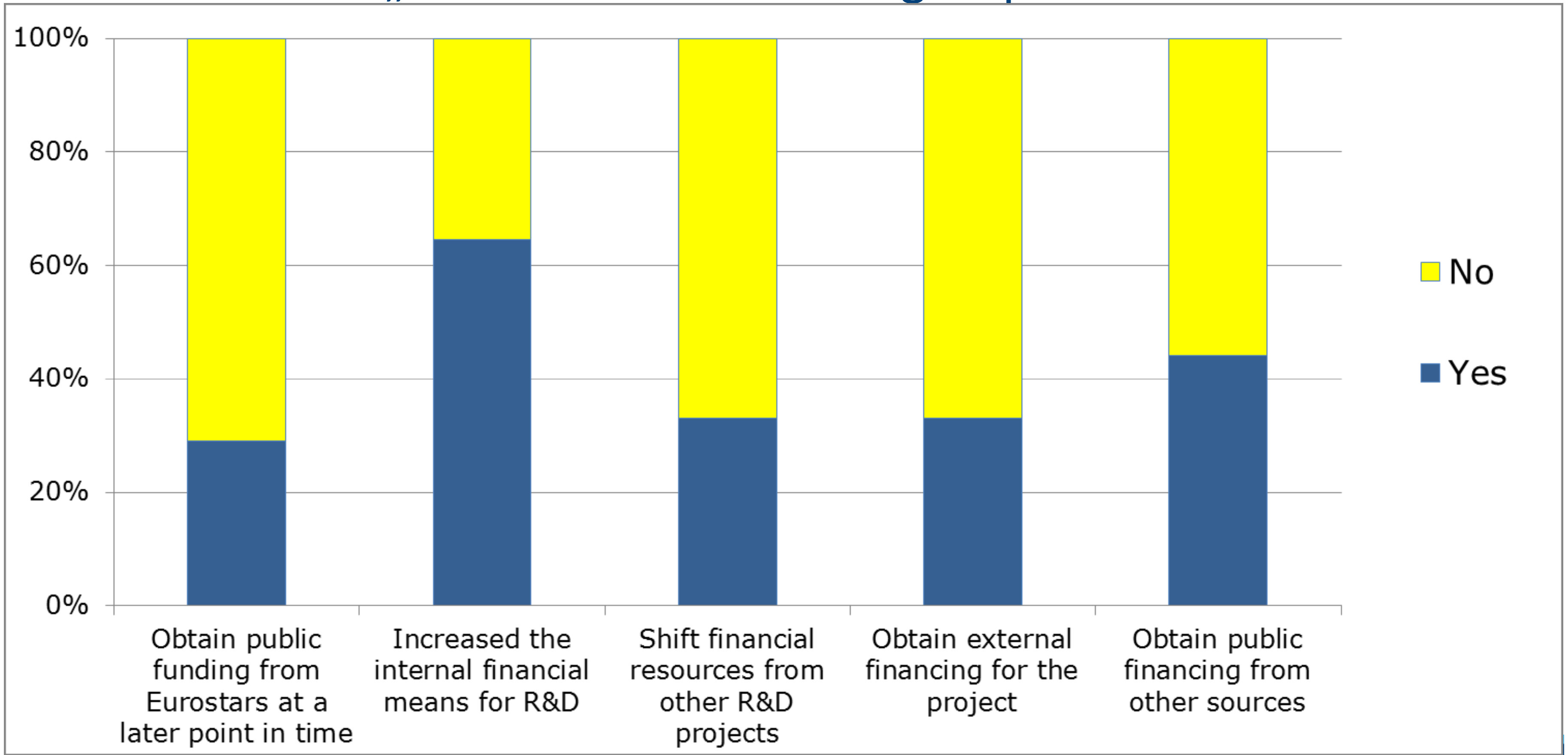
- UK R&D tax credit: policy reform
  - Reform raised size threshold under which firms can access the more generous tax regime for SMEs.
  - In 2008, SME asset threshold value was increased from €43m to €86m, employment from 249 to 499, and sales from €50m to €100m.
  - Treatment: 50% deduction from taxable profits (was also increased after reform to 75%)
- Large effects of tax credit scheme are found:
  - R&D doubled in treated firms
  - Patenting rose by about 60% (and no evidence that these inventions were of lower value)

Advantages/Problems of detailed micro-level studies

- The focus on one particular program may result in misleading conclusions as results may be confounded with receipt of other subsidies.
  - Combined databases are needed: tax treatment, R&D grants etc.
- Studies making use of RDD have very credible identification strategies, but do only identify “local average treatment effects” and not total program effects.
- This makes recommendations on how to improve the policy design challenging.

Indirect effects

- Policy scheme may have indirect effects
- Example Eurostars: even rejected applications may have effects
  - Beware: „contaminated control group“



Conclusions

- The state of the art in the area of European innovation policy studies is formed by counterfactual impact evaluation studies.
- There is no “one approach fits all” methodology. The empirical research design has to be chosen carefully based on the exact program and its design.
- Finding a good control group in studies on effects of R&D tax credits seems not obvious, but rather challenging.
- Currently, scholars tend to exploit non-linearities in program design, such as variations in subsidy rates, caps, etc.

Conclusions

- Taking into account multiple sources of funding in a single study is the next step.
- This requires collaborative engagements between government, funding agencies and researchers in order to make data available while not jeopardizing appropriate data protection.
  - OECD microBeRD project
  - Belgian government makes linked firm-level data available to researchers: firm level characteristics, tax credits, direct R&D grants, etc.
- General conclusions such as 1 dollar R&D per dollar R&D tax credit seem not to be supported in general anymore.
  - The actual effects may be more heterogeneous.

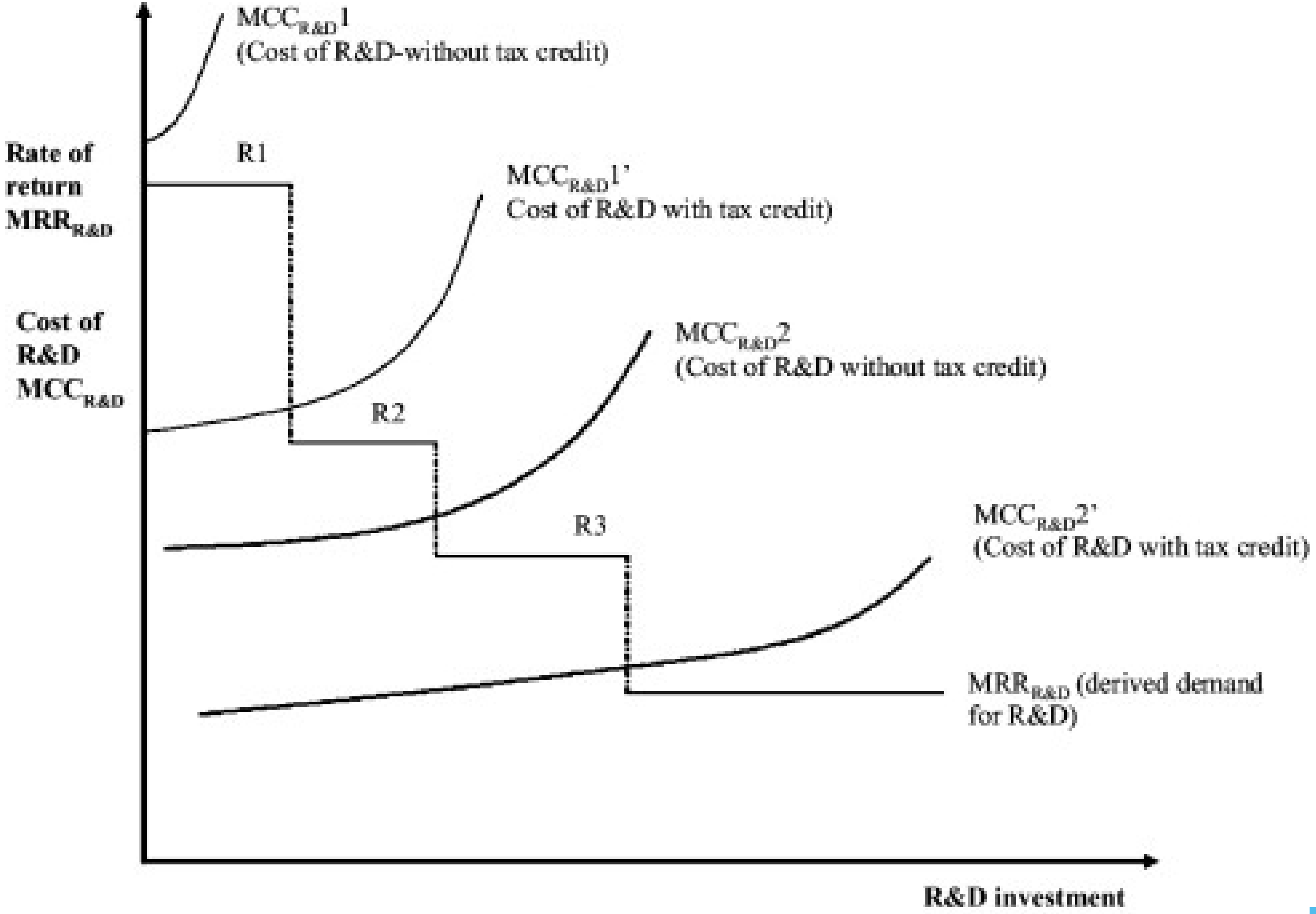
Thanks for your attention!

dirk.czarnitzki@kuleuven.be

Other remarks

- Tax credits might faciliate persistent monopoly positions of industry incumbents (or leaders)
- Neglect the imperfect divisibility of R&D projects

  ➔ smaller firms are relatively disadvantaged compared to larger firms.


MCC$_{R\&D}$1
(Cost of R&D-without tax credit)
Rate of return MRR$_{R\&D}$
R1
MCC$_{R\&D}$1'
Cost of R&D with tax credit)
Cost of R&D MCC$_{R\&D}$
MCC$_{R\&D}$2
(Cost of R&D without tax credit)
R2
R3
MCC$_{R\&D}$2'
(Cost of R&D with tax credit)
MRR$_{R\&D}$ (derived demand for R&D)
R&D investment

KU LEUVEN