ONLINE APPENDIX

Regulation, institutions and productivity: new macroeconomic evidence from OECD countries

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1. Data issues

1.1 Measuring MFP

The type of MFP used in empirical analysis is of utmost important. Mismeasuring the level and dynamics of MFP has important implications. It determines growth at the country level. It also affects the frontier level to which convergence is supposed to take place in the long run. MFP can be calculated as a residual of output once all inputs (capital and labor) are accounted for. Typically, the log-level of MFP is derived on the basis of equation (1) below.

$$\ln(\mathrm{MFP}_t) = \ln(Y_t)/\tau - \ln(HK_t) - \ln(L_t) - (1-\tau)/\tau \times \ln(K_t) \quad (1)$$

where Y_t is real output, HK_t, K_t and L_t are the stock of human and physical capital and labor input, respectively.[1] τ is the share of labor and $1-\tau$ the share of capital in the production function. In the paper, $\tau = 0.67$. Y expressed in national currency units is sufficient to study the evolution of MFP over time. Cross-country comparison of MFP levels necessitates the conversion of output into a common currency unit. It is usually done using the purchasing power parity exchange rate (the ratio of absolute price levels in the domestic and foreign (reference) country), which accounts for different levels of economic development. Our benchmark MFP calculation is based on 2005 PPPs[2]. Another issue relates to labor input. Conventional measures of labor input consider people living in the country. Not accounting for people working but not living in the country[3] or those working abroad for domestic companies would bias the labor force numbers and thus the MFP calculations. Equation (1) is therefore complemented by a labor force adjustment term (CLF):

$$\ln(\mathrm{MFP}_t) = \ln(Y_t)/\tau - \ln(HK_t) - \ln(L_t) - ln(CLF_t) - (1-\tau)/\tau \times \ln(K_t) \quad (2)$$

Human capital is approximated by the Mincer equation using mean years of schooling of total population (MYS). We compute a number of alternative aggregate MFP measures and find that whether human capital is included or excluded from MFP matters the most. The other parameters, including the type of PPP rate to make MFP levels comparable across countries, alternative measures of capital and labor input, matter to a lesser extent. Figure 1 shows a measure calculated using (1) (MFP12) and a measure obtained using (2) (MFP22). MFP12 exhibits some oddities. First, the USA is far away from the top performers until the mid-1990s. Second, some frontier economies exhibited a trend decline. Third, other countries further down in the distribution also have a trend decrease in MFP over the sample period covering three decades (Figure A1).

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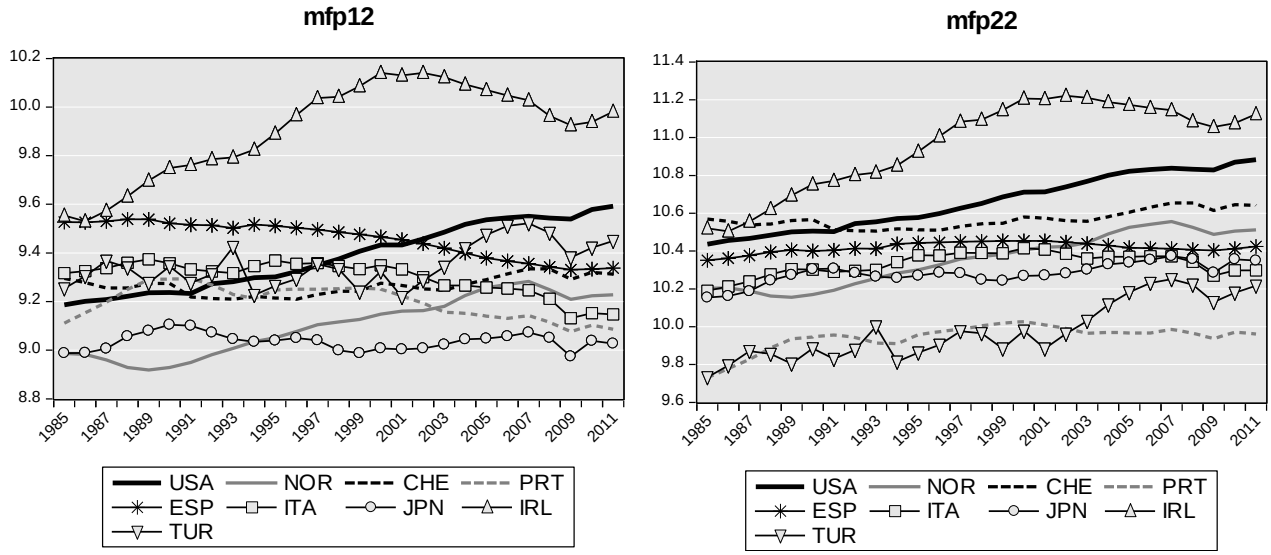
1 Equation (1) gives MFP which is consistent with Harrod-neutral labor augmenting technical progress.

2 The absolute price level of a given country in 2005 divided by the absolute price level in the USA in 2005.

3 For instance many French people work in Luxembourg and Switzerland but live in France.

Figure A1. MFP measures excluding (MFP12) and including (MFP22) human capital



1.2 The determinants of MFP

1.2.1 Innovation intensity

This paper uses a number of alternative measures for innovation intensity based on spending on R&D. Two types of R&D spending are used: business expenditures on R&D (BERD) and general (or total) expenditures on R&D (GERD). Both measures are further decomposed into expenditures financed by industry (GERDPRIV, BERDPRIV) and expenditures financed by the government (GERDPUB, BERDPUB). The source of these series is the OECD's Main Science and Technology Indicators database.

We also use a measure of general expenditures on basic R&D, capturing fundamental research. Another way of capturing basic research is to look at Nobel Prize winners. We collected the Nobel Prize winners for medicine, biology, chemistry and physics from 1985 to 2014. The idea being that a Nobel Prize given in 2014 reflects research done several decades earlier. This alleviates problems related to endogeneity between R&D and MFP. Nobel Prizes are assigned to countries not in terms of nationality of the laureates but as a function of the affiliation at the time of the Nobel Prize. Shared Nobel Prizes are split, if applicable, across countries proportionately to the number of laureates.

This is a modified version of the variable constructed by Horvath (2011).[4] He uses data for four categories of Nobel Prize winners: physics, chemistry, medicine and economics. We take up this idea but construct an indicator excluding economics (as it conveys limited knowledge on technological progress). Our horizon is also different. Horvath (2011) construct his Nobel Prize measure for 1945 to 1975. We use data from 1985 to 2014 as the Nobel Prize awards lag by decades to the discovery and the actually investment spent on the awarded research.

[4] Horvath, Roman. 2011. "Research & development and growth: a Bayesian model averaging analysis." *Economic Modelling*, 28(6): 2669-2673.

1.2.2 Trade openness

Trade openness is usually considered as enhancing technology diffusion and adoption through trade (and foreign direct investment), resulting in a higher MFP level. Trade openness can be calculated as exports and imports of goods and services over GDP divided by two. Data used for the calculation are drawn from the World Bank's WDI database. The openness indicator starts in 1960 and runs until 2013 for most countries. For countries of the former soviet bloc (CZE, EST, HUN, POL, SVN, SVK), the series start in the early/mid-1990s.

One potential problem with trade openness is that it might be automatically greater for smaller countries and lower for larger countries. For instance, individual federal states in Germany are comparably open to countries similar in size (e.g. Slovakia or the Czech Republic). Nevertheless, Germany as a country is much less open, as federal states trade a lot with each other. One way to account for this size-bias is to regress openness on country size, measured for instance by total population. The regression residuals are the part of openness, which cannot be explained by country size. Therefore, they can be considered as the size-adjusted openness ratio. This paper uses such a size-adjusted openness ratio.

The regression is a pooled regression for the 34 OECD countries without country and time fixed effects. Openness, expressed in percentage points is regressed on a constant and population in millions for 1960 to 2011. The constant and the coefficient estimate on total population are 38.96 and -0.178, respectively and statistically significant at the 1% level. The regressions adjusted R-squared is 0.176. Also, log openness is regressed on a common constant and log total population for the same period. The constant and the coefficient estimate on log total population are 3.96 and -0.250, respectively and statistically significant at the 1% level. The regressions adjusted R-squared is 0.405. This implies that country size is indeed negatively correlated to openness but openness can be explained only partially by country size.

Trade openness adjusted for country size is very high and increases very steeply for Luxembourg. We therefore run a regression excluding Luxembourg from the sample (equation (7) in Table R2). Estimation results are fairly robust to the exclusion of Luxembourg.

1.2.3 Product, labor market regulations and tax policies

Product market regulation could be captured by the OECD's Product Market Regulation (PMR) indicator or the World Bank's Doing Business indicator. The drawback of the PMR indicator is that it is available every five years (1998, 2003, 2008 and 2013).[5] The Doing Business indicators are available at annual frequency. However, they only cover the period from 2002 to 2014.

The OECD's electricity, transport and communications regulation (ETCR) indicator, a subset of the OECD's Product Market Regulation (PMR) indicator, covers a longer period as it starts in 1975 and ends in 2013. It also has annual observations. For these two reasons, this paper uses the ETCR indicator, which

[5] Westmore (2013) and Andrews and Westmore (2014) use the PMR indicator by filling in the gaps between the observations in 1998, 2003, 2008 and 2013 via linear interpolation.

Westmore, B. (2013), "R&D, Patenting and Growth: The Role of Public Policy", *OECD Economics Department Working Papers*", No. 1047.

Andrews, D. and B. Westmore (2014), "Managerial capital and business R&D as enablers of productivity convergence", *OECD Economics Department Working Papers*, No.1137, OECD publishing.

measures the degree of product market regulation on a scale of 0 to 6. Low numbers indicate less regulation, higher numbers refer to more stringent regulation. The rational for using this indicator is that more regulation would be associated with a lower MFP level. We will also use the two components of ETCR: barriers to entry and public ownership. It should be noted that data are not available for the USA in the 2013 vintage of the ETCR indicator. We therefore use the 2007 vintage for the USA. The value in 2007 is used to replace the missing values from 2008 to 2011 (the estimation period ends in 2011 as MFP series stop in 2011).

In addition to product market regulation, labor market regulation can also bear an impact on MFP through the direct effects of the allocation of labor resources and the indirect impact on capital reallocation. Therefore, we use three indicators capturing labor market regulation: i.) per capita spending on active labor market policies (ALMP), ii.) the employment protection legislation (EPL) indicator (for permanent contracts), and iii.) the gross unemployment benefit replacement rate. These data series are borrowed from Gal and Theising (2015)[6], who provide details on data sources and definitions.

1.2.4 Controls - human capital and the output gap

Human capital is used as a control variable for at least two reasons. First, human capital is conducive to the creation and adoption of new technologies. Second, it captures the part of MFP due to human capital for MFP measures which include human capital. Our measure of human capital has a positive relation to MFP in estimations including country fixed effects only. However, when time fixed effects are also included, human capital becomes statistically nonsignificant or has a negative sign. Most of the results reported in Tables R1 and R6 hereafter are fairly robust to the exclusion of human capital from the regressions. An exception is Table R3 as the positive coefficient on ALMP loses statistical significance. These estimation results are not reported here but are available upon request.

A measure of output gap is employed to control for short-term cyclical fluctuations in the annual MFP series. Output gap is obtained as the difference between the level real GDP and a trend estimated using the HP filter. To alleviate the famous end-point problem, the real GDP series were extended: beyond 2013, OECD projections were used (Table A1).

[6] Gal, P. and A. Theising (2015), The macroeconomic impact of policies on labor market outcomes in OECD countries: a reassessment, *OECD Economics Department Working Paper* No. 1271.

Table A1. Variable definitions and sources – time-varying variables

NAME	DEFINITION	SOURCE	MAX TIME COVERAGE
Openness			
open	exports and imports of goods and services over GDP divided by two	World Bank WDI	1960-2013
open_adj	openness adjusted for country size, obtained as the residual from a regression of openness on a constant and total population	World Bank WDI	1960-2011
Innovation intensity			
berd	business expenditures on R&D, % of GDP	OECD Main STI indicators	1981-2013
berdpriv	business expenditures on R&D, financed by industry, % of GDP	OECD Main STI indicators	1981-2013
berdpub	business expenditures on R&D, financed by government, % of GDP	OECD Main STI indicators	1981-2013
gerd	general expenditures on R&D, % of GDP	OECD Main STI indicators	1981-2013
gerdpriv	general expenditures on R&D, financed by industry, % of GDP	OECD Main STI indicators	1981-2013
gerdpub	general expenditures on R&D, financed by government, % of GDP	OECD Main STI indicators	1981-2013
gerdbasic	general expenditures on basic R&D, % of GDP	OECD Main STI indicators	1981-2013
nobel	Nobel prize winners in hard sciences (economics excluded), 1985 and 2014	data collected from	1985-2014
Product market regulations			
ETCR all	Regulation in Electricity, Transport and Communication (ETCR)	OECD PMR database	1975-2013
ETCR en	entry barriers in ETCR	OECD PMR database	1975-2013
ETCR pow	public ownership in ETCR	OECD PMR database	1975-2013
Labour market regulations			
ALMP	per capita spending on active labour market policies	OECD ELS statistics	1985-2012
EPL	the employment protection legislation (EPL) indicator for permanent contracts	OECD ELS statistics	1985-2013
gross unemployment benefit replacement rate		OECD ELS statistics	1961-2011
Controls			
hcap	human capital, calculated using a Mincer equation and mean years of schooling	OECD EO database	1980-2013
og	output gap: difference between the level real GDP and a trend estimated using the HP filter	OECD EO database	1960-2013

1.2.5 The role of time–invariant variables: regulations and institutions

1. There are a number of variables, which do not change or if they do, they change only very slowly over time. Institutions are typically such variables. Some other variables can be observed only infrequently, or only few observations are available for them. Such variables are specific indicators of economic regulations. These variables, which are constants from a purely statistical point of view, can be used in two different ways: they can either be interacted with the time-varying variables summarised in Table A2, or they can be used as constants in the regressions, to replace country fixed effects. For such purposes, the country averages of the time varying variables can also be employed. The two groups of constants used in the empirical analysis are as follows (Table A2 and Figure A2).

The first group includes institutions and variables capturing economy-wide regulation such as the quality of institutions (rule of law, the quality of the legal system, law enforcement and judicial independence). These data are obtained from the World Bank's Doing Business database. The quality of the legal system, law enforcement and judicial independence are drawn from the Fraser Institute's Economic Freedom of the World database. For each country, the mean of the available observations is calculated and used in the estimations.

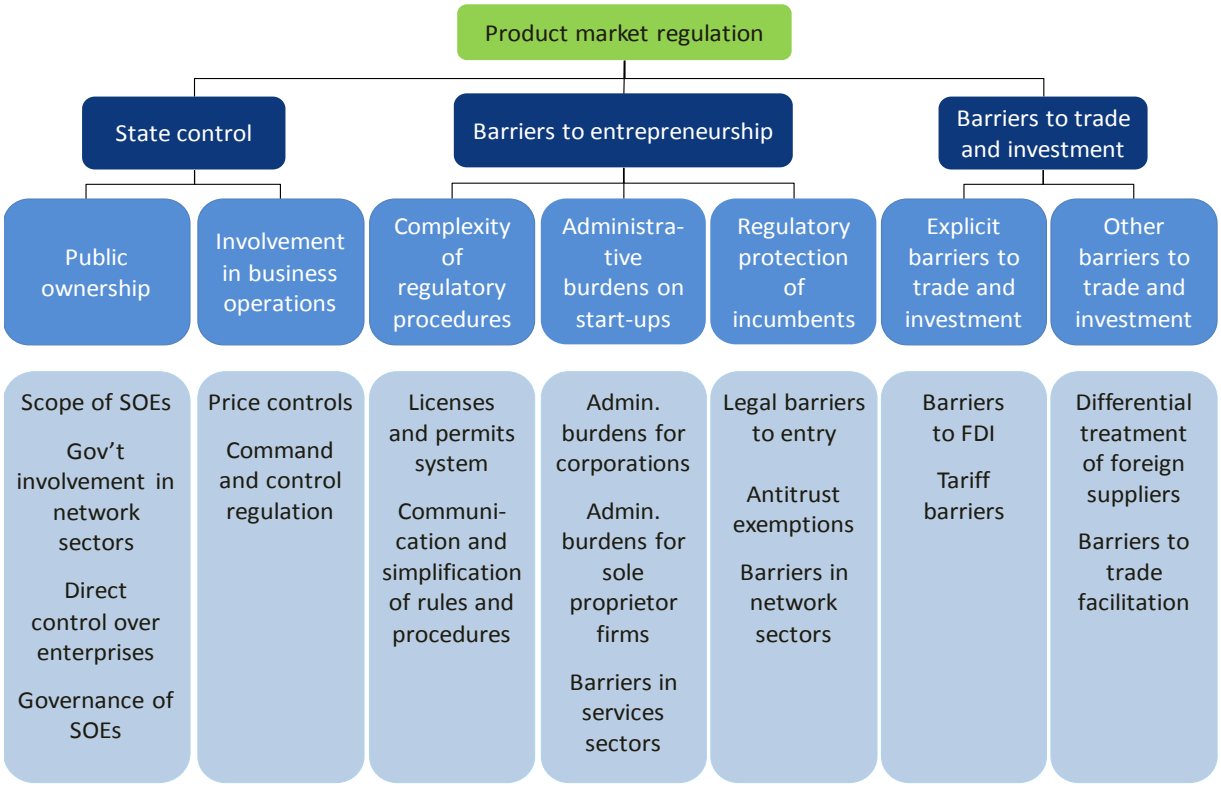
The second group relates to product market regulation. This group includes the cost and time of insolvency procedures and starting a business, drawn from the World Bank's Doing Business database, and the OECD's Product Market Indicator (PMR). The headline PMR indicator and its disaggregated subindices

are used (Figure A2). These series are available from 1998 to 2013 at five year intervals. For each country, the average of the available observations is employed.

Table A2. Variable definitions and sources – time-invariant variables

NAME	SOURCE	AVERAGED FOR
Institutions		
rule of law	World Bank, Governance Indicators	1996-2013
legal system &property rights	Fraser Institute, Economic Freedom of the World	1995-2012
legal enforcement of contracts	Fraser Institute, Economic Freedom of the World	2002-2012
judicial independence	Fraser Institute, Economic Freedom of the World	1995-2012
cost of contract enforcement (% of claim)	World Bank, Doing Business	2004-2014
time of contract enforcement (days)	World Bank, Doing Business	2004-2014
Product market regulations		
PMR and subcomponents	OECD Product Market Regulations	1998-2013
regulation of professional services	OECD Product Market Regulations	1998-2013
cost of starting a business	World Bank, Doing Business	2004-2014
time of starting a business	World Bank, Doing Business	2004-2014
cost of insolvency (% of estate)	World Bank, Doing Business	2004-2014
time of insolvency (years)	World Bank, Doing Business	2004-2014
recovery rate of insolvency (cents on the dollar)	World Bank, Doing Business	2004-2014

Figure A2. The Product Market Regulation indicator and its subcomponents



Source: OECD

2 Estimation issues

2.1 Linear specifications

Our baseline equation includes the level of MFP as the dependent variable and openness, innovation intensity and product market regulation as regressors:

$$MFP_{j,t} = f(OPEN_{j,t}, INNOVATION_{j,t}, PMR_{j,t}) \quad (3)$$

Equation (3) implies that the level of MFP depends on the level of openness (adjusted for country size), innovation intensity (measured as business expenditures on R&D by the private sector) and the level of product market regulation. Two control variables are used: human capital to control for the human capital part in MFP, and the output gap to filter out the business cycle from the independent and dependent variables. Equation (3) always includes country and time fixed effects. As argued earlier, time fixed effects can be viewed as the MFP frontier.

Equation (3) is also augmented by additional variables on labor market regulations (EPL, ALMP and the unemployment benefit replacement rate):

$$MFP_{j,t} = f(OPEN_{j,t}, INNOVATION_{j,t}, PMR_{j,t}, LMR_{j,t}) \quad (4)$$

Labor market regulations are measured by four indicators drawn from OECD data sources: the Employment Protection Legislation (EPL) indicator (for permanent contracts), the unemployment benefit replacement rate (UBRR) and spending on active labor market policies (ALMP). Higher values of the first three variables indicate more strict regulation. Higher labor market regulation is expected to be correlated with lower MFP through a deterioration in labor reallocation.

2.2 Non-linear specifications

2.2.1 Threshold nonlinearities

Nonlinear effects can occur more abruptly when the variable of interest has different coefficients below and above the tipping point of the threshold variable (threshold nonlinearity). If the threshold variable is the same variable, this is a classical 'univariate' nonlinear effect. If the threshold variable is another policy variable, the results are comparable to interactions. For instance, the impact of labor market policies could depend on the level of restrictiveness of product market regulation or the other way around (equation 5). The threshold value is determined endogenously through a grid search: A grid search with steps of 1% of the distribution is carried out to identify the value of the threshold variable that minimises the sum of squared residuals of the estimated two-regime model. The grid search starts at 15% of the distribution and stops at 85% to ensure that a sufficient number of observations falls into each regime. There is evidence for nonlinearity if the null hypothesis of $\beta_1 = \beta_2$ can be rejected against the alternative hypothesis of $\beta_1 \neq \beta_2$.

$$MFP_{j,t} = \begin{cases} \alpha_1 + \alpha_2 OPEN_{j,t} + \alpha_3 INNOVATION_{j,t} + \beta_1 PMR_{j,t} + \varepsilon_t & if \quad LMR < T \\ \alpha_1 + \alpha_2 OPEN_{j,t} + \alpha_3 INNOVATION_{j,t} + \beta_2 PMR_{j,t} + \varepsilon_t & if \quad LMR \geq T \end{cases} \quad (5)$$

where T is a given value of LMR.

2.2.2 Smooth policy interactions

The impact of one policy could depend on the level of another policy in a smooth fashion (policy interactions). The type of interactions we are looking at in this paper is when policies changing over time are interacted with time invariant country institutional or policy characteristics. Some policies such as institutions change slowly over time and can be observed at high intervals or we only have a few observations of them. These variables could not be used as determinants of MFP in regressions with country fixed effects (because country fixed effects captures these variables) but could be interacted with the time varying variables. In this case, the interaction term would tell for instance whether the relation between innovation and MFP depends on the quality of institutions (equation 6). Note that variables are demeaned before they enter the interactions.

$$MFP_{j,t} = f(OPEN_{j,t}, INNOVATION_{j,t}, PMR_{j,t}, INNOVATION_{j,t} * INSTITUTIONS_j) \quad (6)$$

2.3 Estimation methods

Given the trending nature of the data (even if country and year fixed effects are accounted for), cointegration techniques are needed to estimate the level relationships linking multi-factor productivity with its long-term drivers. If the variables are not related through a cointegrating vector, the estimated level equations may be spurious.

The long-term coefficients are estimated on the basis of the Dynamic OLS (DOLS) estimator: Over the standard OLS estimator, it has the advantage that it corrects for the possible endogeneity of the regressors and autocorrelation in the residuals by incorporating leads and lags of the regressors in first differences (Stock and Watson, 1993)[7]:

$$Y_{j,t} = \beta_0 + \sum_{i=1}^{n} \beta_n X_{j,i,t} + \sum_{i=1}^{n} \sum_{l=-k_1}^{k_2} \gamma_{i,l} \Delta X_{j,i,t-l} + \varepsilon_t \quad (7)$$

where Y_t is MFP and $\overline{X}$ is the vector of MFP drivers. j stands for individual countries, i for the regressors, and k1 and k2 represent respectively leads and lags. Equation (7) can be estimated using country and time fixed effects. In the empirical analysis, one lead and one lag of the covariates will be used.

Whether or not the variables of interest are cointegrated can be tested in two ways. First, the residuals obtained from the long-term relationship (ε_t) can be used to estimate the error correction model in the

[7] Stock, J. and M. Watson (1993), A simple estimator of cointegrating vectors in higher order integrated systems, *Econometrica*, 61 (4), 783-820.

second stage. Weak evidence for the presence of cointegration is if the error correction term in this second stage is statistically significant and has a negative sign. This implies an error correction mechanism to be in place. A second and more formal test of cointegration is when the estimated residuals from the long-term relationship are tested for the presence of a unit root. The rejection of the null hypothesis of a unit root can be interpreted in favour of cointegration, in the spirit of the Engle and Granger residual-based cointegration approach. This paper uses Kao's residual-based panel cointegration tests (Kao, 1999)[8], which, along equation (7), allow for country-specific intercepts but imposes homogenous coefficients.

[8] Kao, C. (1999), Spurious regression and residual-based tests for cointegration in panel data, *Journal of Econometrics*, 90(1), 1-44.

3 Estimation results

Table R1. Baseline estimation results

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
	c	9.891**	9.702**	9.904**	10.266**	10.233**	10.519**	10.492**	10.317**	10.817**	10.465**	10.485**	10.477**	10.871**	11.39**	10.504**	10.2**	10.377**	10.326**
etcr overall	etcr_new_	-0.039**			-0.005														
etcr entry barriers	etcr_en_		-0.024**			0.003													
etcr public ownership	etcr_po_			-0.042**			-0.026**	-0.027**	-0.019**	-0.017**	-0.026**	-0.028**	-0.024**	-0.02**	-0.016*	-0.022**	-0.021**	-0.025**	
log (etcr public ownership)	l_etcr_po_																		-0.053**
openness size adjusted	open_adj_	0.007**	0.007**	0.008**	0.008**	0.008**	0.008**	0.008**	0.009**	0.009**	0.008**	0.008**	0.008**	0.008**	0.011**	0.002**	0.009**	0.008**	
log(openness size adjusted)	l_open_adj_																		0.197**
business exp. on R&D	berd_	0.041**	0.038**	0.053**	0.031**	0.032**	0.038**												
business exp. on R&D by industry	berdpriv_							0.059**									0.072**		0.046**
business exp. on R&D by government	berdpub_								-0.178**								-0.275**		
business exp. on R&D by government (-5)	berdpub5_									-0.186**									
general exp. on R&D	gerd_										0.031**								
general exp. on R&D by industry	gerdpriv_											0.054**						0.065**	
general exp. on R&D by government	gerdpub_												-0.005					-0.062*	
general exp. on R&D by government (-5)	gerdpub5_													-0.01					
general exp. on basic R&D	gerdbasic														0.349**				
Nobel Prize winners	nobel_new_															0.003**			
human capital	l_hcap_	0.485**	0.599**	0.489**	0.052	0.054	-0.109	-0.092	0.091	-0.328	-0.065	-0.084	-0.033	-0.342	-1.103**	0.010	0.146	0.018	0.035
output gap	og_hp_	0.008**	0.008**	0.008**	0.013**	0.013**	0.013**	0.013**	0.011**	0.014**	0.012**	0.013**	0.012**	0.013**	0.018**	0.011**	0.013**	0.013**	0.013**
cointegration test, H0: no cointegration (p-value)		0.012	0.010	0.002	0.012	0.010	0.002	0.001	0.000	0.001	0.003	0.001	0.004	0.001	0.004	0.018	0.000	0.000	0.004
error correction term		-0.033**	-0.033**	-0.029**	-0.045**	-0.044**	-0.043**	-0.043**	-0.043**	-0.062**	-0.042**	-0.044**	-0.043**	-0.067**	-0.064**	-0.046**	-0.045**	-0.044**	-0.048**
adjusted R-squared		0.951	0.95	0.952	0.957	0.957	0.958	0.959	0.959	0.968	0.958	0.959	0.958	0.97	0.98	0.966	0.961	0.959	0.952
No. of observations		756	756	756	756	756	756	755	752	604	758	739	741	604	441	725	752	739	755
No. of countries		34	34	34	34	34	34	34	34	33	34	34	34	33	27	34	34	34	34
country fixed effects		YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
time fixed effects		NO	NO	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Note: * and ** denote statistical significance at the 10% and 5% levels, based on robust standard errors

Table R2. Robustness checks: alternative time and country coverage

		1980-2006	**1990-2006**	**1990-2011**	**alternative country coverage**			
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
	c	10.291**	11.01**	10.954**	10.544**	10.643**	11.198**	10.44**
etcr public ownership	etcr_po_	-0.025**	-0.01	-0.019**	-0.026**	-0.018**	-0.042**	-0.024**
openness size adjusted	open_adj_	0.009**	0.007**	0.007**	0.008**	0.005**	-0.0004	0.01**
business exp. on R&D by industry	berdpriv_	0.069**	0.01	0.009	0.058**	0.101**	0.116**	0.048**
human capital	l_hcap_	0.075	-0.535**	-0.467**	-0.116	-0.219	-0.578**	-0.055
output gap	og_hp_	0.014**	0.016**	0.014**	0.013**	0.017**	0.017**	0.013**
cointegration test, H0: no cointegration (p-value)		0.003	0.001	0.001	0.002	0.017	0.130	0.001
error correction term		-0.034**	-0.059**	-0.064**	-0.043**	-0.044**	-0.039**	-0.048**
adjusted R-squared		0.966	0.98	0.971	0.957	0.944	0.925	0.959
No. of observations		622	483	616	718	636	460	746
No. of countries		33	33	34	**31**	**25**	**17**	**33 (no LUX)**
country fixed effects		YES	YES	YES	YES	YES	YES	YES
time fixed effects		YES	YES	YES	YES	YES	YES	YES

Note: * and ** denote statistical significance at the 10% and 5% levels, based on robust standard errors

Table R3. Baseline specifications augmented with labor market regulations

		(1)	(2)	(3)	(4)	(5)	(6)
	c	11.279**	10.786**	10.896**	11.016**	10.744**	10.812**
etcr public ownership	etcr_po_	-0.031**	-0.02**	-0.019**	-0.025**	-0.021**	-0.02**
openness size adjusted	open_adj_	0.007**	0.006**	0.01**	0.006**	0.006**	0.01**
business exp. on R&D by industry	berdpriv_	0.024	0.102**	0.016	0.032	0.1**	0.022
ALMP	almp_	4.0E-04					
unemployment benefit replacement rate	ubrr_		2.0E-05				
EPL	epl_			0.026			
log(ALMP)	l_almp_				0.033**		
log(unemployment benefit replacement rate)	l_ubrr_					0.001	
log(EPL)	l_epl_						0.123**
human capital	l_hcap_	-0.656**	-0.352**	-0.445**	-0.54**	-0.316*	-0.398**
output gap	og_hp_	0.01**	0.018**	0.009**	0.011**	0.017**	0.009**
cointegration test, H0: no cointegration (p-value)		0.018	0.010	0.002	0.010	0.016	0.002
error correction term		-0.062**	-0.046**	-0.060**	-0.055**	-0.046**	-0.060**
adjusted R-squared		0.969	0.948	0.966	0.969	0.949	0.966
No. of observations		570	629	607	570	629	607
No. of countries		32	29	34	32	29	34
country fixed effects		YES	YES	YES	YES	YES	YES
time fixed effects		YES	YES	YES	YES	YES	YES

Note: * and ** denote statistical significance at the 10% and 5% levels, based on robust standard errors

Table R4. Threshold regressions - policy interactions

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
threshold variable		**open**		**berdpriv**	**almp**	**epl**		**etcr_po**
F-test of nonlinearity (p-value)		0.000	0.000	0.000	0.000	0.000	0.000	0.000
threshold percentile		0.75	0.75	0.71	0.54	0.22	0.57	0.21
threshold value		5.934	5.934	1.149	19.076	1.595	2.341	3.048
	c	10.803**	10.619**	10.786**	11.776**	10.784**	10.938**	11.399**
etcr public ownership	etcr_po_	-0.026**		-0.026**			-0.008	-0.056**
openness size adjusted	open_adj_	0.009**	0.008**		0.006**	0.010**	0.008**	0.010**
business exp. on R&D by industry	berdpriv_		0.064**	0.058**	0.042**	0.030	-0.099**	0.003
nonlinear variables	berdpriv__low	0.066**						
	berdpriv__high	0.012						
	open_adj__low			0.010**				
	open_adj__high			0.004**				
	etcr_po__low		-0.024**		-0.047**	-0.064**		
	etcr_po__high		-0.038**		-0.024**	-0.005		
	almp__low						0.007**	
	almp__high						-0.001**	
	epl__low							-0.034*
	epl__high							0.031*
	l_hcap_	-0.370**	-0.203	-0.360**	-1.054**	-0.341*	-0.402*	-0.689**
	og_hp_	0.014**	0.013**	0.013**	0.009**	0.010**	0.006**	0.006*
cointegration test, H0: no cointegration (p-value)		0.001	0.001	0.001	0.005	0.002	0.002	0.000
error correction term		-0.046**	-0.046**	-0.035**	-0.072**	-0.053**	-0.068**	-0.078**
adjusted R-squared		0.960	0.960	0.962	0.970	0.969	0.977	0.974
No. of observations		755	755	755	570	607	549	607
No. of countries		34	34	34	32	34	32	34
country fixed effects		YES	YES	YES	YES	YES	YES	YES
time fixed effects		YES	YES	YES	YES	YES	YES	YES

Note: * and ** denote statistical significance at the 10% and 5% levels, based on robust standard errors

Table R5. Interaction terms – policy interactions

interacted with		ETCR 1980-2011	ETCR 1990-2011	business R&D funded by industry 1980-2011	business R&D funded by industry 1990-2011	general spending on basic R&D 1980-2011	general spending on basic R&D 1990-2011
education							
pisa_math	rdXapisa_maths			0.002**	0.002**	1.0E-04	0.001*
pisa-science	rdXapisa_sci			0.002**	0.001**	-3.0E-04	-3.0E-04
institutions							
rule of law	rdXarulelaw			0.166**	0.118**	0.017	0.022
legal system	rdXalegsys			0.073**	0.047**	-0.007	-0.010
legal system enforcement	rdXalegsys_enf	-0.010**	-0.010**	0.057**	0.063**	-0.002	0.054**
legal system jud. Independence	rdXalegsys_ji			0.067**	0.042**	0.021*	0.001
cost of contract enforcement	rdXacontract_cost			-0.009**	-0.012**	-0.004**	-0.008**
time of contract enforcement	rdXacontract_time			-0.0003**	-0.0002**	1.0E-04	-1.0E-04
business environment							
insolvency cost	rdXainsolv_cost			-0.006**	-0.007**	-0.007**	-0.016**
insolvency time	rdXainsolv_time			-0.068**	-0.058**	-0.014	-0.027
insolvency recovery rate	rdXainsolv_rr			0.002*	0.001	5.0E-04	0.002**
starting a business - cost	rdXastart_cost			-0.011**	-0.001	-0.002	-1.0E-04
starting a business - time	rdXastart_time			-0.006**	-0.007**	-0.005**	-0.008**
PMR overall indicator	rdXapmr_lev1			-0.097**	-0.013	0.137**	0.119*
state control 2	rdXapmr_stc2			0.054	0.032	0.049*	-0.042
public ownership 3	rdXapmr_pow3			0.089**	0.060**	0.026*	-0.033
involvement in business operations 3	rdXapmr_ibo3			-0.069**	-0.028	0.011	0.020
price controls 4	rdXapmr_pct4			-0.067**	-0.035*	0.015	0.031
command and control reg 4	rdXapmr_ccr4			-0.016	-0.005	-0.011	-0.027
barriers to entrepreneurship 2	rdXapmr_bte2			-0.054	0.004	0.146**	0.298**
complexity of regulatory procedures 3	rdXapmr_crp3			-0.010	-0.008	0.089**	0.129**
admin. burdens on startups 3	rdXapmr_abs3			-0.09**	-0.043	-0.066**	-0.096**
regulatory protection of incumbents 3	rdXapmr_rpi3			0.034	0.09**	0.015	0.140**
barriers to trande and investment 2	rdXapmr_bti2	0.009	-0.05**	-0.209**	-0.095**	-0.029	0.019
explicit barriers 3	rdXapmr_xbr3	-0.023*	-0.045**	-0.003	0.062**	0.042	0.093**
barriers to FDI 4	rdXapmr_fdi4	-0.030**	-0.052**	0.021	0.094**	0.041	0.107**
tariff barriers 4	rdXapmr_trf4	-0.008	-0.025	-0.022	0.025	0.029	0.073**
other barriers 3	rdXapmr_obr3	0.018**	-0.014	-0.158**	-0.134**	-0.059**	-0.109**
differential treatment of foreign suppliers 4	rdXapmr_tfs4	-0.013	-0.062**	-0.106**	-0.117**	-0.065**	-0.075**
barriers to trade facilitation 4	rdXapmr_trd4	0.018**	0.005	-0.095**	-0.077**	-0.030**	-0.060**

Note: The coefficients reported are coming from a full specification in line with equation 6. * and ** denote statistical significance at the 10% and 5% levels, based on robust standard errors.

Table R6. Replacing country fixed effects by regulations and institutions

		(1)	(2)	(3)	(4)	(5)	(6)
	c	9.331**	9.899**	10.492**	9.461**	11.030**	10.799**
etcr public ownership	etcr_po_	-0.002	-0.042**	-0.027**	-0.013	-0.026**	-0.021**
openness size adjusted	open_adj_	0.005**	0.008**	0.008**	0.005**	0.002**	0.003**
business exp. on R&D by industry	berdpriv_	0.055**	0.082**	0.059**	0.050**	0.051**	0.0180
rule of law - constant	arulelaw					0.225**	0.351**
PMR barriers to trade&investment - constant	apmr_bti2					-0.173**	-0.139**
EPL - country averages	aepl_					-0.207**	
ALMP - country averages	aalmp_					0.006**	
EPL	epl_						-0.186**
ALMP	almp_						0.004**
output gap	og_hp_	0.003	0.008**	0.013**	0.006	0.018	0.013
human capital	l_hcap_	0.909**	0.475**	-0.092	0.85**	-0.467**	-0.429**
cointegration test, H0: no cointegration (p-value)		0.001	0.001	0.001	0.001	0.001	0.006
error correction term		-0.05**	-0.029**	-0.043**	-0.04**	0.001	1.0E-05
adjusted R-squared		0.410	0.953	0.959	0.411	0.694	0.732
No. of observations		755	755	755	755	708	549
No. of countries		34	34	34	34	32	32
country fixed effects		NO	YES	YES	NO	NO	NO
time fixed effects		NO	NO	YES	YES	NO	NO

Note: * and ** denote statistical significance at the 10% and 5% levels, based on robust standard errors