Spillovers from Public Intangibles

Cecilia Jona Lasinio (LUISS Lab and ISTAT, Italy), Carol Corrado (The Conference Board, United States), and Jonathan Haskel (Imperial College, United Kingdom)

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Discussant: Thomas Niebel, Centre for European Economic Research (ZEW), Mannheim

SPINTAN
smartpublicintangibles

ZEW
Zentrum für Europäische Wirtschaftsforschung GmbH
Centre for European Economic Research

Motivation

- Global productivity slowdown has renewed interest in **policies that might boost economic growth**
- One area of interest: **spillovers from public sector investments**
- Public sector is a **major investor in intangible assets**: human and scientific capital via investments in education and R&D

⇒ **Believed to exert positive macroeconomic effects in the long run**

Intangibles

- Itangibles that are included in national accounts (SNA08):

  R&D, software and databases, mineral exploration, artistic and entertainment originals)

- Non-national accounts intangibles (CHS):

  Design, brand equity, and organizational capital, firm-specific training

⇒ **Both types covered in this paper**

Contribution

Scope: Paper looks at the correlation between TFP growth and different measures of public sector knowledge creation

⇒ **examine possible spillovers between public sector intangibles and business sector productivity performance**

- **R&D**: First paper that re-examines public sector R&D spillovers using national accounts R&D data
- **Market Sector Non-R&D**: Previous findings are revisited in this paper using additional controls and additional data.

Related Literature

- Extensive literature on the (positive) effects of R&D **but focus on private sector R&D**
  - Exception: Guellec and Van Pottelsberghe de la Potterie (2002, 2004) - they found strong positive effects

- **Non-R&D intangibles**: Corrado et al. (2014) found evidence of productivity spillovers to increases in intangible capital in market sector industries

Preview of Results

Main findings:

- Authors find evidence of spillovers from **public sector R&D** to productivity in the market sector.

- The findings of Corrado et al. (2014) of spillovers from **private nonR&D intangible capital** holds in the extended data set (inclusion of the United States, extension of the time period to cover the financial crises, and inclusion of public R&D as an additional control)

Framework

Total economy:

$$\Delta \ln TFP^{Q}_{c,t} = a_c + a_t + d^{L}\Delta lnL_{c,t} + d^{ICT}\Delta lnK^{ICT}_{c,t} + d^{NonICT}\Delta lnK^{NonICT}_{c,t} + d^{R}\Delta lnR_{c,t} + v_{c,t}$$

Spillover from non-market to market:

$$\Delta lnTFP^{Q,MKT}_{c,t} = a_c + a_t + d^{L}\Delta lnL^{MKT}_{c,t} + d^{K}\Delta lnK^{MKT}_{c,t} + d^{R}\Delta lnR^{MKT}_{c,t} + \boldsymbol{\rho}(N^{NonMKT}/Q^{MKT})_{c,t} + v_{c,t}$$

The interpretation of d^R is an 'excess over market' returns because output includes R&D and inputs include market R&D at its ex post user cost. The interpretation of $\boldsymbol{\rho}$ is a **spillover from non-market to market**.

Data I

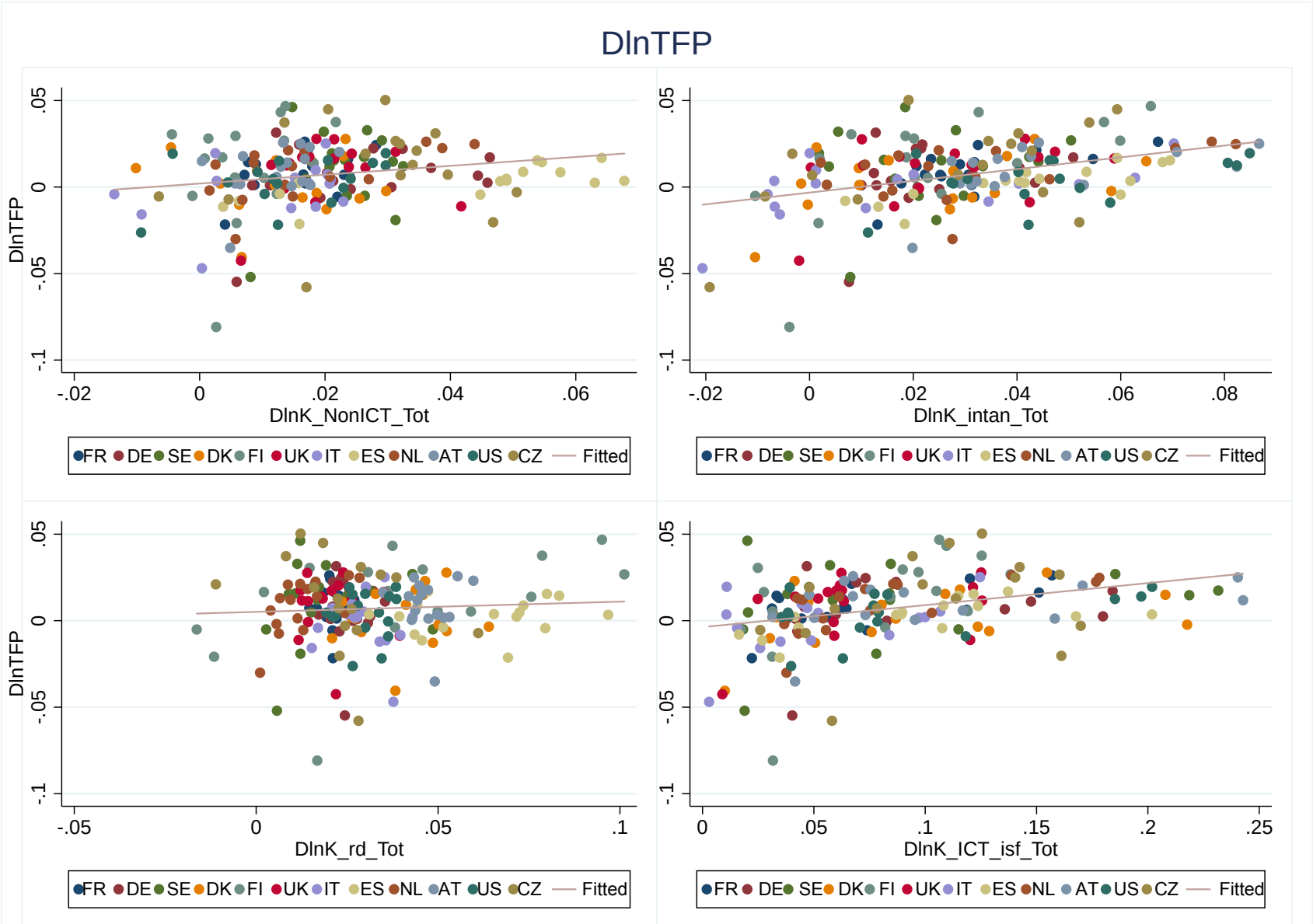
Dataset covers 4 dimensions:

1. *Countries:* US DE, FR, UK DK, FI, SE AT, CZ, NL IT, ES
2. *Industries:* NACE rev. 2 A21 industry level - but aggregated
3. *Institutional Sectors:*
   - **market**: (non)-financial corporations (S11, S12), households (S14)
   - **nonmarket**: government (S13) and nonprofit institutions - NPISH (S15);
4. *Time:* 1998-2013

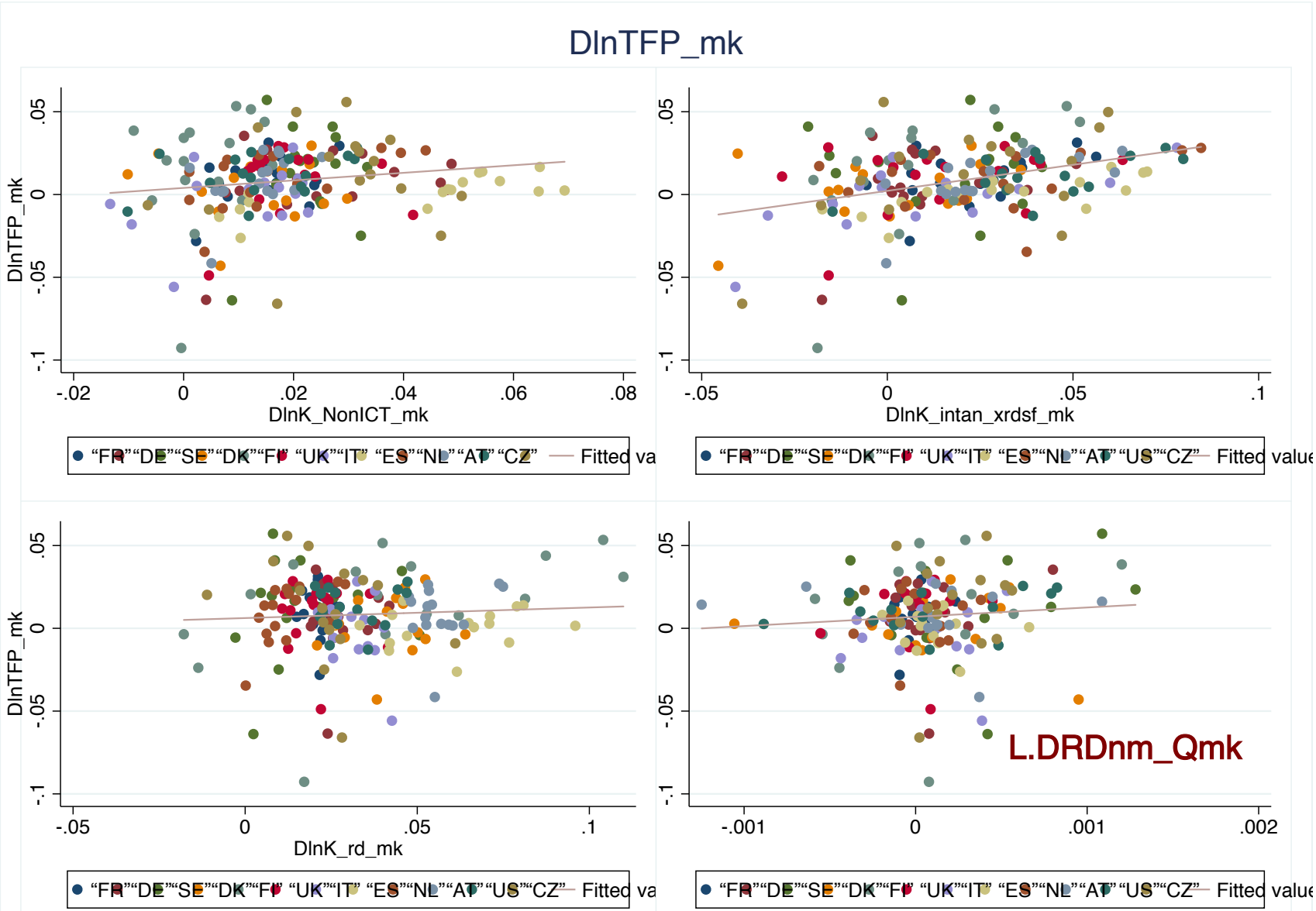
Data II

- **Market Sector Intangibles**:
  - Cover intangible assets capitalized in national accounts as well as those that are not, as previously indicated
  - *Source:* Updated INTAN-Invest database
- Further **breakdown by institutional sector** (market and nonmarket)
  - For industries M72, P, Q, and R (R&D services, Education, Health, and Arts and Recreation industries)
  - *Source:* Preliminary data from SPINTAN

TFP growth, whole economy and capital inputs



TFP and Market and Non-market Intangibles



Spillover Regressions, 1998 to 2013: Total Economy

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	DDlnTFP(Q)					
	1998-2013					1998-2007
D.DlnK_NonICT_te	-0.111	-0.110	-0.125	-0.155	-0.155	-0.283*
	(0.138)	(0.133)	(0.129)	(0.130)	(0.129)	(0.153)
D.DlnK_ICT_te	0.053	-0.007	-0.007	0.028	0.033	0.038
	(0.041)	(0.043)	(0.043)	(0.039)	(0.039)	(0.035)
D.DlnK_intan_te		**0.248*** **	**0.245*** **			
		(0.073)	**(0.073)**			
D.DlnK_intan_xrdsf_te				**0.163*** **	**0.162*** **	**0.176*** **
				(0.044)	**(0.044)**	**(0.047)**
D.DlnK_rd_te				0.101		
				(0.090)		
D.DlnL_te	0.005	-0.016				
	(0.064)	(0.063)				
D.DlnL_te$_{(t-1)}$			0.008	0.009	0.008	0.010
			(0.018)	(0.018)	(0.018)	(0.014)
D.DlnK_rd_te$_{(t-1)}$					**-0.168***	**-0.190****
					(0.091)	**(0.077)**
Observations	192	192	192	192	192	120
Number of ctrycode	12	12	12	12	12	12

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Spillover Regressions, 1998 to 2013: Market Sector

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	DlnTFPmk					
	1998-2013					1998-2007
DlnK_NonICT_mk	-0.333***	-0.348***	-0.347***	-0.373***	-0.367***	-0.492***
	(0.109)	(0.108)	(0.108)	(0.108)	(0.109)	(0.128)
DlnK_ICT_isf_mk	0.036	0.027	0.032	0.041	0.043	0.027
	(0.033)	(0.032)	(0.033)	(0.034)	(0.035)	(0.033)
DlnK_rd_mk		**0.105***	**0.108***	**0.109***		0.001
		(0.060)	**(0.061)**	**(0.060)**		(0.057)
RD_Q_nm			1.316			
			(1.488)			
DlnK_intan_xrdsf_mk		**0.073***	**0.081***	**0.101****	**0.104****	**0.112****
		(0.041)	**(0.041)**	**(0.041)**	**(0.042)**	**(0.045)**
$RD\_Q\_nm_{(t-1)}$				**4.032*****	**3.851****	**7.092*****
				(1.534)	**(1.547)**	**(1.896)**
$DlnK\_rd\_mk_{(t-1)}$					0.025	
					(0.061)	
Observations	192	192	192	192	192	120
Number of ctrycode	12	12	12	12	12	12

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Rates of Return to Public Sector R&D

The coefficient on N^{NonMKT}/Q^{MKT} indicates a rate of return, in column 4 of 403 percent $\Rightarrow$ **This is clearly too high**.

- Variation in N^{NonMKT}/Q^{MKT} is mostly cross country
- Pooled regression with 12 countries, 3 crosssections (1996-2007, 2008-2009 and 2010-2013) gives more reasonable values of around 30 percent

Conclusion

1. Support for earlier findings in the literature (Guellec and Van Pottelsberghe de la Potterie 2002, 2004) that there are spillovers from public sector R&D to market sector productivity.

2. No evidence that non-market non-R&D intangible investment has spillover benefits to the market sector

3. Evidence that market sector investments in non-R&D intangible capital generate spillovers to productivity

4. Mixed results regarding spillovers from market sector investments in R&D (1998-2007 vs 1998-2013)

Comments

- Paper has great potential:
  - Very relevant topic
  - (When completed) unique data set
- As the authors point out (and plan to fix in an updated version of the paper), the fact that the labor input is not quality adjusted is problematic
- More detailed discussion regarding the chosen rate of return for the construction of factor shares for the public sector (social rate of time preferences)

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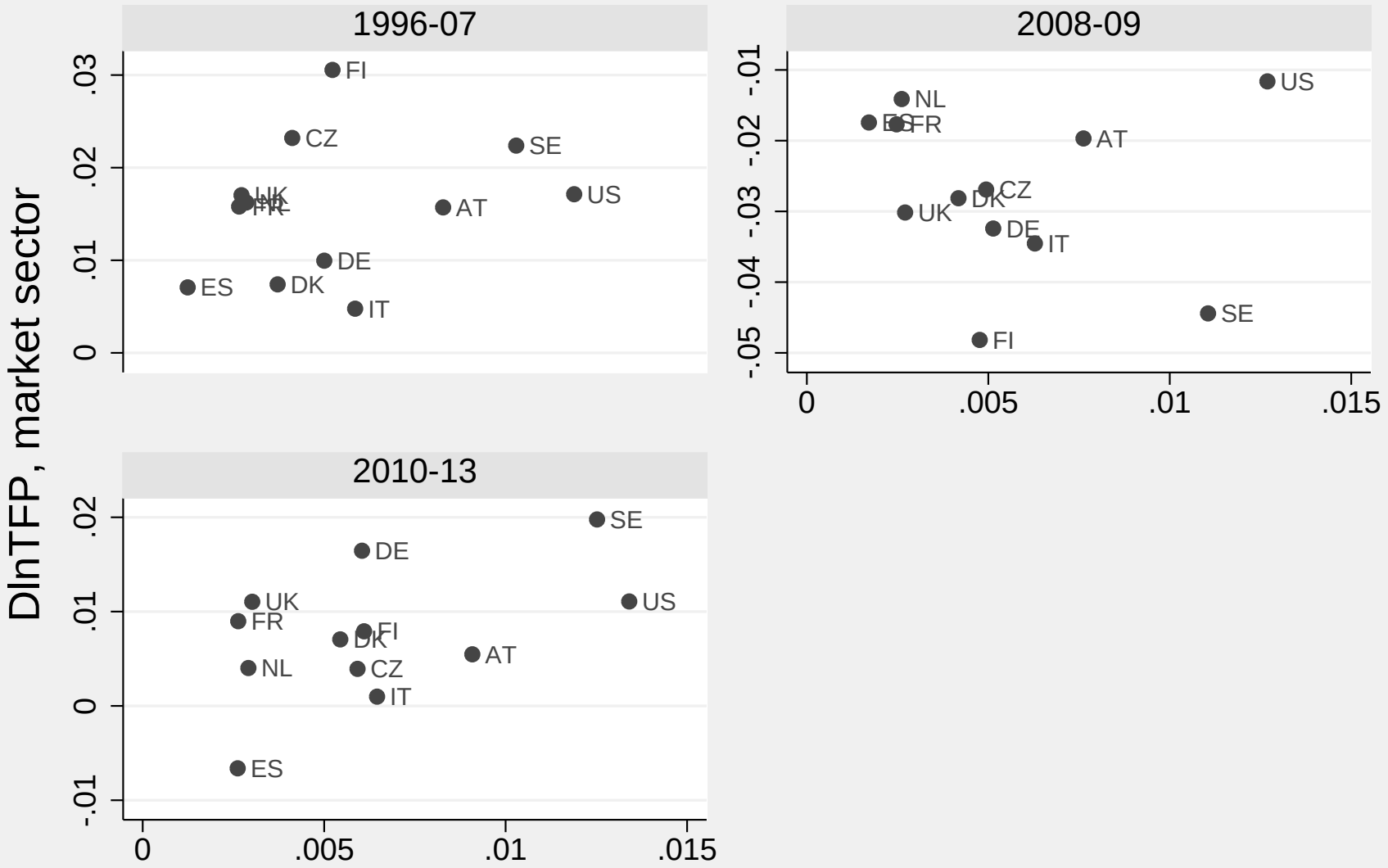
DlnTFP, market sector and Nonmarket R&D



$$\Delta lnTFP_{c,t}^{Q,MKT} = a_c + a_t + d^K \Delta lnK_{intan,c,t}^{MKT} + d^R \Delta lnR_{c,t}^{MKT} + \rho(N^{NonMKT}/Q^{MKT})_{c,t} + v_{c,t}$$

VARIABLES	(1) DlnTFP_mk	(2) DlnTFP_mk	(3) DlnTFP_mk	(4) DlnTFP_mk	(5) DlnTFP_mk	(6)[1] DlnTFP_mk
LRDnm_Qmk	0.526*	0.412	0.323	0.321	0.323	5.345
	(0.283)	(0.325)	(0.256)	(0.254)	(0.252)	(4.710)
DlnK_intan_xrdsf_mk			**0.167*** **	**0.166*** **	**0.167*** **	0.148
			(0.055)	(0.055)	(0.057)	(0.176)
DlnK_rd_mk			-0.000			
			(0.074)			
LDlnK_rd_mk				-0.006		
				(0.062)		
Dummy for 2008-09		**-0.043*** **	**-0.039*** **	**-0.039*** **	**-0.039*** **	**-0.041*** **
		(0.005)	(0.005)	(0.006)	(0.006)	(0.007)
Dummy for 2010-13		**-0.009*** **	**-0.006** **	**-0.006** **	**-0.006** **	-0.011*
		(0.002)	(0.002)	(0.002)	(0.003)	(0.006)
Constant	**-0.004** **	**0.013*** **	**0.010*** **	**0.010*** **	**0.010*** **	-0.017
	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.027)
Observations	36	36	36	36	36	36
R-squared	0.00743	0.829	0.843	0.843	0.843	0.498
Number of countries	12	12	12	12	12	12

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

1. Fixed effects. All other columns are random effects.

References

Corrado, C., Haskel, J. and Jona-Lasinio, C. (2014), Knowledge Spillovers, ICT and Productivity Growth, CEPR Discussion Papers 10057, C.E.P.R. Discussion Papers.

Guellec, D. and Van Pottelsberghe de la Potterie, B. (2002), 'R&D and productivity growth', *OECD Economic Studies* **2001**(2), 103–126.

Guellec, D. and Van Pottelsberghe de la Potterie, B. (2004), 'From R&D to productivity growth: Do the institutional settings and the source of funds of R&D matter?', *Oxford Bulletin of Economics and Statistics* **66**(3), 353–378.

Value added in country c, industry i and time t:

$$\Delta lnQ_{c,i,t} = \epsilon^{L}_{c,i,t}\Delta lnL_{c,i,t} + \epsilon^{K}_{c,i,t}\Delta lnK_{c,i,t} + \epsilon^{R}_{c,i,t}\Delta lnR_{c,i,t} + \Delta lnA_{c,i,t}$$

For a cost-minimizing firm (output elasticity = factor share):

$$\epsilon^{X}_{c,i,t} = s^{X}_{c,i,t},\ X = L, K, R$$

If firms can benefit from the L, K or R in other firms, industries, or countries

$$\epsilon^{X}_{c,i,t} = s^{X}_{c,i,t} + d^{X}_{c,i,t},\ X = L, K, R$$

Output elasticities equal factor shares plus d, where d is any deviation of elasticities from factor shares due to e.g., spillovers

Might be rewritten as:

$$\Delta lnTFP^{Q}_{c,i,t} = d^{L}_{c,i,t}\Delta lnL_{c,i,t} + d^{K}_{c,i,t}\Delta lnK_{c,i,t} + d^{R}_{c,i,t}\Delta lnR_{c,i,t} + \Delta lnA_{c,i,t}$$

where $\Delta lnTFP^{Q}_{c,i,t}$ is calculated as

$$\Delta lnTFP^{Q}_{c,i,t} = \Delta lnQ_{c,i,t} - s^{L}_{c,i,t}\Delta lnL_{c,i,t} - s^{K}_{c,i,t}\Delta lnK_{c,i,t} - s^{R}_{c,i,t}\Delta lnR_{c,i,t}$$

$$\begin{aligned}\Delta lnTFP^{Q}_{i,c,t} &= d^{L}_{i,c,t}\Delta lnL_{i,c,t} + d^{K}_{i,c,t}\Delta lnK_{i,c,t} + d^{R}_{i,c,t}\Delta lnR_{i,c,t} \\ &\quad +\gamma_{i,c,t}\Delta lnR_{\_i,c,t}\end{aligned}$$

$$\begin{aligned}\Delta lnTFP^{Q}_{i,c,t} &= d^{L}_{i,c,t}\Delta lnL_{i,c,t} + d^{K}_{i,c,t}\Delta lnK_{i,c,t} + d^{R}_{i,c,t}\Delta lnR_{i,c,t} \\ &\quad + \gamma_{i,c,t}(\Sigma\omega_{i,j\neq i}\Delta lnR_{i,c,t}) \ .\end{aligned}$$

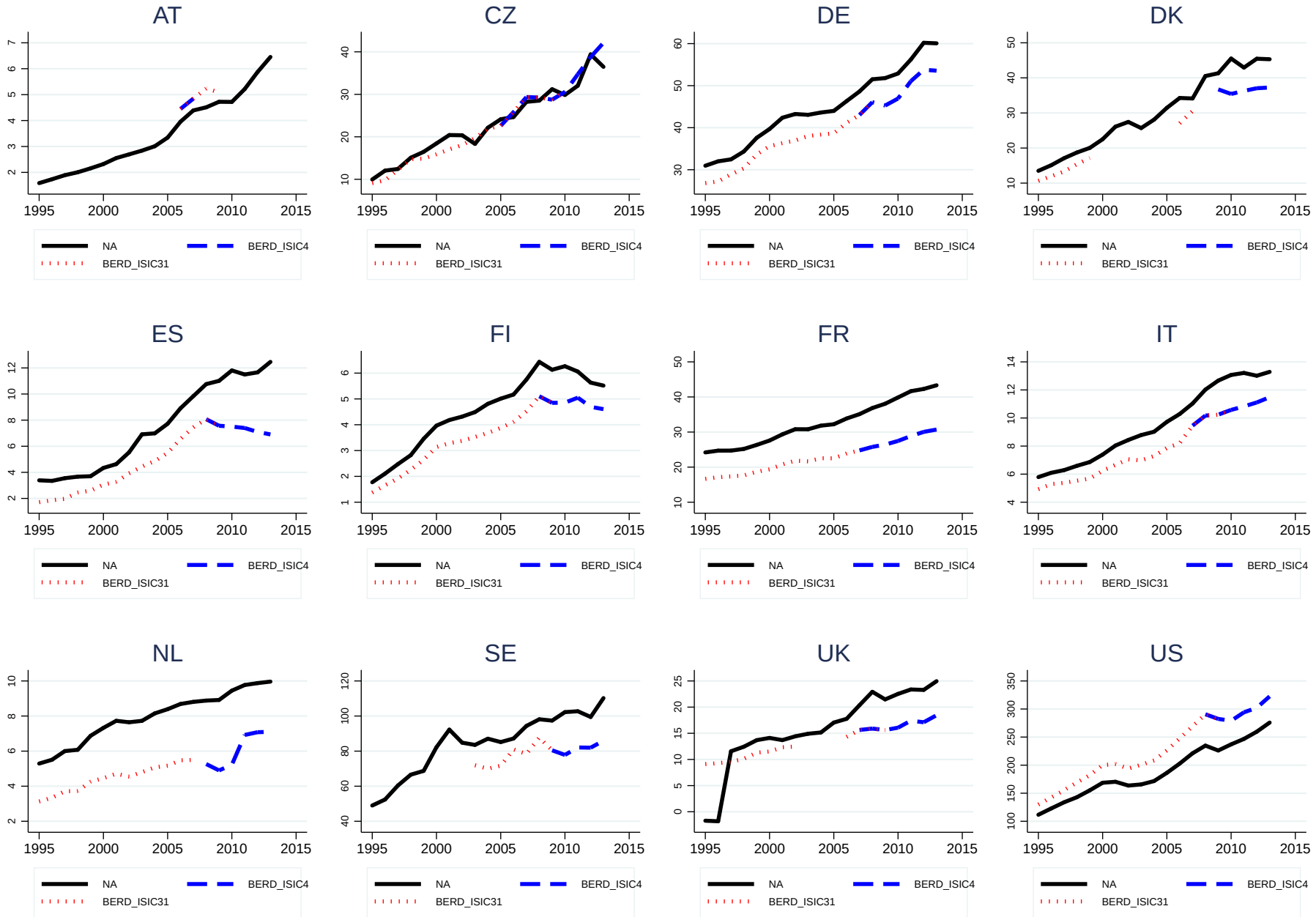


FIGURE 1. BERD AND NATIONAL ACCOUNTS R&D DATA

Note. BERD data downloaded from OECD website July 14, 2016. National accounts data are sourced from EUROSTAT; processed into SPINTAN database July 18, 2016.

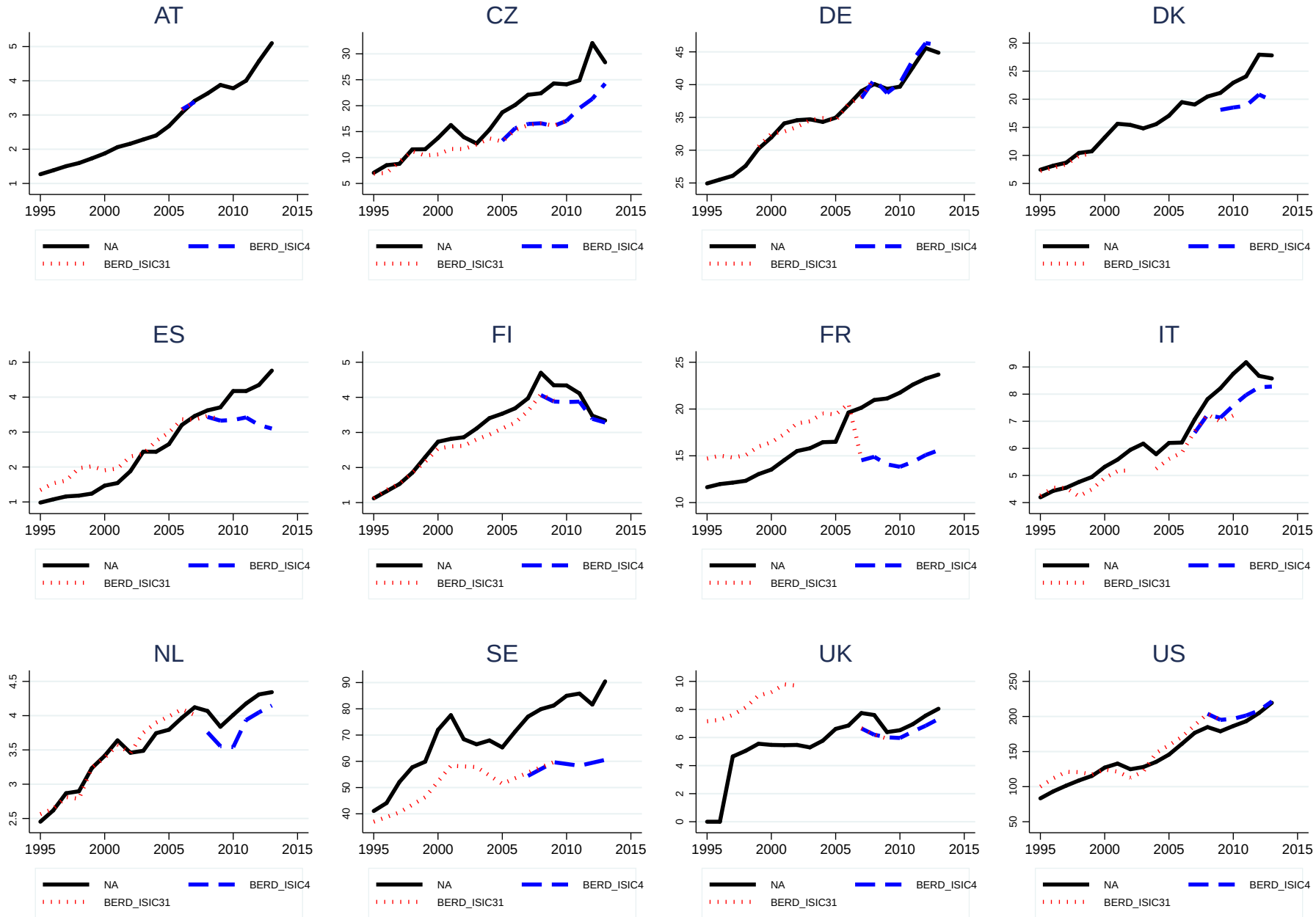


FIGURE 2. BERD AND NATIONAL ACCOUNTS MANUFACTURING R&D DATA

Note. BERD data downloaded from OECD website July 14, 2016. National accounts data are sourced from EUROSTAT; processed into SPINTAN database July 18, 2016.