Employment Protection and Innovation Intensity

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Outline

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Motivation

- **Relevant for both research and policy**
  - Theoretical predictions are ambiguous

  - Empirical evidence is limited and inconclusive

  - From a policy perspective, innovation has been identified as a major driver of economic growth

EPL and Innovation: Theoretical Literature

Two Channels

- **Human Capital Investment**
  - strong EPL increases job security and incentivises employees to invest in human capital and innovation, (Acemoglu, 1997; Akerloff, 1982; Belot et al., 2007)

- **Adjustment Costs**
  - high hiring and firing costs increase the adjustment cost of firms and thus can discourage firms from innovation, (Saint-Paul, 1997; 2002; Samaniego, 2006; Cuñat and Melitz, 2010)

EPL and Innovation: Empirical Evidence

Empirical Findings

Acarya et al (2010)   Positive link

Barbosa and Faria (2011)   Negative link

Griffith and McCartney (2010)   Both ⎰ Positive (incremental innovation)
                                                        ⎱ Negative (radical innovation)

EPL – Innovation Link is Conditioned

- **Industry Characteristics**
    - Competition, (Aghion et al. 2001, 2005; Aghion and Griffith, 2005)
    - Distance to the technology frontier, (Aghion at al. 2005, 2009)
    - Technology and skills intensity, (Saint Paul 1997; Samaniego 2006)
    - Layoff propensity (Bassanini et al 2009)

- **Other Labour Market Institutions**
    - Wage setting institutions Haucap and Wey, 2004; Bassanini and Ernst., 2002);
    - Unionisation (Tauman and Weiss, 1987; Ulph and Ulph, 1994, 1998, 2001; Menezes-Filho et al.,1998)

Added Value

- Focus on within country, between industry differences over time: build on the econometric framework of Rajan and Zingales (1998), Bassanini et al (2009), Murphy and Siedschlag (2011)

- Basic identification assumption: the effect of EPL on innovation intensity will be greater in industries with a higher layoff propensity

- Three measures of EPL
    - Overall, Regular Employment, Temporary Employment

Empirical Methodology

Baseline Model

$$\ln INNO_{ijt} = \alpha L_j EPL_{it-1} + \beta L_j \Delta EPL_{it} + \lambda_{it} + \mu_{jt} + \varepsilon_{ijt}$$

Augmented Model

$$\ln INNO_{ijt} = \alpha L_j EPL_{it-1} + \beta L_j \Delta EPL_{it} + \gamma Z_{ij,t-1} + \gamma X_{i,t-1} Y_j + \lambda_{it} + \mu_{jt} + \varepsilon_{ijt}$$

$INNO_{ijt}$, is a measure of innovation intensity in country i, industry j, at time t.

L_j layoff propensity in industry j

EPL_j Stringency of Employment Protection in country i

Z_{ijt} time varying industry covariates

$X_{it} Y_j$ other country-industry covariates

λ_{it} control for unobserved country-time effects

μ_{jt} control for unobserved industry-time effects

ε_{ijt} is an idiosyncratic error term.

Data

Variable	Description	Notes
Dependent Variable		
Patent Intensity	No of patents granted by USPTO per employee hours worked in each industry in each year	EUKLEMS linked database, 1970-1999
Explanatory Variables		
Industry Job Reallocation Rate	The total number of the jobs terminated, plus jobs created, in period t divided by average employment over the period $t-1$ and t in each industry	EUKLEMS micro files US used as industry benchmark, 1990-2004
Employment Protection Variable	Indicator variable based on rules governing dismissal of workers: severance pay, notice period, appeals procedures.	OECD EP database 3 measures: Overall *EPL*, Regular *EPLR*, Temporary *EPLT*. Scale of 0 to 6, 1985-2008

Other Explanatory Variables

Industry-level

- Distance to the technological frontier

- Import competition

- Product market regulation

- Human capital intensity

- Physical capital intensity

Country-level

- Labour market institution variables; Union Density, Unemployment Benefit Duration, Wage Coordination, Wage Centralisation, Labour Market Activation Policy

Empirical Results

Innovation Intensity and Employment Protection, Baseline Model

	EPL	EPLR	EPLT	EPLR, EPLT
	(1)	(2)	(3)	(4)
$jr_{us,j} * EPL_{it-1}$	-0.343***			
	(0.106)			
$jr_{us,j} * \Delta EPL_{it}$	1.108			
	(1.586)			
$jr_{us,j} * EPLR_{it-1}$		-0.177		-0.018
		(0.123)		(0.131)
$jr_{us,j} * \Delta EPLR_{it}$		-1.912		-2.455
		(2.319)		(2.309)
$jr_{us,j} * EPLT_{it-1}$			-0.250***	-0.252***
			(0.068)	(0.072)
$jr_{us,j} * \Delta EPLT_{it}$			1.112	1.272
			(0.921)	(0.934)
Country* Time Fixed Effects	yes	yes	yes	yes
Sector* Time Fixed Effects	yes	yes	yes	yes
Country-Industry groups	180	180	180	180
Observations	1620	1620	1620	1620
Adjusted R^2	0.747	0.746	0.748	0.747
Economic Significance of EPL Job Reallocation Interaction				
25th- 75th percentile	-1.72	-0.89	-1.91	
10th - 90th percentile	-9.21	-3.26	-10.99	

Innovation Intensity and Employment Protection, Additional Controls

	EPL	EPLR	EPLT	EPLR, EPLT
	(1)	(2)	(3)	(4)
$jr_{us,j} * EPL_{it-1}$	-0.595***			
	(0.113)			
$jr_{us,j} * \Delta EPL_{it}$	0.251			
	(1.541)			
$jr_{us,j} * EPLR_{it-1}$		-0.312**		-0.004
		(0.144)		(0.152)
$jr_{us,j} * \Delta EPLR_{it}$		-0.495		-0.595
		(2.546)		(2.363)
$jr_{us,j} * EPLT_{it-1}$			-0.424***	-0.425***
			(0.069)	(0.073)
$jr_{us,j} * \Delta EPLT_{it}$			0.122	0.142
			(0.885)	(0.889)
$ky_{us,j} * KY_{it-1}$	0.057***	0.058***	0.058***	0.058***
	(0.004)	(0.004)	(0.004)	(0.004)
$hc_{us,j} * HCAP_{it-1}$	0.020***	0.019***	0.020***	0.020***
	(0.002)	(0.002)	(0.002)	(0.002)
dtf_{ijt-1}	0.011	0.010	0.021	0.021
	(0.021)	(0.023)	(0.020)	(0.022)
$impcomp_{ijt-1}$	0.192***	0.184***	0.200***	0.200***
	(0.045)	(0.046)	(0.046)	(0.047)
pmr_{ijt-1}	-1.290***	-1.172***	-1.379***	-1.381***
	(0.341)	(0.359)	(0.340)	(0.347)
Country* Time Fixed Effects	yes	yes	yes	yes
Sector* Time Fixed Effects	yes	yes	yes	yes
No of groups	170	170	170	170
Observations	1530	1530	1530	1530
Adjusted R^2	0.809	0.806	0.810	0.810

Innovation Intensity and Employment Protection (EPL Index), Other LMI

	Union Density	Tax Wedge	Benefit Duration	Benefit Duration (alt)	Coordination	Centralisation	Labour Market Activation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$jr_{us,j} * EPL_{it-1}$	-0.569***	-0.511***	-0.370***	-0.543***	-0.692***	-0.722***	-0.480***
	(0.154)	(0.159)	(0.132)	(0.128)	(0.142)	(0.142)	(0.146)
$jr_{us,j} * \Delta EPL_{it}$	0.707	0.764	0.258	0.427	0.414	-1.017	0.667
	(1.517)	(1.594)	(1.495)	(1.530)	(1.429)	(1.503)	(1.659)
$ky_{us,j} * KY_{it-1}$	0.046***	0.047***	0.053***	0.053***	0.053***	0.052***	0.052***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
$hc_{us,j} * HCAP_{it-1}$	0.024***	0.027***	0.021***	0.020***	0.020***	0.020***	0.020***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
dtf_{ijt-1}	0.092***	0.074***	0.027	0.027	0.029	0.034	0.022
	(0.021)	(0.022)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)
$impcomp_{ijt-1}$	0.327***	0.342***	0.162***	0.164***	0.168***	0.170***	0.152***
	(0.035)	(0.035)	(0.047)	(0.047)	(0.046)	(0.047)	(0.049)
pmr_{ijt-1}	-0.697	-0.636	-0.699	-0.658	-0.668	-0.459	-1.007
	(0.663)	(0.683)	(0.642)	(0.646)	(0.663)	(0.650)	(0.741)
$jr_{us,j} * LMI_{it-1}$	0.004	0.016	-0.034***	-0.025*	0.328**	0.408***	-0.183
	(0.007)	(0.013)	(0.010)	(0.014)	(0.137)	(0.144)	(0.200)
$jr_{us,j} * \Delta LMI_{it}$	10.526	0.016*	-1.822***	0.199	-2.380	6.065	0.587
	(12.569)	(0.061)	(0.513)	(0.552)	(3.391)	(4.881)	(1.105)
Country*Time Fixed Effects	yes	yes	yes	yes	yes	yes	yes
Sector*Time Fixed Effects	yes	yes	yes	yes	yes	yes	yes
No of groups	150	140	160	160	160	160	150
Observations	1350	1260	1440	1440	1440	1440	1350
Adjusted R^2	0.826	0.808	0.812	0.811	0.812	0.812	0.808

Innovation Intensity and Employment Protection (EPLR, EPLT), Other LMI

	Union Density	Tax Wedge	Benefit Duration	Benefit Duration (alt)	Coordina-tion	Centralisa-tion	Labour Market Activation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$jr_{us,j} * EPLR_{it-1}$	0.141	- 0.286*	0.091	-0.006	-0.194	-0.315	-0.027
	(0.163)	(0.172)	(0.169)	(0.162)	(0.171)	(0.194)	(0.188)
$jr_{us,j} * \Delta EPLR_{it}$	-0.554	-2.855	-0.610	-0.624	-0.650	-0.635	-0.441
	(2.336)	(4.440)	(2.519)	(2.415)	(2.355)	(2.240)	(2.487)
$jr_{us,j} * EPLT_{it-1}$	-0.487***	-0.530***	-0.319***	-0.400***	-0.412***	-0.376***	-0.378***
	(0.085)	(0.091)	(0.082)	(0.077)	(0.079)	(0.076)	(0.119)
$jr_{us,j} * \Delta EPLT_{it}$	0.221	0.270	0.119	0.200	0.314	-0.500	0.331
	(0.834)	(0.830)	(0.835)	(0.880)	(0.831)	(0.894)	(0.951)
$ky_{us,j} * KY_{it-1}$	0.046***	0.047***	0.053***	0.053***	0.053***	0.052***	0.052***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
$hc_{us,j} * HCAP_{it-1}$	0.024***	0.027***	0.020***	0.020***	0.020***	0.020***	0.020***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
dtf_{ijt-1}	0.105***	0.094***	0.034	0.034	0.033	0.035	0.028
	(0.022)	(0.023)	(0.025)	(0.025)	(0.025)	(0.025)	(0.026)
$impcomp_{ijt-1}$	0.343***	0.364***	0.170***	0.171***	0.172***	0.171***	0.159***
	(0.035)	(0.036)	(0.048)	(0.048)	(0.048)	(0.048)	(0.050)
pmr_{ijt-1}	-0.791	-0.706	-0.756	-0.713	-0.710	-0.477	-1.004
	(0.673)	(0.685)	(0.649)	(0.654)	(0.672)	(0.666)	(0.742)
$jr_{us,j} * LMI_{it-1}$	0.005	0.024*	-0.037***	-0.027*	0.301**	0.392**	-0.139
	(0.007)	(0.012)	(0.010)	(0.014)	(0.140)	(0.165)	(0.204)
$jr_{us,j} * \Delta LMI_{it}$	6.532	0.164**	-1.392***	0.275	-1.383	5.833	0.670
	(13.233)	(0.064)	(0.537)	(0.532)	(3.468)	(4.911)	(1.113)
Country* Time Fixed Effects	yes	Yes	yes	yes	yes	yes	yes
Sector* Time Fixed Effects	yes	Yes	yes	yes	yes	yes	yes
No of groups	150	140	160	160	160	160	150
Observations	1350	1260	1440	1440	1440	1440	1530
Adjusted R^2	0.827	0.827	0.813	0.811	0.812	0.812	0.813

Sensitivity Analysis

1. Alternative EPL measure (i.e. Allard 2005)

2. Alternative measure of industries' propensity to adjust labour (i.e. US layoff rates)

3. Exclusion of one country at a time

Innovation Intensity and Employment Protection, Alternative EPL Measure

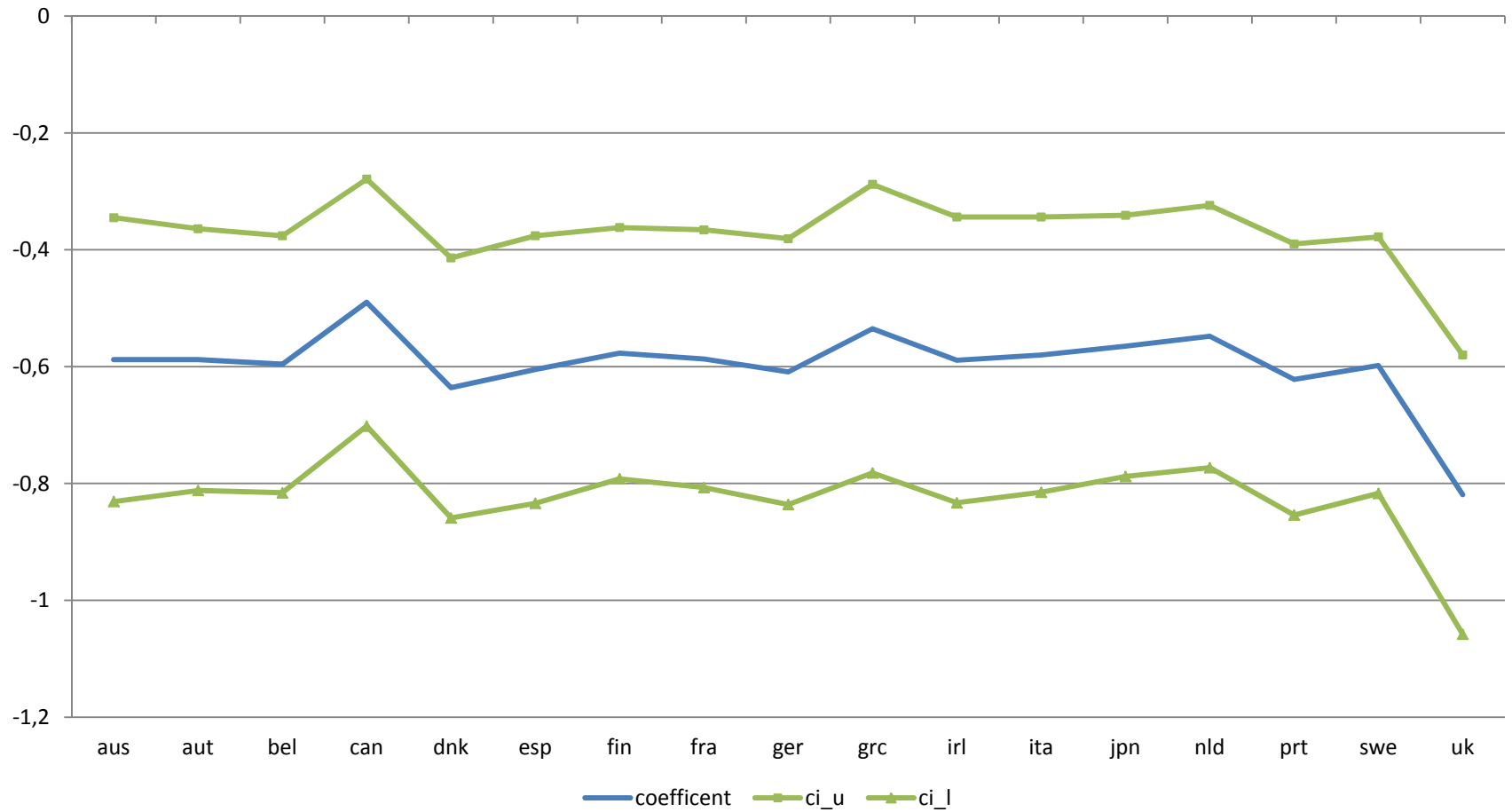|	Baseline Model	Augmented Model	Union Density	Tax Wedge	Benefit Duration	Benefit Duration (alt)	Coordina-tion	Centralisa-tion	Labour Market Activation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$jr_{us,j} * EPL_{it-1}$	-0.318**	-0.533***	-0.374**	-0.467**	-0.397***	-0.611***	-0.603***	-0.700***	-0.433**
	(0.127)	(0.142)	(0.164)	(0.195)	(0.148)	(0.149)	(0.148)	(0.149)	(0.183)
$jr_{us,j} * \Delta EPL_{it}$	-0.657	-1.229	-1.070	-4.475**	-0.544	-1.610	-1.154	-1.423	-1.157
	(1.386)	(1.438)	(1.527)	(2.204)	(1.293)	(1.444)	(1.484)	(1.478)	(1.455)
$ky_{us,j} * KY_{it-1}$		0.053***	0.047***	0.047***	0.053***	0.054***	0.054***	0.053***	0.052***
		(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
$hc_{us,j} * HCAP_{it-1}$		0.020***	0.023***	0.026***	0.021***	0.020***	0.020***	0.020***	0.019***
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
dtf_{ijt-1}		0.027	0.096***	0.079***	0.026	0.027	0.030	0.034	0.024
		(0.024)	(0.021)	(0.023)	(0.024)	(0.024)	(0.024)	(0.024)	(0.025)
$impcomp_{ijt-1}$		0.166***	0.325***	0.345***	0.161***	0.162***	0.167***	0.169***	0.151***
		(0.047)	(0.034)	(0.035)	(0.046)	(0.047)	(0.047)	(0.046)	(0.049)
pmr_{ijt-1}		-0.822	-0.822	-0.749	-0.759	-0.750	-0.802	-0.620	-1.170
		(0.664)	(0.661)	(0.683)	(0.639)	(0.647)	(0.664)	(0.655)	(0.740)
$jr_{us,j} * LMI_{it-1}$			0.002	0.014	-0.041***	-0.035**	0.195	0.342**	-0.277
			(0.007)	(0.013)	(0.009)	(0.014)	(0.131)	(0.143)	(0.200)
$jr_{us,j} * \Delta LMI_{it}$			-2.242	0.130*	-1.903***	0.256	-4.120	6.166	-0.046
			(12.306)	(0.066)	(0.542)	(0.546)	(3.621)	(4.573)	(1.106)
Country* Time Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
Sector* Time Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
No of groups	160	160	150	140	160	160	160	160	150
Observations	1440	1440	1350	1260	1440	1440	1440	1440	1350
Adjusted R^2	0.765	0.810	0.825	0.824	0.812	0.810	0.810	0.811	0.807

Innovation Intensity and Employment Protection, Alternative Industry Benchmark Measure

	Baseline Model (1)	Augmented Model (2)	Union Density (3)	Tax Wedge (4)	Benefit Duration (5)	Benefit Duration(alt) (6)	Coordination (7)	Centralisation (8)	Labour Market Activation (7)
$lr_{us,j} * EPL_{it-1}$	-0.019***	-0.020***	-0.023***	-0.026***	-0.014***	-0.019***	-0.021***	-0.020***	-0.019***
	(0.005)	(0.004)	(0.006)	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)
$lr_{us,j} * \Delta EPL_{it}$	-0.045	-0.034	-0.017	-0.018	-0.040	-0.040	-0.052	-0.117**	-0.021
	(0.069)	(0.064)	(0.063)	(0.067)	(0.058)	(0.059)	(0.054)	(0.055)	(0.067)
$ky_{us,j} * KY_{it-1}$		0.057***	0.046***	0.046***	0.053***	0.053***	0.052***	0.052***	0.051***
		(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
$hc_{us,j} * HCAP_{it-1}$		0.019***	0.023***	0.026***	0.020***	0.019***	0.019***	0.019***	0.019***
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
dtf_{ijt-1}		0.027	0.101***	0.086***	0.038*	0.039*	0.044**	0.044**	0.044**
		(0.020)	(0.020)	(0.021)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
$impcomp_{ijt-1}$		0.173***	0.307***	0.329***	0.173***	0.165***	0.152***	0.153***	0.135***
		(0.045)	(0.036)	(0.038)	(0.050)	(0.049)	(0.046)	(0.048)	(0.049)
pmr_{ijt-1}		-1.118***	-1.329**	-0.921	-1.094*	-1.142*	-1.058*	-1.103*	-1.203*
		(0.333)	(0.632)	(0.658)	(0.592)	(0.599)	(0.623)	(0.603)	(0.702)
$lr_{us,j} * LMI_{it-1}$			-0.000	0.001**	-0.001***	-0.001**	0.005	-0.000	0.012
			(0.000)	(0.000)	(0.000)	(0.000)	(0.004)	(0.004)	(0.008)
$lr_{us,j} * \Delta LMI_{it}$			0.657	0.001	-0.075***	-0.020	-0.165	0.357**	-0.008
			(0.403)	(0.002)	(0.022)	(0.018)	(0.126)	(0.156)	(0.045)
Country* Time Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
Sector* Time Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
No of groups	180	170	150	140	160	160	160	160	150
Observations	1620	1530	1350	1260	1440	1440	1440	1440	1350
Adjusted R^2	0.752	0.812	0.832	0.830	0.816	0.815	0.814	0.815	0.811

Innovation Intensity and Employment Protection (Regular and Temporary Employment Index): Industry Layoff Rates

	Baseline Model	Augmented Model	Union Density	Tax Wedge	Benefit Duration	Benefit Duration(alt)	Coordination	Centralisation	Labour Market Activation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$lr_{us,j} * EPLR_{it-1}$	-0.004	-0.008	-0.010	-0.010	-0.006	-0.007	-0.012**	-0.009	-0.011*
	(0.006)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
$lr_{us,j} * \Delta EPLR_{it}$	-0.014	0.026	0.011	0.004	0.018	0.019	0.023	0.022	0.016
	(0.081)	(0.074)	(0.083)	(0.150)	(0.078)	(0.078)	(0.076)	(0.078)	(0.079)
$lr_{us,j} * EPLT_{it-1}$	-0.012***	-0.011***	-0.012***	-0.015***	-0.007**	-0.010***	-0.010***	-0.011***	-0.009**
	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
$lr_{us,j} * \Delta EPLT_{it}$	-0.034	-0.033	-0.018	-0.021	-0.035	-0.036	-0.044	-0.084***	-0.022
	(0.042)	(0.037)	(0.035)	(0.035)	(0.033)	(0.033)	(0.030)	(0.029)	(0.038)
$ky_{us,j} * KY_{it-1}$		0.057***	0.046***	0.046***	0.053***	0.053***	0.052***	0.052***	0.051***
		(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
$hc_{us,j} * HCAP_{it-1}$		0.019***	0.022***	0.026***	0.020***	0.019***	0.019***	0.019***	0.019***
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
dtf_{ijt-1}		0.028	0.101***	0.087***	0.039*	0.040*	0.044**	0.045**	0.043**
		(0.020)	(0.020)	(0.021)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
$impcomp_{ijt-1}$		0.169***	0.304***	0.323***	0.171***	0.161***	0.150***	0.148***	0.134***
		(0.045)	(0.037)	(0.038)	(0.050)	(0.049)	(0.047)	(0.048)	(0.049)
pmr_{ijt-1}		-1.096***	-1.328**	-0.888	-1.094*	-1.140*	-1.052*	-1.096*	-1.223*
		(0.330)	(0.632)	(0.661)	(0.593)	(0.599)	(0.625)	(0.605)	(0.702)
$lr_{us,j} * LMI_{it-1}$			-0.000	0.001**	-0.001***	-0.001**	0.005	-0.000	0.011
			(0.000)	(0.000)	(0.000)	(0.001)	(0.004)	(0.005)	(0.008)
$lr_{us,j} * \Delta LMI_{it}$			0.640	0.002	-0.074***	-0.019	-0.191	0.384**	-0.010
			(0.408)	(0.002)	(0.024)	(0.018)	(0.132)	(0.155)	(0.045)
Country* Time Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
Sector* Time Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
No of groups	180	170	150	140	160	160	160	160	150
Observations	1620	1530	1350	1260	1440	1440	1440	1440	1350
Adjusted R^2	0.752	0.812	0.832	0.830	0.816	0.815	0.814	0.815	0.820

JR*EPL interaction coefficient when a country is excluded from regression sample

Legend: coefficent — ci_u — ci_l

x-axis: aus, aut, bel, can, dnk, esp, fin, fra, ger, grc, irl, ita, jpn, nld, prt, swe, uk

Key Findings

- In industries with a higher job reallocation (layoff) propensity
  - Stricter employment protection led to lower innovation intensity
  - Restrictions on the use of temporary contracts had a bigger negative impact on innovation intensity than employment protection for regular contracts

- Changes in EPL did not affect innovation performance in the short-run

- Our findings are robust to controls for industry and country characteristics that may affect innovation performance and industry job reallocation (layoff) propensity

Policy Implications

- *Targeted labour market deregulation* in industries with a high propensity to adjust to industry-specific technological and market driven factors through job reallocation (layoffs) could foster innovation

- Labour market reforms are likely to affect innovation performance significantly in the *long-run* while short-run effects are unlikely to be sizeable

- Consider economic efficiency versus other policy objectives

Further Relevant Issues/Questions

- *Social protection measures* are needed to offset possible negative effects of labour market reforms on employment and income

- Is the impact of labour market institutions on innovation conditioned by *the state of the economy* – booms versus downturns?

- Does the *type of innovation* matter –technological versus non-technological innovation?