Impact of R&D tax incentives on greenfield FDI projects in R&D activities

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Concordi 2019, Seville 25.9.2019

Motivation

- Many OECD countries increased R&D tax incentives or introduced R&D tax incentives for the first time
- The B-index (for large and profitable firms) increased from 0.05 to 0.13 for a sample of 32 advanced countries during 2003-2018 (= 160 per cent)
- Aim of R&D tax incentives is to strengthen domestic R&D activities and innovation activities but also to attract FDI in R&D activities
- Little is known about the impact of the R&D tax incentives on FDI inflows in R&D activities

Motivation

Aim

- Impact of R&D tax incentives on FDI inflows in R&D and related activities

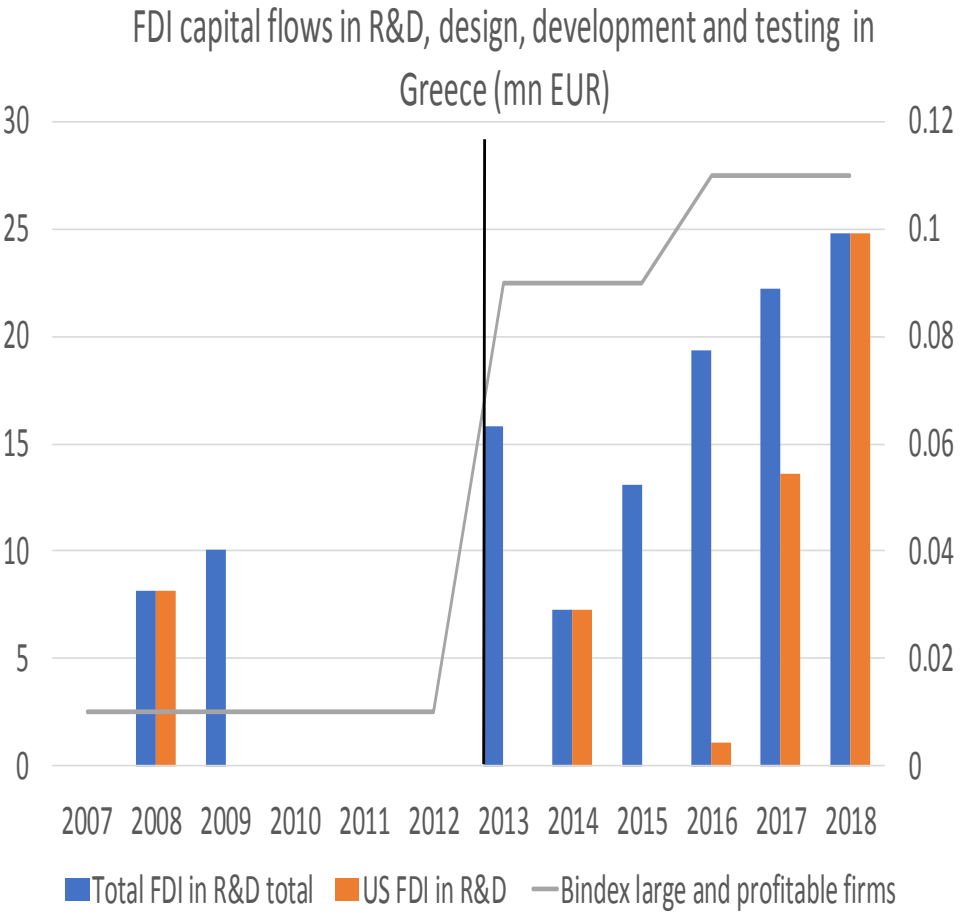
Contribution

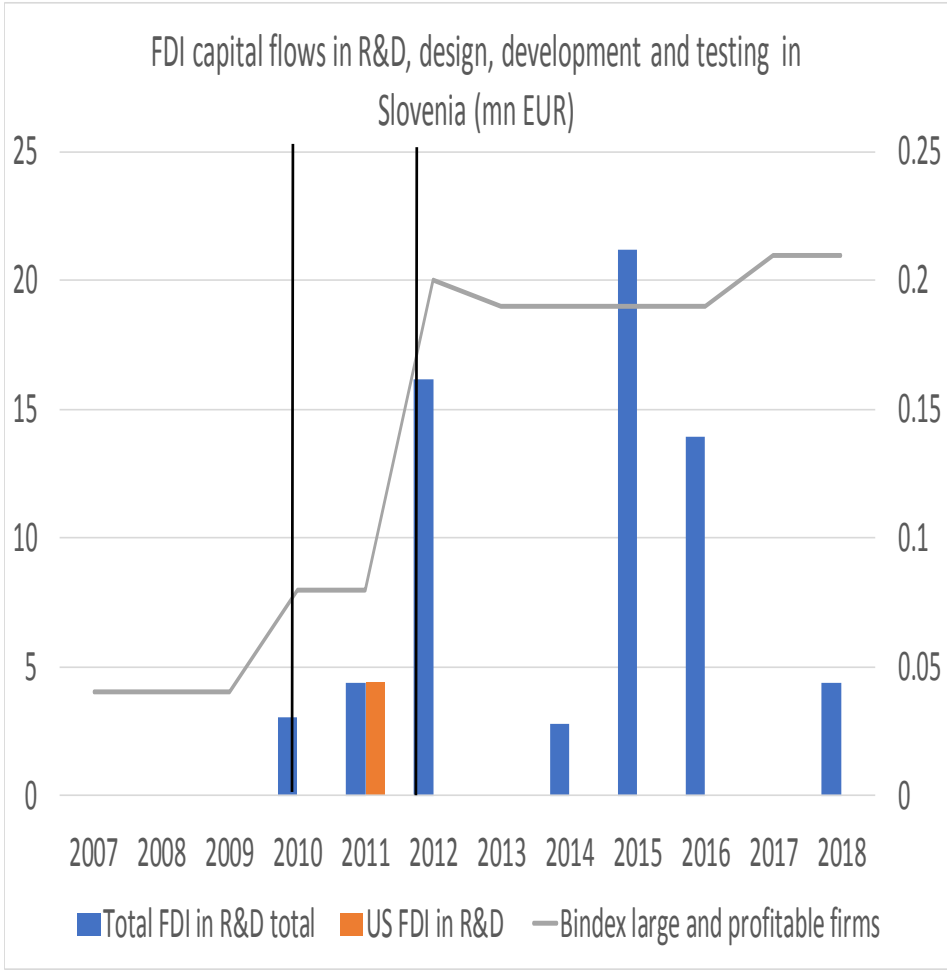
- First attempt to estimate the effects
- Relatively long sample period allows subsample regressions
- Separate results by source country (US)

Method

- Use of the difference in differences method combined with panel count data models
- Controlling for covariates

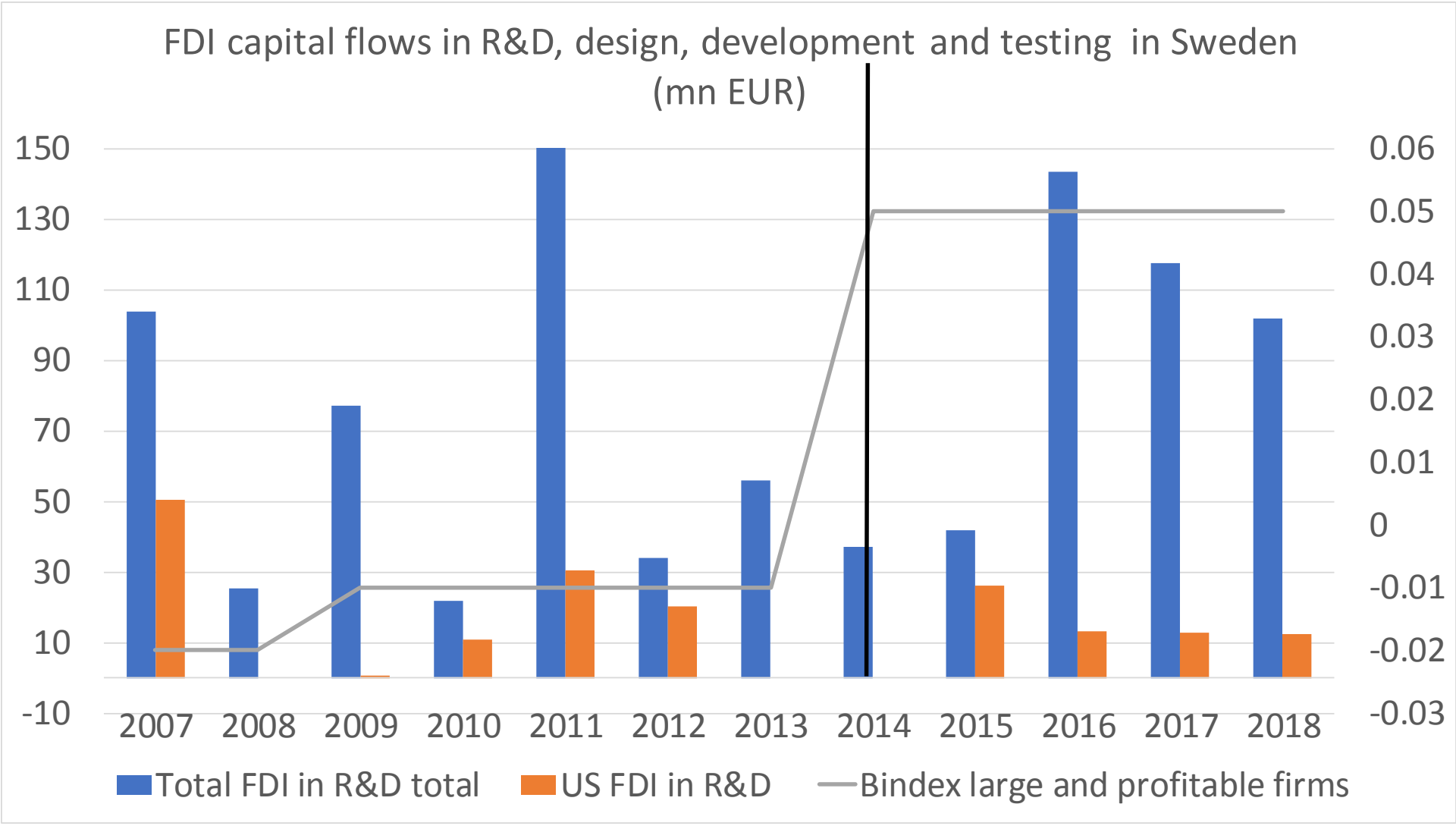
Motivation





Source: FDImarkets database, OECDSTATs

Motivation



Source: FDImarkets database, OECDSTATs

Motivation

Evolution of the B-index for large and profitable firms (introduction of R&D tax incentives)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Belgium	-0.01	0.10	0.09	0.10	0.13	0.15	0.15	0.15	0.15	0.16	0.16	0.16	0.16	0.16	0.16
China	-0.01	-0.01	-0.01	-0.01	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Czech R.	-0.02	0.30	0.27	0.27	0.23	0.21	0.20	0.20	0.20	0.20	0.21	0.21	0.21	0.21	0.21
Greece	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.09	0.09	0.09	0.11	0.11	0.11
Iceland	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
Italy	-0.03	-0.03	-0.03	0.12	0.12	0.12	0.12	0.12	-0.02	-0.02	-0.02	0.04	0.04	0.09	0.09
Latvia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.31	0.31	0.31	0.31	-0.01
Lithuania	0.00	0.00	0.00	0.00	0.31	0.45	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31
Poland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.10	0.22
Portugal	-0.01	-0.01	0.28	0.28	0.28	0.41	0.41	0.41	0.41	0.41	0.40	0.39	0.39	0.39	0.39
Romania	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Russia	-0.01	-0.01	-0.01	-0.01	-0.01	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Slovak R.	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	0.11	0.11	0.10	0.28
Slovenia	-0.01	0.05	0.05	0.04	0.04	0.04	0.08	0.08	0.20	0.19	0.19	0.19	0.19	0.21	0.21
Sweden	-0.02	-0.02	-0.02	-0.02	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01	0.05	0.05	0.05	0.05	0.05

Source: OECDSTATs

Motivation

Evolution of the B-index for large and profitable firms (increase of R&D tax incentives)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Austria	0.10	0.09	0.09	0.09	0.09	0.09	0.09	0.12	0.12	0.12	0.12	0.12	0.15	0.15	0.17
France	0.15	0.15	0.21	0.21	0.43	0.43	0.43	0.44	0.44	0.45	0.45	0.45	0.43	0.43	0.43
Hungary	0.18	0.18	0.18	0.24	0.24	0.24	0.22	0.22	0.22	0.36	0.35	0.35	0.35	0.22	0.21
Ireland	0.21	0.21	0.21	0.21	0.21	0.26	0.26	0.25	0.27	0.26	0.27	0.29	0.29	0.29	0.29
Japan	0.16	0.16	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.13	0.13	0.17	0.17
Nether-lands	0.06	0.07	0.07	0.07	0.07	0.09	0.09	0.10	0.12	0.14	0.15	0.15	0.15	0.15	0.13

Source: OECDSTATs

Theoretical background

- Internationalisation of R&D activities has increased in recent decades (Hall, 2011; Castellani et al. 2013; Siedschlag, et al. 2013; Dachs et al., 2014; Damioli & Véresy 2017, Ciraci et al. 2016; Papanastassiou et al. 2019)
- R&D tax incentives are widely regarded as appropriate instruments to stimulate domestic R&D activities (Hall, 2019; What Works Centres for Local Economic Growth) and as a location factor for foreign R&D
- Other factors (availability of skilled labour force, quality of universities, corporate tax rate, size of market, growth of the market)
- With increased generosity in the OECD countries, the effects of R&D tax incentives are likely to decline over time
- “Beggar the neighbor” (Wilson, 2009) -> separate results for Extra EU FDI inflows (US)

Empirical approach

DID approach

- Compare the difference in number of FDI projects in R&D activities between the treatment group (countries with an increase of the B-index by more than 2 percentage points and the control group (countries with a stable or falling B-index) before and after the introduction
- Control group a) countries that never introduced R&D tax incentives based on the B-index for large and profitable firms (CH, DE, BG, CY, EE, NZ) or countries with a stable B-index (NO, UK, US) or falling B-index (KO)
- Inclusion of control variables

Empirical approach

Panel DID approach

$$FDIRD_{it} = \alpha_i + \sum_{n=1}^{3} ß_{1n}\, POST_{itn} \cdot TREAT_{it} + \sum_{j=1}^{11} ß_{2j}\, d_{jt} + X_{it}\gamma + e_{it}$$

i: country; t: =2007,….,2018; α_i country fixed effects

FDIRD: i number of greenfield FDI projects in R&D, design, development and testing (alternatively amount of this investment in million Euro or number of jobs generated by this investment); alternatively *FDIRD_US:* US investments

$POST$ Dummy variable equal to one if there is an increase in the B-index for large and profitable firms by more than two index points (for instance from 0 to 0.03)

$TREAT$: Dummy variable equal to one if the country offers R&D tax incentives

d_{jt} : yearly dummy variables,

X_{it} control variables including GDP per capita, an indicator of intellectual property rights and other location specific attractiveness factors

Empirical approach

Estimation method

- Number of FDI projects is a count data variable and contain a significant proportion of zero values (12 per cent over the sample period, 22 per cent for US investments)
- Conditional fixed-effects Poisson regression is employed (Cameron and Trivedi, 2013)
- Estimator can be applied to any non-negative continuous variables (Silva and Tenreyro, 2006)
- Standard errors are adjusted for clustering on country (to account for repeated observations over time at the country level)
- The identification of DID is based on the usual common trend assumption
- Placebo test (one year before the treatment)

Empirical approach

Main hypotheses:

- R&D tax incentives lead to an increase in greenfield investment in R&D and related activities
- Effects are robust when extra EU FDI is considered
- Impact of R&D tax incentives might decline over time since more and more countries have recently introduced R&D tax incentives (SE, SK, LV, PL) or increased their financial incentives (AT, HU, IS, SK)
- Separate regressions for subsamples are carried out (2007-2018 and 2013-2018)

Data

- fDi Markets database: Worldwide register of about 200,000 greenfield investment projects 2003-2018
- Definition greenfield FDI: new foreign establishments and expansions of existing foreign investments using information on investment plans
- Information on the types of greenfield FDI projects categorised by function, cluster, name and national origin of parent company, destination country, number of jobs generated by greenfield investment, and amount of capital flow
- Def: (i) R&D and (ii) design, testing and development activities
- Estimation sample is based on 8 395 greenfield FDI projects in R&D and related activities in 38 advanced countries for the period 2003-2018
- Greenfield FDI projects in R&D activities account for one fourth of the projects (2269)

Empirical results

- R&D tax incentives (measured by the increase in the B-index by more than 2 p.p. for large and profitable firms) lead to a significant increase in greenfield investment flows in R&D and relative activities
- Effect occurs with one year lag but can only be observed for capital flows
- Treatment effect is only significant at the 10 per cent level when measured as the number of FDI projects
- No significant effects can be observed when FDI activities are measured by the number of jobs generated.
- Strength of the effect of R&D tax incentives: coefficient of 0.28 for the greenfield FDI flows means: number of FDI flows in R&D increase by 32 per cent one year after the introduction or increase in R&D tax incentives (0.32=exp(0.28)-1)
- The number of FDI projects in R&D and related activities increase by 20 per cent

Empirical results

Fixed effects Poisson estimates of the introduction or increase in R&D tax incentives (2007-2018)

	Number of projects			capital flows in EUR			number of jobs		
	Coeff		z-stat	Coeff		z-stat	Coeff		z-stat
change in R&D tax incentives by 2 p. p (t)	0.18	*	1.79	-0.01		-0.06	0.18		1.23
Year dummy variables	yes			yes			yes		
control variables	yes			yes			yes		
Number of observations	444			444			444		
Number of countries	37			37			37		
Number of treated cases	29			29			29		

Notes: Asterisks ***, ** and * denotes significance at the 1, 5 and 10 per cent levels. Estimations are based on the fixed effects Poisson estimator with clustered adjusted standard errors by country

Empirical results

Fixed effects Poisson estimates of the introduction or increase in R&D tax incentives (2007-2018)

	Number of projects			capital flows in EUR			number of jobs		
	With lagged effects								
	Coeff		z-stat	Coeff		z-stat	Coeff		z-stat
change in R&D tax incentives by 2 p. p (t)	0.17		1.63	0.02		0.19	0.19		1.20
change in R&D tax incentives by 2 p. p (t-1)	0.08		0.85	0.28	**	2.30	0.12		0.83
change in R&D tax incentives by 2 p. p (t-2)	0.11		1.02	0.22	*	1.80	0.09		0.75
change in R&D tax incentives by 2 p. p (t-3)	0.14		1.32	0.22	**	2.03	0.08		0.63
Year dummy variables	yes			yes			yes		
control variables	yes			yes			yes		
Number of observations	444			444			444		
Number of countries	37			37			37		
Number of treated cases	29			29			29		

Notes: Asterisks ***, ** and * denotes significance at the 1, 5 and 10 per cent levels. Estimations are based on the fixed effects Poisson estimator with clustered adjusted standard errors by country

Empirical results

Separate estimations for FDI projects in R&D originating from US based multinationals

- Much stronger effects

Subsample regressions (total FDI inflows):

- For the recent subsample (2013-2018) no significant effect of R&D tax incentives can be detected
- Indicates that the effects of R&D incentives are declining over time
- This may be partly due to the fact that more and more countries introduced R&D tax incentives for the first time (SE 2014, LV 2014; PL 2016; SK 2014, 2018)

Robustness checks: Different thresholds for the treatment dummy (>3 p.p.; >4 p.p)

Empirical results

Fixed effects Poisson estimates of the introduction or increase in R&D tax incentives on FDI flows in R&D of US multinationals (2007-2018)

	Number of projects			capital flows in EUR r			number of jobs		
	Coeff.		z-stat	Coeff.		z-stat	Coeff.		z-stat
change in R&D tax incentives by 2 p. p (t)	0.17		1.38	0.31	**	2.42	0.38	*	1.85
Year dummy variables	yes			yes			yes		
control variables	yes			yes			yes		
Number of observations	432			432			432		
Number of countries	36			36			36		
Number of treated cases	29			29			29		
	With lagged effects								
	Number of projects			capital flows in EUR r			number of jobs		
	Coeff.		z-stat	Coeff.		z-stat	Coeff.		z-stat
change in R&D tax incentives by 2 p. p (t)	0.17	*	1.72	0.33	***	15.98	0.40	***	46.26
change in R&D tax incentives by 2 p. p (t-1)	0.09		0.87	0.26	***	11.79	0.32	***	33.64
change in R&D tax incentives by 2 p. p (t-2)	0.12		1.19	0.23	***	10.61	-0.07	***	-6.38
change in R&D tax incentives by 2 p. p (t-3)	0.17	*	1.74	0.16	***	7.80	-0.05	***	-4.78
Year dummy variables	yes			yes			yes		
control variables	yes			yes			yes		
Number of observations	432			432			432		
Number of countries	36			36			36		
Number of treated cases	29			29			29		

Notes: Asterisks ***, ** and * denotes significance at the 1, 5 and 10 per cent levels. Estimations are based on the fixed effects Poisson estimator with clustered adjusted standard errors by country

Empirical results

Fixed effects Poisson estimates of the introduction or increase in R&D tax incentives (2013-2018)

	Number of projects			capital flows in EUR n			number of jobs		
	Coef.		z-stat	Coef.		z-stat	Coef.		z-stat
change in R&D tax incentives by 2 p. p (t)	-0.12		-1.02	-0.45		-1.7	-0.36		-1.39
Year dummy variables	yes			yes			yes		
control variables	yes			yes			yes		
Number of observations	223			223			223		
Number of countries	37			37			37		
Number of treated cases	14			14			14		

Notes: Asterisks ***, ** and * denotes significance at the 1, 5 and 10 per cent levels. Estimations are based on the fixed effects Poisson estimator with clustered adjusted standard errors by country

Empirical results

Fixed effects Poisson estimates of the introduction or increase in R&D tax incentives (2013-2018)

	Number of projects			capital flows in EUR n			number of jobs		
	With lagged effects								
	Coef.		z-stat	Coef.		z-stat	Coef.		z-stat
change in R&D tax incentives by 2 p. p (t)	-0.12		-0.95	-0.40		-1.93	-0.37	*	-1.68
change in R&D tax incentives by 2 p. p (t-1)	0.10		0.92	0.62	***	2.85	0.42		1.46
change in R&D tax incentives by 2 p. p (t-2)	-0.04		-0.44	-0.09		-0.43	-0.06		-0.24
change in R&D tax incentives by 2 p. p (t-3)	0.00		0.02	-0.12		-0.56	-0.22		-0.79
Year dummy variables	yes			yes			yes		
control variables	yes			yes			yes		
Number of observations	223			223			223		
Number of countries	37			37			37		
Number of treated cases	14			14			14		

Notes: Asterisks ***, ** and * denotes significance at the 1, 5 and 10 per cent levels. Estimations are based on the fixed effects Poisson estimator with clustered adjusted standard errors by country

Conclusions

- Several countries introduced R&D tax incentives or increased its intensity
- DID approach to compare the level of FDI inflows in R&D before and after the tax change
- Increase in R&D tax incentives leads to an increase in FDI flows in R&D and related activities
- Stronger effects for US based FDI flows
- Effects tend to a decline over time

Limitations and Future work

Limitations: FDI measure is restricted to Greenfield FDI in R&D and related activities

Future work:

- Separate results for CN FDI projects in R&D activities (important to distinguish between Extra and Intra EU inflows)
- FDI gravity model (allows to account for tax incentives of the host and destination country) (Castellani et al. 2013)
- Continuous treatment (dose function approach)
- Extension to the city level -> makes it possible to investigate each case separately
- Synthetic control function approach -> makes it possible to investigate each case separately
- Consideration of other treatments (strong decline in the corporate tax rate)