Regulation, Trade and Productivity in Romania

An Empirical Assessment

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Abstract

Inappropriate regulation can influence productivity performance by affecting incentives to invest and adopt new technologies, as well as by directly curbing competitive pressures. Results of a labor productivity growth model for European countries suggest that improving the regulatory environment—proxied by the Worldwide Governance Indicators regulatory quality indicator—and boosting effective exposure to competition through increasing trade integration—expressed as the ratio of exports plus imports to gross domestic product—have positive effects on productivity growth. In Romania a 10 percent increase in openness to global trade over 1995–2010 would have boosted productivity growth by 9.7 percent per year. A 10 percent increase in openness to European Union trade,

in particular, would have led to an annual increase in productivity of 7 percent. Realizing the benefits from trade integration depends to some extent on regulation. In this regard, the effects of regulation on productivity growth are found to be positive, regardless of the indicator used to measure regulation, and both through direct and indirect channels (by increasing the speed at which a country catches up with productivity leaders). Simulation results also show how countries with different levels of regulatory quality would benefit from a regulatory improvement: had Romania improved its regulatory environment to the same level as Denmark in 2010, its annual productivity growth would have been 14 percent higher over 1995–2010.

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Regulation, Trade and Productivity in Romania: An Empirical Assessment¹

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1. INTRODUCTION

Several theoretical and empirical studies are devoted to examining the question of whether less productive economies are catching up with their more productive counterparts. A particular strand of the empirical literature has tried to highlight the channels through which institutional settings can affect productivity differences across countries. The regulatory dimension is identified as one such channel, based on the premise that inappropriate regulation can shape the incentives to invest and adopt new technologies, as well as effectively curb competitive pressures, thus limiting the effects that the spur of competition can have on productivity enhancements.

Based on a set of OECD countries and using industry-level data, Nicoletti and Scarpetta (2003)⁵ measure the extent to which multi-factor productivity (MFP) growth is affected by measures of product market regulation (reflecting the intensity of competition). They find that restrictive regulation in manufacturing tends to reduce MFP growth mainly via the process of technological catch-up. Using a similar approach, Conway et al. (2006)⁶ and Arnold, Nicoletti and Scarpetta (2008)⁷ find evidence that anti-competitive regulation is harmful particularly for technology-driven productivity improvements in ICT-intensive sectors.⁸ Using a different approach, Anos Casero and Udomsaph (2009)⁹ analyze micro-level data from countries in Europe and Central Asia to estimate total-factor productivity (TFP) and examine how changes in business environment and productivity growth are correlated in the 2001-2004 period. Successful efforts to improve the business environment are found to have a strong impact on firm productivity.

Openness to trade can also be expected to positively affect productivity growth. Traditional models of the innovation-focused growth literature (see Grossman and Helpman (1991)¹⁰ and Romer (1990)¹¹ for seminal interpretations) highlight three main channels through which trade could raise productivity: through diffusion of intermediate goods (or, implicitly, technologies); through an expansion of the market for the output of innovation; and through diffusion of general knowledge. The effective impact of increasing openness to trade on income and productivity growth is likely to depend on the country's

⁵ Nicoletti, G. and S. Scarpetta (2003) "Regulation, productivity and growth: OECD evidence", *Economic Policy* 18 (36), 9–72

⁶ Conway, P., D. De Rosa, G. Nicoletti and F. Steiner (2006), "Product Market Regulation and Productivity Convergence", *OECD Economic Studies* No. 43: 39-76

⁷ Arnold, J., G. Nicoletti and S. Scarpetta (2008), "Regulation, Allocative Efficiency and Productivity in OECD Countries: Industry and Firm-Level Evidence", *OECD Economics Department Working Papers*, No. 616

⁸ All these studies use the framework proposed by Aghion and Griffith (2005) in which productivity growth in a country/sector depends on the pace with which the country/sector grows in relation to the country/sector leader. In this sense, productivity growth of a lagging country depends on how fast the leader grows and the speed at which the productivity gap is being closed. This, in turn, depends on the policy environment in the follower country/sector, especially with reference to policies that promote firm rivalry and market entry. Apart from this common framework, these three studies have some differences. Arnold, Nicoletti and Scarpetta (2008) use micro-level data and focus on MFP growth. Nicoletti and Scarpetta (2003) also measure MFP but using industry level information, while Conway et al (2006) also rely on industry level data but measuring labor productivity growth. Finally, all these studies rely on the OECD sample of countries.

⁹ Anos Casero, P. and C. Udomsaph, (2009) "What Drives Firm Productivity Growth?" *World Bank Policy Research Working Paper Series* N.4841,.

¹⁰ Grossman, G.M., and E. Helpman. (1991). *Innovation and growth in the global economy*. Cambridge, MA: MIT Press.

¹¹ Romer, P (1990) "Endogenous Technological Change" *The Journal of Political Economy*, Vol. 98, No. 5, Part 2

institutional framework.¹² As highlighted by Aghion, Howitt and Mayor-Foulkes (2005)¹³ and Acemoglu, Johnson and Robinson (2005)¹⁴, the positive long-run effects of trade on growth would only arise when combined with an institutional framework of a certain quality, which would include different types of laws, regulations, enforcement of property rights, social arrangements, etc.

This study attempts to shed light on the effect of trade and regulation on productivity convergence while focusing on the specific case of Romania.

The main results of the analysis can be summarized as follows:

- Openness to trade (measured both in relation to global trade as well as to trade with EU partners) is shown to have a positive impact on productivity convergence when controlling for the level of regulatory quality. The potential gains from increasing trade intensity are particularly high in Romania: a ten percentage point increase in openness to global trade over the 1995-2010 period would have boosted productivity growth by 9.7 percent per year. A 10% increase in openness to EU trade, in particular, would have led to an annual increase in productivity of 7%.
- As the realization of the benefits from trade integration depends to some extent on regulation, the effects of regulation on productivity growth are shown to be positive, regardless of the indicator used to measure regulation, and both through direct and indirect channels. Simulation results also show how countries with different levels of regulatory quality would benefit from a regulatory improvement: had Romania improved its regulatory environment to the same level as Denmark in 2010, its annual productivity growth would have been 14 percent higher over the 1995-2010 period.
- Productivity growth in the leader country has a positive and significant impact on productivity growth in the follower countries.
- The more distant a country is from the technological frontier, the greater is the scope for productivity improvements arising from the catching-up process.
- The coefficient of human capital (measured as education achievement but not necessarily representing the skills of the labor force) does not appear to be statistically significant, suggesting that the effect of quality of human capital -- at least in the measure used here -- is fully captured by the productivity gap term.

2. COUNTRY-LEVEL ANALYSIS

To test the effect of regulation on catch-up to best practice, a model of labor productivity based on Conway et al. (2006) is adapted and estimated at the **country level**. In this framework, the productivity growth of a country depends on its ability to keep pace with the leader by either innovating or taking advantage of technology transfers. This potential is influenced by the policy environment in follower

¹² In fact, there might be also negative consequences of openness to trade, particularly when a greater international trade leads a country to specialize in sectors with relatively growth potential (Grossman and Helpman (1991))

¹³ Aghion, P., P. Howitt, and D. Mayor-Foulkes. (2005) "The effect of financial development on convergence: Theory and evidence" *Quarterly Journal of Economics* 120: 173–222

¹⁴ Acemoglu, D., Johnson, S. and J. A. Robinson (2005) "Institutions as the Fundamental Cause of Long-Run Growth." In Philippe Aghion and Steve Durlauf, eds., *Handbook of Economic Growth*.

countries that can affect, positively or negatively, the incentives to increase productivity. The following specification is used:

$$\Delta \ln LP_{it} = \delta(\Delta \ln LP_{it}^{leader}) + \sigma(prodgap_{it-1}) + \gamma Reg_{it} + \alpha(Reg * prodgap)_{it-1} + \beta humanK_{it-1} + \tau Open_trade_{it-1} + \sum_i \gamma Country_i + \sum_t \theta time_t + \epsilon_{it} \quad \text{Eq.(1)}$$

where i and t denote countries and years, respectively. LP is labor productivity, defined as value added per employee, where both value added and number of employees are based on Eurostat data.

$\Delta \ln LP_{it}^{leader}$ reflects the productivity shocks in the leader country; productivity growth in the frontier country widens the production possibility set leading to faster productivity growth in follower countries.¹⁵

$prodgap_{it-1}$ is the productivity gap and is defined as the log ratio of the level of productivity in each country relative to that of the productivity leader. Assuming that a country's distance from the technological leader measures the scope for technology transfer, the σ coefficient captures the effect of differences in productivity levels between each country and the productivity leader on productivity growth. As $prodgap_{it}$ varies in the interval $[-\infty, 0]$, a negative coefficient would suggest that the higher the productivity gap the greater is the scope for productivity improvements that might arise from the technological catch-up process.

Reg_{it} is the indicator of economy-wide regulation and proxies the policy environment of each country. In this particular exercise, it is measured by the regulatory quality indicator from the Worldwide Governance Indicators (WGI) database and is available from 1995 to 2010. The indicator captures the ability of a government to formulate and implement sound policies and regulations that permit and promote private sector development. The indicator is standardized between -2.5 and 2.5 with high scores corresponding to better outcomes.¹⁶ The γ coefficient measures the *direct* influence of regulation on productivity growth.

In order to reflect the possible effect of regulation on the speed with which each country catches up to the productivity leader, the model includes an interaction between regulatory quality and the productivity gap. Thus, the α coefficient measures the indirect effect of regulation on productivity growth. As $prodgap_{it}$ is always negative, a favorable regulatory environment (captured by higher – and positive – values of Reg_{it}) would imply a negative value for the interaction term. As such, a *negative* and significant value of the α coefficient would suggest that a *better* regulatory environment accelerates the catch up process. Figure 1 presents the evolution of the regulatory quality indicator for Romania and some selected EU countries (while Table II, Annex, presents the indicator values for all countries).

¹⁵ The productivity leader is allowed to change over time.

¹⁶ Details of how this indicator is constructed are presented in Kaufman, K., A. Kraay, and M. Mastruzzi. (2009). “Governance Matters VIII: Aggregate and Individual Governance Indicators, 1996-2008”, World Bank Policy Research Working Paper No. 4978.

Figure 1: Regulatory Quality indicator:1996-2010

Source: WGI dataset available on <http://info.worldbank.org/governance/wgi/index.asp>

$humanK_{it-1}$ is included to control for a possible (direct) influence (not reflected in the productivity gap term) of the quality of human capital on the ability of the economy to respond to shocks in the productivity frontier. It is defined as the proportion of the workforce with secondary education, with data drawn from the World Development Indicators (WDI) dataset.

$Open_trade_{it-1}$ measures trade openness accounting for the effect of competition from global trade on the country's ability to converge to the productivity frontier. Two different measures are tested: i) the country's openness to *global* trade, defined as the sum of country i 's global exports and imports divided by country i 's GDP; and ii) the openness to trade *within the EU region*, defined as the sum of country i 's exports to and imports from the EU region divided by country i 's GDP. Both trade and GDP data are from UNCTAD.

$Country_i$ is a vector of country dummies included to account for unobserved time-invariant factors that might affect productivity growth in a particular country, while $time_t$ is a vector of time dummies included to control for possible productivity shocks that might occur in a given year.

The model is estimated over the 1995-2010 period for a set of 30 countries: EU countries, including Romania, plus Iceland, Norway and Switzerland¹⁷. Tables 1 and 2 below provide summary statistics for the variables listed in Eq(1) while the estimation results are presented in Table 3.

¹⁷ See Table I, annex, for the set of countries covered by the current analysis.

Table 1: Summary Statistics of Variables (all countries, 1995-2010 period)

Variables	N	Mean	Std. Dev	25th pctile	75th pctile
$\Delta \ln LP$	450	0.05	0.07	0.02	0.08
$\Delta \ln LP^{leader}$	450	0.03	0.04	0.01	0.06
<i>prodgap</i>	480	-0.96	0.80	-1.59	-0.38
<i>Reg</i>	480	1.23	0.43	0.95	1.60
<i>humanK</i>	480	47.74	16.85	38.60	60.25
<i>Open_trade</i>	480	101.95	48.16	66.00	133.00
<i>Open_trade_EU</i>	480	52.96	26.09	33.00	70.00

Table 2: Summary Statistics of Variables (Romania, 1995-2010 period)

Variables	N	Mean	Std. Dev	25th pctile	75th pctile
$\Delta \ln LP$	15	0.08	0.16	0.01	0.17
$\Delta \ln LP^{leader}$	15	0.03	0.04	0.01	0.06
<i>prodgap</i>	16	-2.38	0.35	-2.65	-2.12
<i>Reg</i>	16	0.23	0.27	0.03	0.50
<i>humanK</i>	16	57.26	4.72	52.20	61.13
<i>Open_trade</i>	16	69.75	8.27	62.50	76.00
<i>Open_trade_EU</i>	16	42.63	7.41	35.00	48.00

Productivity growth in the leader country is found to have a positive and significant impact on productivity growth in the follower countries. The coefficient of the productivity gap term is negative and significant, suggesting that the more distant a country is from the technological frontier the greater is the scope for productivity improvements arising from the catching-up process. The coefficient of human capital (measured as education achievement but not necessarily representing the skills of the labor force) does not appear to be statistically significant, suggesting that the effect of quality of human capital -- at least in the measure used here -- is fully captured by the productivity gap term.¹⁸

¹⁸ In principle any effect of quality of human capital (or of any other input) on productivity growth by country should be captured by the productivity gap term. Human capital is included as a distinct variable in the model to check whether it has a *direct* effect on the ability of the country to catch up with the productivity frontier.

Table 3: Productivity Convergence and Regulation: country-level analysis for 1995-2010 period

(robust std errors in parenthesis)

Dependent variable: growth in labor productivity	1	2
$\Delta \ln LP_{it}^{leader}$	0.4869*** (0.103)	0.5013*** (0.103)
$prodgap_{it-1}$	-0.1058*** (0.021)	-0.1199*** (0.021)
Reg_{it}	0.0401* (0.022)	0.0411* (0.022)
$(Reg * prodgap)_{t-1}$	-0.0256* (0.013)	-0.0226* (0.013)
$humanK_{it}$	0.0006 (0.001)	0.0008 (0.001)
$Open_trade_{it-1}$	0.0006** (0.000)	
$Open_tradeEU_{it-1}$		0.0010*** (0.000)
Constant	-0.2778*** (0.059)	-0.2203*** (0.061)
Country dummies	Yes	Yes
Time dummies	Yes	Yes
R-squared	0.451	0.453
N. obs	450	450

Note: * significant at 10%; ** significant at 5%; *** significant at 1%

Openness to global trade is shown to have a positive impact on productivity convergence. On average, ten extra percentage points of global trade intensity over the 1995-2010 period would lead to an increase in average annual productivity growth of 0.6 percent per year.¹⁹ An increase in trade openness within EU region by 10 percentage points would lead to an average annual increase in productivity growth of 1.0 percent.

When measuring the marginal effect of trade intensity by country, the potential benefits of trade integration are particularly high for Romania (see Figure 2)²⁰. All else equal, an increase of 10 percentage

¹⁹ As the dependent variable is in logarithmic format, the exact percentage change in the predicted productivity growth associated with a change in the regressor X is computed as $[\exp(\hat{\beta}\Delta X) - 1] \times 100$ where $\hat{\beta}$ is the estimated coefficient.

²⁰ The marginal effect of trade openness by country was computed in two steps. First, through the estimation of the following equation:

$$\Delta \ln LP_{it} = \delta(\Delta \ln LP_{it}^{leader}) + \sigma(prodgap_{it-1}) + \gamma Reg_{it} + \alpha(Reg * prodgap)_{t-1} + \beta humanK_{it-1} + \tau Open_trade_{it-1} + \sum_i \vartheta Country_i * Open_trade_{it-1} + \sum_i \gamma Country_i + \sum_t \theta time_t + \epsilon_{it}$$

and then through the computation of the following term $\partial(\Delta \ln Prod)/\partial(Open_trade)$ for each country. The exact percentage change in the predicted productivity growth associated with a change in openness to trade is computed as $\left\{ \exp \left[\left(\frac{\partial(\Delta \ln Prod)}{\partial(Open_trade)} \right) * \Delta Open_trade \right] - 1 \right\} * 100$.

points in Romania's openness to global trade over the 1995-2010 period would boost the country's productivity growth by 9.7 percent per year, the highest value among the countries for which the average marginal effect is statistically significant, where the effect in the country with the second highest predicted effect -- Latvia -- is only 4.9 percent, 50% less than for Romania. The same exercise for trade intensity within the EU region shows similar results. Romania, again, is the country that could potentially benefit most from increasing trade intensity: ten extra percentage points of openness to trade within the EU region would increase productivity growth by almost 7% per year.

Figure 2: Increase in average annual productivity growth over the 1995-2010 period given an increase of ten percentage points of openness to trade

Note: this figure shows the results of those countries for which the average marginal effect of openness to trade was statistically significant. Table III, Annex, presents the estimated marginal effect of openness to trade for all countries.

Reaping the benefits from trade integration depends to some extent on regulation. In this regard, the direct effect of regulation on productivity growth is found to be positive (and significant), indicating that a less burdensome regulatory environment is conducive to productivity growth. Based on the model, regulatory improvement would also have indirect consequences for productivity growth by impacting the speed of the catch up process. As argued by Conway et al (2006), this could be due to the fact that less burdensome regulation would increase the incentives and reduce the costs of incorporating new technologies into the production process. The coefficient of $(Reg * prodgap)_{it-1}$ is negative and statistically significant at 10% level suggesting that well-functioning regulation is positively associated to a faster catch-up process.

The *total* effect of the regulatory environment on productivity growth (combining the direct and indirect channels) can be assessed by estimating the average marginal effect of the Reg_{it} variable in Eq(1). Results show that, all else equal, improving the regulatory indicator by one standard deviation (0.43) over the 1995-2010 period is associated with an increase of 2.86 percent in average annual productivity growth.²¹

²¹ The average marginal effect of regulatory quality was 0.0648; the 2.86 percent results from the following computation $[\exp(0.0648*0.43)-1]*100$.

To show how countries with different levels of regulatory quality would benefit from an improved regulatory improvement, we estimate the average marginal effect of the Reg_{it} variable by country and then simulate the gains in productivity growth across countries if they all engage in a sustained reform effort aimed at achieving the best practice of the countries in the sample. Following a reasonable conjecture, this hypothetical improvement would not have the same magnitude in all countries, as it would be conditioned on the last observed value for regulatory conditions in 2010. Specifically, the reform would imply, for each country, augmenting the Reg_{it} variable from its observed value in 2010 to the value of the country with the highest observed value in the same year, which is Denmark (with a value of 1.9). In other words, the benchmark for regulatory reform used in this exercise is the implementation of the regulatory settings related with the country with the best environment in 2010. The closer a country is to this 2010 benchmark the less ambitious would be the reform it would implement.

It is worth acknowledging that the simulated values produced by this kind of exercise should be only considered as indicative parameters. Regulatory reform is not assumed to change the estimated average parameters of the model, and for this reason, it would not change the estimated average relationship between the outcome variable and the other covariates. Nevertheless, this kind of exercise can be a useful instrument to have a sense of the magnitude of the impact on the economy of a possible policy change.

Figure 3 presents the results of a simulation that considers the impact on productivity growth due to a regulatory reform initiative that improves the country's regulatory environment to the level of Denmark in 2010. The average increase in annual productivity growth ranges from 0.5 percent for Finland to 15.5 percent for Bulgaria. Romania stands out with the second highest productivity dividend (14.1 percent).

Figure 3: Increase in average annual productivity growth (over 1995-2010) given a move to a regulatory environment equivalent to Denmark in 2010

*Note: The regulatory environment is measured by the regulatory quality indicator (WGI data). Results for Switzerland and Luxembourg are not presented as the corresponding marginal effects of regulatory quality were not statistically significant. Table IV, Annex, presents the average marginal effect of regulatory quality for all countries. The figure is based on the estimation of Eq(1) with **Open_trade** variable. Results are robust to the use of **Open_tradeEU** variable.*

3. SECTOR-LEVEL ANALYSIS

In order to shed light on the sectoral dimension of productivity growth, the following equation is estimated:

$$\Delta \ln LP_{ijt} = \delta(\Delta \ln LP_{ijt}^{leader}) + \sigma(prodgap_{ijt-1}) + \gamma Reg_{it} + \alpha(Reg * prodgap)_{ijt-1} + \beta humanK_{it-1} + \tau Open_trade_{it-1} + \sum_i \gamma Country_i + \sum_j \pi sector_j + \sum_t \theta time_t + \epsilon_{ijt}$$

Eq.(2)

where:

i, j and t denote countries, sectors (Nace 1.1)²² and years, respectively. LP stands for labor productivity and is defined as sectoral value added per employee, based on Eurostat data. Reflecting data availability, the model is estimated **at sector level over the period of 2003-08** for the same countries of Eq(1), except for Switzerland and Malta, given the lack of data on sectoral productivity for these countries.

All the variables are defined as in Eq(1), except *Reg* for which an additional proxy for the quality of the regulatory environment is used.²³ In addition to the regulatory quality indicator - from the WGI database - a set of alternative indicators constructed through a principal component analysis (PCA) based on Doing Business (DB) data is used. The first (All DB) is a comprehensive index including all DB indicators in all topics. The second (Business Start-up_DB) measures the complexity of a number of procedural aspects related to the entry and exit process; it encompasses the indicators for *starting a business*, *registering property* and *closing a business*. The third (Business Operations_DB) captures the burden of regulations faced by an enterprise in managing regular operations; it covers the topics of *dealing with construction permits*, *paying taxes*, *trading across borders* and *employing workers*. The fourth and last index (Institutional Environment_DB) measures the quality of the legal and institutional framework and aggregates the indicators for *protecting investors*, *getting credit* and *enforcing contracts*. All PCA indices based on DB data are coded such that higher values indicate simpler regulation.²⁴ It is worth mentioning that none of the regulatory proxies are available at the sector level, only at the country level. The same happens with *Open_trade* and *humanK*. Table VI (Annex) provides summary statistics for all proxies of regulatory environment used for the estimation at sector level while Figure 4 shows the evolution of the comprehensive PCA indicator on DB data (Table VII, Annex, shows the values for all PCA indicators for all comparator countries).

²² See Table IV in the annex.

²³ The productivity leader is allowed to change over time and across sectors.

²⁴ In this sense, the PCA indices – based on DB data - are consistent with the regulatory quality indicator (based on WGI data); even though the PCA indices are scaled differently, they are also defined in such a way that higher values mean better regulatory environment.

Box 1 – Constructing alternative proxies of regulatory environment: Principal Component Analysis using Doing Business data

The PCA indices are linear combinations of Doing Business sub-indicators, where each sub-indicator is multiplied by an optimal weight that best accounts for the variance of the indicators. For example, the principal components analysis index for business entry is calculated through the following equation:

$$\text{Business Entry index} = w_0 * (\text{Starting a Business}) + w_1 * (\text{Registering Property}) + w_2 * (\text{Closing a Business}),$$

where the weights w_0 , w_1 , and w_2 are the weights that lead to the greatest variance. All principal components analysis indices are coded so higher numbers indicate less complex regulation.

Figure 4: PCA indicator (All_DB):2003-2008

Note: Authors' elaboration based on DB data

The results of estimating Eq(2) are given in Table 4. Consistent with the previous set of results at the country level, labor productivity growth in less productive sectors is positively influenced by the speed at which productivity grows in the same sectors in the best performing countries. In addition, the coefficient of productivity gap is, again, always negative.

Table 4: Productivity Convergence and Regulation: sector level analysis for 2003-08 period (robust standard errors in parenthesis)

	1	2	3	4	5	6	7	8	9	10
$\Delta \ln L P_{it}^{leader}$	0.0257*** (0.007)	0.0334*** (0.007)	0.0276*** (0.007)	0.0309*** (0.007)	0.0302*** (0.007)	0.0246*** (0.007)	0.0326*** (0.007)	0.0278*** (0.007)	0.0300*** (0.007)	0.0298*** (0.007)
$prodgap_{ijt-1}$	-0.0548*** (0.007)	-0.0568*** (0.014)	-0.0946*** (0.022)	-0.0483*** (0.013)	-0.0217 (0.017)	-0.0556*** (0.007)	-0.0576*** (0.014)	-0.0947*** (0.022)	-0.0489*** (0.013)	-0.0217 (0.017)
$humanK_{it-1}$	0.0017 (0.001)	0.001 (0.001)	0.0004 (0.001)	0.0011 (0.001)	0.0015 (0.001)	0.0015 (0.001)	0.001 (0.001)	0.0003 (0.001)	0.0011 (0.001)	0.0013 (0.001)
$Open_trade_{it-1}$	0.0005 (0.001)	0.0004 (0.001)	-0.0003 (0.001)	0.0005 (0.001)	0.000 (0.000)					
$Open_tradeEU_{it-1}$						0.0003 (0.001)	0.0005 (0.001)	-0.0007 (0.001)	0.0005 (0.001)	-0.0003 (0.001)
Reg_{it}	0.0515* (0.0340)					0.0439* (0.025)				
$(Reg * prodgap)_{it-1}$	-0.0110** (0.004)					-0.0104** (0.004)				
All_DB_{it}		0.0047*** (0.002)					0.0047*** (0.002)			
$(All_DB * prodgap)_{ijt-1}$		-0.0002** (0.000)					-0.0001** (0.000)			
$Start - up_DB_{it}$			0.0081*** (0.002)					0.0081*** (0.002)		
$(Start - up_DB * prodgap)_{ijt-1}$			0.0003 (0.000)					0.0003 (0.000)		
$Bus_Operations_DB_{it}$				0.0025** (0.001)					0.0024* (0.001)	
$(BusOperations_DB * prodgap)_{ijt-1}$				-0.0003 (0.000)					-0.0002 (0.000)	
$Inst - Env_DB_{it}$					0.002* (0.001)					0.0019* (0.001)
$(Inst - Env_DB * prodgap)_{ijt-1}$					-0.0007*** (0.000)					-0.0007*** (0.000)
_cons	-0.5913*** (0.157)	-0.7969*** (0.179)	-0.9979*** (0.221)	-0.6575*** (0.171)	-0.5876** (0.229)	-0.5314*** (0.154)	-0.7765*** (0.184)	0.000 (0.000)	-0.6335*** (0.175)	-0.5541** (0.234)
R-squared (within)	0.1348	0.1312	0.1247	0.1334	0.1379	0.136	0.1322	0.1239	0.1347	0.1379
N. obs	5129	5129	5129	5129	5129	5129	5129	5129	5129	5129

Note: Country, sector and time dummies were included but not reported. * significant at 10%; ** significant at 5%; *** significant at 1%

The *direct* effect of regulation on productivity convergence is found to be positive regardless of the proxy used to measure the quality of the regulatory environment. Regarding the *indirect* effect of regulation, the coefficient of the $(Reg * prodgap)_{ijt-1}$ variable is shown to be negative and statistically significant for three out of the five proxies of regulatory environment, suggesting that, at least for these cases, the effect of regulation on the speed of the catch-up process is positive.

The total effect of regulation on productivity growth – when assuming both direct and indirect effects – is also shown to be positive: estimations of the marginal effect of the quality of the regulatory environment on productivity growth points to a positive (and statistically significant) effect for all proxies used (see Table VI in the Annex for the results). Figure 5 below displays the estimated effect on productivity growth due to a one standard variation in each regulatory proxy over the 2003-08 period. Results suggest that productivity dividends are higher when the regulatory framework is measured by the indicator Institutional Environment_DB, which captures the quality of the legal and institutional framework for *protecting investors, getting credit and enforcing contracts*.

Figure 5: Increase in average annual productivity growth (over 2003-08 period) given a one standard deviation increase in each regulatory proxy

Note: Reg is the regulatory quality indicator, according to WGI data. One standard deviation of each regulatory proxy is computed over the whole sample of countries for the 2003-08 period. See Table VI, Annex, for the respective values considered.

To identify the sectors in which the impact of regulation on productivity growth is higher, the average marginal effect of the regulatory variable was computed.²⁵ Results show that the marginal impact of the regulatory environment on productivity growth is positive and statistically significant for all sectors, regardless of the proxy used. Table 5 displays the effects on productivity growth associated with a one standard deviation (0.38) increasing of regulatory quality indicator (Reg) over the 2003-08 period.²⁶ Sectoral

²⁵ See Table VIII in the Annex for the estimated marginal effects of all regulatory proxies used.

²⁶ The effects on productivity growth due to variation of other proxies of regulatory environment were also computed. Results are available upon request.

productivity dividends resulting from regulatory improvement range from 3.9 to 5.2 percent annually. The low variance of these estimations suggests that potential gains of regulatory upgrading seem to be equally distributed across sectors. However, among the sectors listed, the non-manufacturing ones – like Electricity, gas and water supply; Water transport; Air transport, Post and telecommunications, Retail trade and Other business activities – are particularly relevant, as these are normally the most regulated in the economy and inappropriate regulation of these activities tends to have “trickle down” effects on the rest of the economy, as all industries tend to be heavy users of non-manufacturing inputs.

Table 5: Increase in average annual productivity growth by sector given a one standard deviation augment of regulatory environment over 2003-08 period

Sector	Estimated effect (%)
Mining of coal and lignite; extraction of peat	5.2
Manufacture of wearing apparel; dressing; dyeing of fur	5.2
Manufacture of leather and leather products	5.2
Manufacture of textiles	5.1
Hotels and restaurants	5.1
Manufacture of furniture; manufacturing n.e.c.	5.1
Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	5.1
Manufacture of wood and wood products	5.0
Manufacture of other transport equipment	5.0
Manufacture of food products and beverages	5.0
Manufacture of fabricated metal products, except machinery and equipment	5.0
Other business activities	5.0
Manufacture of machinery and equipment n.e.c.	5.0
Manufacture of rubber and plastic products	5.0
Manufacture of electrical machinery and apparatus n.e.c.	5.0
Forestry, logging and related service activities	5.0
Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel	4.9
Fishing	4.9
Land transport; transport via pipelines	4.9
Construction	4.9
Manufacture of radio, television and communication equipment and apparatus	4.9
Manufacture of other non-metallic mineral products	4.9
Manufacture of medical, precision and optical instruments, watches and clocks	4.9
Manufacture of motor vehicles, trailers and semi-trailers	4.9
Publishing, printing and reproduction of recorded media	4.9
Manufacture of pulp, paper and paper products	4.9
Recycling	4.9
Agriculture, hunting and related services	4.9
Manufacture of basic metals	4.8
Wholesale trade and commission trade, except of motor vehicles and motorcycles	4.8
Manufacture of office machinery and computers	4.8
Other mining and quarrying	4.8

Computer and related activities	4.8
Supporting and auxiliary transport activities; activities of travel agencies	4.8
Air transport	4.7
Manufacture of chemicals, chemical products and man-made fibres	4.7
Post and telecommunications	4.7
Water transport	4.6
Research and development	4.6
Manufacture of tobacco products	4.5
Electricity, gas and water supply	4.5
Renting of machinery and equipment without operator and of personal and household goods	4.4
Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction, excluding surveying	4.3
Manufacture of coke, refined petroleum products and nuclear fuel	4.3
Real estate activities	3.9

Note: one standard deviation of regulatory quality indicator (0.38) is computed over the whole sample of countries for the 2003-08 period (see Table VI, Annex).

Results from Table 4 show that openness to trade – measured at the country level – does not present a statistically significant effect on productivity convergence at sector level. When testing alternative measures for openness to (overall) trade at sector level - covering agriculture, fishing, mining and manufacturing sectors at 2 digit level of Nace 1.1 - estimation results in Table 6 suggest that trade openness has in fact a positive (and statistically significant) effect on productivity growth.²⁷

²⁷ Openness to (global) trade at sector level is defined as the sum of sector j's global exports and imports divided by sector j's production value. Data for global imports and exports by sector is from Comtrade, while production value information is from Eurostat.

Table 6: Productivity Convergence and Regulation: sector level analysis for 2003-08 period with openness to trade data at sectoral level (robust standard errors in parenthesis)

	1	2	3	4	5
$\Delta \ln LP_{it}^{leader}$	0.0278*** (0.009)	0.0336*** (0.009)	0.0296*** (0.009)	0.0315*** (0.009)	0.0311*** (0.009)
$prodgap_{ijt-1}$	-0.0735*** (0.009)	-0.0762*** (0.018)	-0.1073*** (0.028)	-0.0693*** (0.016)	-0.034 (0.024)
$humanK_{it-1}$	0.0005 (0.002)	-0.0002 (0.002)	-0.0001 (0.002)	-0.0001 (0.002)	0.0006 (0.002)
$Open_trade_{ijt-1}$	0.0001** (0.000)	0.0001** (0.000)	0.0001** (0.000)	0.0001** (0.000)	0.0001** (0.000)
Reg_{it}	0.1184** (0.048)				
$(Reg * prodgap)_{it-1}$	-0.0044** (0.002)				
All_DB_{it}		0.0049** (0.002)			
$(All_DB * prodgap)_{ijt-1}$		-0.002** (0.000)			
$Start - up_DB_{it}$			0.0069** (0.003)		
$(Start - up_DB * prodgap)_{ijt-1}$			0.0003 (0.000)		
$Bus_Operations_DB_{it}$				0.0030** (0.001)	
$(BusOperations_DB * prodgap)_{ijt-1}$				-0.0001 (0.000)	
$Inst - Env_DB_{it}$					0.0019* (0.001)
$(Inst - Env_DB * prodgap)_{ijt-1}$					-0.0006* (0.000)
_cons	-0.6108*** (0.146)	-0.7523*** (0.186)	-0.9707*** (0.273)	-0.6276*** (0.168)	-0.5760** (0.263)
R-squared (within)	0.1259	0.1262	0.1249	0.1257	0.1252
N. obs	3155	3155	3155	3155	3155

Note: Country, sector and time dummies were included but not reported. * significant at 10%; ** significant at 5%; *** significant at 1%

The computation of the marginal effect of trade openness on productivity convergence by sector allows identifying the industries for which productivity growth is most responsive to a variation in trade intensity. Figure 6 displays the effects on productivity growth due to a one standard deviation increasing of trade openness by sector over the 2003-08 period.²⁸ Only the sectors for which the estimated effect was statistically significant are presented. Manufacture of basic metals is the activity with the highest productivity dividend: a one standard deviation increase in the sector's openness to trade over the 2003-08 period would lead to a productivity growth almost 34 percent higher (yearly). The average value of trade openness for this sector in Romania is largely inferior to the sector average of all countries considered in the analysis; this

²⁸ The presented effects of trade openness on productivity growth refer to the model that includes *Reg* as the regulatory proxy used. The trade effects considering alternative regulatory proxies were also computed. Results are available upon request.

suggests that there is space for Romania to increase its trade integration which can largely benefit productivity convergence. The same seems to happen to the other selected sectors.

Figure 6 - Increase in average annual productivity growth by sector given a one standard deviation augment of sectoral openness to trade over 2003-08 period

Figure 7- Average openness to trade by sector: 2003-08 period

Note: one standard deviation of trade openness for the manufacture of basic metals, manufacture of motor vehicles, trailers and semi-trailers, and mining of coal and lignite (63.7, 15.5 and 42.8, respectively) are computed over the whole sample of countries for the 2003-08 period.

4. CONCLUDING REMARKS

This paper attempts to shed light on the effect of trade and regulation on productivity convergence while focusing on the specific case of Romania. A model of labor productivity based on Conway et al. (2006) was adapted and estimated, first, at country the level over the 1995-2010 period for a set of 30 countries: EU countries, including Romania, plus Iceland, Norway and Switzerland. Proxying the regulatory environment by the regulatory quality indicator from the WGI dataset, the **country level** model has provided results which can be summarized as follows:

- Openness to global trade (measured both in relation to global trade as well as to trade with EU partners) is shown to have a positive impact on productivity convergence when controlling for the level of regulatory quality. The potential gains for increasing trade intensity in Romania are particularly high: a 10% increase in openness to global trade over the 1995-2010 period would have boosted productivity growth by 9.7 percent per year. A 10% increase in openness to EU trade, in particular, would have led to an annual increase in productivity of 7%.
- As the realization of the benefits from trade integration depends to some extent on regulation, the effects of regulation on productivity growth are shown to be positive, regardless of the indicator used to measure regulation, and both through direct and indirect channels. Simulation results also show how countries with different levels of regulatory quality would benefit from a regulatory improvement: had Romania improved its regulatory environment to the same level as Denmark in 2010, its annual productivity growth would have been 14 percent higher over the 1995-2010 period.

- Productivity growth in the leader country has a positive and significant impact of productivity growth in the follower countries.
- The more distant a country is from the technological frontier, the greater is the scope for productivity improvements arising from the catching-up process.
- The coefficient of human capital (measured as education achievement but not necessarily representing the skills of the labor force) does not appear to be statistically significant, suggesting that the effect of quality of human capital -- at least in the measure used here -- is fully captured by the productivity gap term.

In order to shed light on the sectoral dimension of productivity growth, the same model was estimated at sector level over the period of 2003-08 for the same countries, except for Switzerland and Malta. In this sector level model, besides the regulatory quality indicator - from WGI database - a set of alternative indicators constructed through a principal component analysis (PCA) based on Doing Business (DB) data was used. The **sector level** results can be summarized as follows.

- Trade openness at sector level has a positive (and statistically significant) effect on productivity growth. The computation of the marginal effect of trade openness on productivity convergence by sector has pointed manufacture of basic metals as the activity to show the highest productivity dividend. As the average value of trade openness for this sector in Romania is largely inferior to the sector average of all countries considered in the analysis, this suggests that there is space for Romania to increase its trade integration to the benefit of productivity convergence.
- The total effect of regulation on productivity growth – when assuming both direct and indirect effects – was also shown to be positive: estimations of the marginal effect of the quality of the regulatory environment on productivity growth points to a positive (and statistically significant) effect for all proxies used. In particular, results suggest that productivity dividends are higher when the regulatory framework is measured by the indicator Institutional Environment_DB, which captures the quality of the legal and institutional framework regarding protecting investors, getting credit and enforcing contracts. In order to identify the sectors in which the impact of regulation on productivity growth is higher, the average marginal effect of the regulatory environment variable was computed and results have shown that the marginal impact of the regulatory environment on productivity growth is positive and statistically significant for all sectors, regardless of the proxy used. Sectoral productivity dividends resulting from regulatory improvement range from 3.9 to 5.2 percent yearly.
- Consistent with the previous set of results at country level, labor productivity growth in less productive sectors is positively influenced by the speed at which productivity grows in the same sectors in the best performing countries. In addition, the coefficient for the productivity gap was, again, negative.

ANNEX

Table I –List of Countries

1	Austria
2	Belgium
3	Bulgaria
4	Cyprus
5	Czech Republic
6	Denmark
7	Estonia
8	Finland
9	France
10	Germany
11	Greece
12	Hungary
13	Iceland
14	Ireland
15	Italy
16	Latvia
17	Lithuania
18	Luxembourg
19	Malta
20	Netherlands
21	Norway
22	Poland
23	Portugal
24	Romania
25	Slovakia
26	Slovenia
27	Spain
28	Sweden
29	Switzerland
30	United Kingdom

Table II – Evolution of Regulatory Quality indicator*

Country	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Denmark	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.80	1.80	1.70	1.80	1.90	1.90	1.90	1.90
Finland	1.35	1.50	1.65	1.80	1.85	1.90	1.90	1.90	1.90	1.80	1.70	1.60	1.50	1.60	1.80	1.80
Netherlands	1.75	1.80	1.85	1.90	2.00	2.10	2.00	1.90	1.70	1.80	1.70	1.70	1.80	1.80	1.80	1.80
Ireland	1.55	1.60	1.65	1.70	1.75	1.80	1.75	1.70	1.60	1.60	1.50	1.80	1.80	1.90	1.70	1.70
Luxembourg	1.65	1.60	1.55	1.50	1.75	2.00	1.95	1.90	1.80	1.80	1.60	1.70	1.70	1.70	1.70	1.70
Sweden	1.45	1.40	1.35	1.30	1.40	1.50	1.60	1.70	1.60	1.70	1.50	1.50	1.60	1.70	1.70	1.70
Switzerland	1.30	1.40	1.50	1.60	1.70	1.80	1.75	1.70	1.70	1.70	1.50	1.50	1.60	1.60	1.60	1.70
United Kingdom	2.00	2.00	2.00	2.00	1.85	1.70	1.70	1.70	1.70	1.80	1.60	1.80	1.90	1.80	1.60	1.70
Germany	1.60	1.50	1.40	1.30	1.45	1.60	1.60	1.60	1.60	1.50	1.50	1.60	1.60	1.50	1.50	1.60
Austria	1.70	1.60	1.50	1.40	1.50	1.60	1.60	1.60	1.60	1.50	1.50	1.60	1.70	1.70	1.50	1.50
Liechtenstein	1.50	1.50	1.50	1.50	1.50	1.50	1.60	1.70	1.60	1.50	1.60	1.30	1.40	1.40	1.50	1.50
Norway	1.55	1.50	1.45	1.40	1.20	1.00	1.15	1.30	1.30	1.50	1.50	1.30	1.40	1.40	1.40	1.50
Cyprus	1.35	1.30	1.25	1.20	1.15	1.10	1.15	1.20	1.20	1.20	1.30	1.30	1.30	1.40	1.30	1.40
Estonia	1.45	1.40	1.35	1.30	1.30	1.30	1.35	1.40	1.30	1.30	1.30	1.30	1.40	1.50	1.50	1.40
Malta	0.85	0.90	0.95	1.00	1.05	1.10	1.10	1.10	1.20	1.10	1.00	1.10	1.10	1.20	1.40	1.40
Belgium	1.30	1.20	1.10	1.00	1.10	1.20	1.25	1.30	1.30	1.40	1.20	1.30	1.40	1.40	1.30	1.30
France	1.05	1.00	0.95	0.90	0.95	1.00	1.00	1.00	1.20	1.20	1.20	1.20	1.30	1.30	1.20	1.30
Czech Republic	1.05	1.00	0.95	0.90	0.85	0.80	1.00	1.20	1.20	1.10	1.10	1.10	1.00	1.20	1.30	1.20
Spain	1.05	1.10	1.15	1.20	1.25	1.30	1.35	1.40	1.30	1.30	1.30	1.20	1.20	1.20	1.20	1.20
Hungary	0.70	0.80	0.90	1.00	1.00	1.00	1.15	1.30	1.10	1.20	1.10	1.20	1.20	1.20	1.10	1.10
Slovakia	0.55	0.50	0.45	0.40	0.45	0.50	0.70	0.90	1.00	1.20	1.20	1.10	1.00	1.10	1.10	1.10
Latvia	1.05	1.00	0.95	0.90	0.80	0.70	0.80	0.90	1.00	1.00	0.90	1.00	1.00	1.00	1.00	1.00
Lithuania	1.35	1.20	1.05	0.90	0.85	0.80	0.95	1.10	1.00	1.10	1.00	1.00	1.10	1.10	1.00	1.00
Poland	0.75	0.70	0.65	0.60	0.60	0.60	0.65	0.70	0.70	0.80	0.80	0.70	0.80	0.80	0.90	1.00
Iceland	0.90	1.00	1.10	1.20	1.35	1.50	1.50	1.50	1.60	1.60	1.60	1.60	1.50	1.10	1.00	0.90
Italy	0.80	0.80	0.80	0.80	0.85	0.90	0.90	0.90	1.00	1.10	1.00	0.90	0.90	0.90	0.90	0.80
Portugal	1.35	1.30	1.25	1.20	1.10	1.00	1.15	1.30	1.20	1.20	1.30	1.10	1.10	1.10	1.10	0.80
Slovenia	1.00	1.00	1.00	1.00	0.85	0.70	0.75	0.80	0.80	0.90	0.80	0.80	0.80	0.80	0.90	0.80
Greece	0.55	0.60	0.65	0.70	0.75	0.80	0.90	1.00	1.00	0.80	0.90	0.80	0.90	0.90	0.80	0.70
Romania	0.05	0.10	0.15	0.20	0.05	-0.10	-0.05	0.00	-0.10	0.20	0.20	0.50	0.50	0.60	0.60	0.70
Bulgaria	-0.20	-0.10	0.00	0.10	0.15	0.20	0.40	0.60	0.60	0.70	0.60	0.60	0.60	0.70	0.60	0.60

*countries are ordered by 2010 values

Note: values for 1995, 1997, 1999 and 2001 were imputed

Table III – Average marginal effect of Openness to Trade by Country (country level analysis, 1995-2010 period)

Country	Average marginal effect $\left[\frac{\partial(\Delta \ln Prod)}{\partial(Open_trade)}\right]$	Average marginal effect $\left[\frac{\partial(\Delta \ln Prod)}{\partial(Open_tradeEU)}\right]$
Austria	0.000	0.000
Belgium	0.000	0.000
Bulgaria	0.001	0.004**
Cyprus	0.002	-0.003
Czech Republic	0.003**	0.003**
Denmark	0.000	-0.001
Estonia	-0.001	-0.001
Finland	0.000	-0.001
France	0.000	-0.001
Germany	-0.001	-0.002
Greece	0.000	0.000
Hungary	0.000	0.000
Iceland	-0.009	-0.020
Ireland	0.001	0.001
Italy	-0.003	-0.009
Latvia	0.005***	0.005**
Lithuania	0.000	0.000
Luxembourg	0.000	0.000
Malta	0.001	0.001
Netherlands	0.000	0.000
Norway	-0.005	-0.013
Poland	0.000	0.000
Portugal	0.002	0.002
Romania	0.009***	0.007***
Slovakia	0.002***	0.002**
Slovenia	0.001	0.001
Spain	0.001	-0.003
Sweden	-0.005	-0.009
Switzerland	0.000	-0.001
United Kingdom	0.004	-0.001

*Note: * significant at 10%; ** significant at 5%; *** significant at 1%*

Table IV – Average marginal effect of Regulatory Quality by Country (country level analysis, 1995-2010 period)

Country	Average marginal Effect ^{\$} $\left[\frac{\partial(\Delta \ln Prod)}{\partial(Reg)}\right]$	Average marginal Effect [#] $\left[\frac{\partial(\Delta \ln Prod)}{\partial(Reg)}\right]$
Austria	0.05**	0.05**
Belgium	0.047*	0.047*
Bulgaria	0.111***	0.104***
Cyprus	0.062***	0.06**
Czech Republic	0.082***	0.078***
Denmark	0.05**	0.05**
Estonia	0.092***	0.087***
Finland	0.051**	0.051**
France	0.051**	0.051**
Germany	0.053**	0.052**
Greece	0.055**	0.054**
Hungary	0.087***	0.082***
Iceland	0.051**	0.05**
Ireland	0.046*	0.046*
Italy	0.049**	0.049**
Latvia	0.097***	0.091***
Lithuania	0.094***	0.089***
Luxembourg	0.042	0.043
Malta	0.07***	0.067***
Netherlands	0.052**	0.052**
Norway	0.044*	0.045*
Poland	0.082***	0.078***
Portugal	0.07***	0.068***
Romania	0.101***	0.095***
Slovakia	0.088***	0.083***
Slovenia	0.07***	0.068***
Spain	0.058**	0.057**
Sweden	0.052**	0.051**
Switzerland	0.041	0.042
United Kingdom	0.049**	0.049**

Note: * significant at 10%; ** significant at 5%; *** significant at 1%

^{\$} Results based on Eq(1) with **Open_trade** variable; [#] Results based on Eq(1) with **Open_tradeEU** variable.

Table V-List of NACE 1.1 Sectors

Agriculture, hunting and related services
Air transport
Computer and related activities
Construction
Electricity, gas and water supply
Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction, excluding surveying
Fishing
Forestry, logging and related service activities
Hotels and restaurants
Land transport; transport via pipelines
Manufacture of food products and beverages
Manufacture of basic metals
Manufacture of chemicals, chemical products and man-made fibres
Manufacture of electrical machinery and apparatus n.e.c.
Manufacture of fabricated metal products, except machinery and equipment
Manufacture of radio, television and communication equipment and apparatus
Manufacture of furniture; manufacturing n.e.c.
Manufacture of leather and leather products
Manufacture of machinery and equipment n.e.c.
Manufacture of medical, precision and optical instruments, watches and clocks
Manufacture of motor vehicles, trailers and semi-trailers
Manufacture of office machinery and computers
Manufacture of coke, refined petroleum products and nuclear fuel
Manufacture of other transport equipment
Manufacture of other non-metallic mineral products
Manufacture of pulp, paper and paper products
Manufacture of rubber and plastic products
Manufacture of tobacco products
Manufacture of textiles
Manufacture of wearing apparel; dressing; dyeing of fur
Manufacture of wood and wood products
Mining of coal and lignite; extraction of peat
Other mining and quarrying
Other business activities
Post and telecommunications
Publishing, printing and reproduction of recorded media
Research and development
Real estate activities
Recycling
Renting of machinery and equipment without operator and of personal and household goods

Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods
Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel
Supporting and auxiliary transport activities; activities of travel agencies
Water transport
Wholesale trade and commission trade, except of motor vehicles and motorcycles

Table VI – Summary Statistics of Regulatory Variables (all countries, 2003-2008 period).

stats	Mean	sd	p25	p75
<i>Reg</i>	1.27	0.38	1.00	1.60
<i>All_DB</i>	71.03	10.16	63.98	77.96
<i>Start – up_DB</i>	82.57	8.06	76.51	87.54
<i>Bus. Operations_DB</i>	78.29	8.87	73.37	83.77
<i>Inst – Env_DB</i>	69.52	10.27	64.52	75.80

Table VII – Values of PCA - DB indicators#

<i>All_DB*</i>						
	2003	2004	2005	2006	2007	2008
Denmark	86.31	86.16	87.48	88.54	90.73	90.28
Ireland	89.10	88.98	89.16	89.25	89.27	89.32
United Kingdom	89.14	89.16	89.07	89.07	89.02	87.65
Norway	84.43	83.90	84.33	83.82	83.39	82.40
Sweden	80.62	79.95	81.98	83.46	83.39	82.10
Finland	81.29	81.62	81.70	81.75	81.68	81.23
Belgium	77.91	79.48	79.49	79.62	80.35	80.67
Austria	77.16	77.12	77.18	77.48	78.01	77.03
Switzerland	76.23	76.29	76.45	76.57	77.63	76.66
Netherlands	74.44	74.48	75.12	75.62	76.30	76.03
Estonia	73.09	73.29	74.47	74.49	75.32	74.93
Germany	74.62	74.62	74.28	75.11	75.10	74.07
France	55.10	56.83	56.98	68.12	68.89	73.11
Lithuania	67.09	69.29	71.57	72.11	71.85	71.67
Latvia	67.83	67.85	69.33	71.61	71.86	71.52
Cyprus	68.46	68.46	68.46	68.46	68.46	67.81
Portugal	63.64	63.64	64.72	67.27	67.76	67.70
Hungary	65.44	65.45	65.50	65.83	66.70	67.61
Bulgaria	59.11	59.09	59.68	61.80	66.89	67.43
Slovakia	60.99	62.38	64.33	65.53	65.72	65.71
Luxembourg	65.40	65.40	65.40	65.40	65.41	64.85
Czech Republic	61.74	61.85	61.72	62.76	66.18	64.82
Poland	63.88	63.96	64.00	65.05	64.93	64.75
Spain	63.82	63.80	64.92	64.93	64.81	64.19
Italy	61.45	63.87	65.09	63.68	63.01	63.81
Romania	47.05	47.48	49.72	62.06	63.66	63.74
Slovenia	57.44	57.51	57.88	57.95	56.60	59.43
Greece	51.85	51.87	52.01	53.69	53.59	55.09
<i>Start – up_DB*</i>						
	2003	2004	2005	2006	2007	2008
Norway	99.1	98.0	99.0	99.8	98.9	98.7
Finland	96.0	96.7	96.8	96.9	96.7	96.6
Sweden	95.2	93.8	94.2	94.3	94.2	94.3
Denmark	87.6	87.6	89.1	89.9	94.1	94.1
Netherlands	90.6	90.7	90.7	91.7	91.4	90.8
Ireland	90.2	90.2	90.3	90.5	90.4	90.6
United Kingdom	89.9	89.9	89.9	89.9	89.8	89.8
Belgium	81.4	84.8	84.9	85.2	86.9	87.0
Lithuania	81.5	86.4	86.5	87.4	87.2	87.0

Austria	86.8	86.7	86.8	86.9	86.7	86.5
Switzerland	85.7	85.9	86.3	86.4	86.4	86.4
Portugal	78.6	78.6	79.8	84.5	85.9	86.1
Estonia	81.6	82.1	83.7	83.8	85.9	85.6
Slovakia	72.4	75.5	79.7	81.8	81.4	84.3
Cyprus	83.5	83.5	83.5	83.5	83.5	83.5
Germany	83.1	83.1	82.4	82.5	82.5	82.3
Spain	79.5	79.5	82.6	82.7	82.6	81.7
Italy	79.2	84.3	84.4	81.8	80.0	81.7
Hungary	76.5	76.5	76.8	77.4	78.5	81.7
Latvia	77.1	77.2	76.9	78.9	78.9	79.0
Bulgaria	74.0	73.9	74.0	75.7	75.4	78.7
Romania	71.7	72.6	75.2	75.6	78.3	78.6
France	73.5	77.5	77.8	77.8	78.8	78.5
Slovenia	71.6	71.7	72.0	72.1	72.4	77.4
Luxembourg	76.1	76.1	76.1	76.1	76.1	76.1
Poland	72.2	72.3	72.4	72.7	73.2	73.3
Czech Republic	66.6	66.8	67.4	68.3	71.2	71.9
Greece	65.1	65.1	65.4	69.9	69.7	70.6

Bus. Operations_DB*

	2003	2004	2005	2006	2007	2008
Denmark	96.84	96.84	97.62	97.68	97.66	96.88
Ireland	90.77	90.60	90.60	90.60	90.69	90.68
United Kingdom	91.07	91.07	91.07	91.07	91.08	88.76
Sweden	89.47	89.47	90.35	90.35	90.36	88.27
Switzerland	86.14	86.14	86.14	86.24	88.02	86.51
Norway	86.24	86.24	86.24	84.90	84.90	83.33
Austria	83.84	83.84	83.84	84.00	84.90	83.33
Estonia	82.97	82.97	83.85	83.76	83.78	83.29
Belgium	83.27	83.27	83.27	83.28	83.33	83.26
Finland	83.42	83.42	83.42	83.47	83.47	82.78
France	60.22	60.22	60.22	75.15	75.15	81.74
Germany	80.94	80.94	80.94	82.11	82.08	81.44
Netherlands	78.76	78.76	79.64	79.73	80.87	80.87
Cyprus	78.63	78.63	78.63	78.63	78.63	78.63
Czech Republic	77.73	77.73	76.07	77.14	79.65	77.79
Lithuania	76.38	76.38	77.17	77.27	77.03	76.88
Latvia	74.06	74.06	74.84	76.44	77.04	76.67
Italy	73.26	73.26	74.97	75.01	75.01	74.97
Luxembourg	75.91	75.91	75.91	75.91	75.92	74.87
Portugal	73.28	73.28	74.17	75.07	75.08	74.61
Poland	74.87	74.87	74.87	75.75	74.86	74.47
Hungary	73.45	73.45	73.45	73.47	74.28	73.75

Bulgaria	67.14	67.14	67.14	68.12	75.02	72.63
Spain	71.89	71.89	71.89	71.89	71.81	71.37
Slovakia	71.73	71.73	72.61	72.72	72.52	69.96
Greece	68.54	68.54	68.54	68.66	68.68	69.87
Romania	48.23	48.23	49.02	67.35	66.77	66.23
Slovenia	67.14	67.14	67.14	67.14	65.81	65.26

Inst – Env_DB*

	2003	2004	2005	2006	2007	2008
Ireland	91.50	91.50	92.22	92.22	92.22	92.22
United Kingdom	90.75	90.75	90.57	90.57	90.57	90.57
Latvia	77.02	77.02	81.37	83.43	83.43	83.43
Belgium	77.95	77.95	77.95	77.95	77.95	79.40
Romania	72.17	72.17	74.23	75.22	77.26	78.28
Norway	75.89	75.89	75.89	75.89	75.89	75.89
Finland	75.35	75.85	75.85	75.85	75.85	75.85
Germany	77.69	77.69	77.80	77.80	77.80	75.75
Austria	74.80	74.80	74.80	75.52	75.52	75.61
Denmark	74.01	73.29	73.45	75.49	75.49	75.49
France	67.61	67.61	67.61	71.70	73.74	73.74
Lithuania	66.59	66.59	72.76	72.76	72.76	72.76
Bulgaria	64.52	64.52	66.58	68.64	70.69	71.42
Netherlands	70.92	70.92	70.92	70.92	70.92	70.92
Estonia	70.63	70.63	70.63	70.63	70.63	70.63
Sweden	61.85	61.85	65.94	70.55	70.55	70.55
Slovakia	66.75	67.83	67.83	67.83	69.88	69.88
Czech Republic	67.57	67.57	70.53	70.53	70.53	68.49
Hungary	68.40	68.40	68.40	68.40	68.40	68.40
Poland	63.96	63.96	64.20	65.19	66.98	66.98
Switzerland	66.61	66.61	66.61	66.61	66.61	66.27
Luxembourg	65.54	65.54	65.54	65.54	65.54	65.54
Spain	62.63	62.63	62.63	62.63	62.63	62.63
Portugal	60.98	60.98	60.98	60.98	60.98	61.70
Slovenia	55.18	55.18	56.39	56.39	54.33	57.72
Cyprus	55.73	55.73	55.73	55.73	55.73	53.76
Greece	47.32	47.32	47.32	47.32	47.32	48.31
Italy	48.15	48.15	48.15	48.25	48.25	48.25

#countries are ordered by 2008 values

*The All DB PCA index is a comprehensive index including all DB indicators in all topics. The PCA index of Business Start-up_DB encompasses the DB indicators for starting a business, registering property and closing a business. The PCA index of Business Operations_DB covers the topics of dealing with construction permits, paying taxes, trading across borders and employing workers. The PCA index of Institutional Environment_DB aggregates the indicators for protecting investors, getting credit and enforcing contracts

Note: The PCA indicators were originally computed for all countries around the world (for which the DB data is available). The table displays only the values for the set of countries covered by the current analysis (EU countries plus Iceland, Norway and

Switzerland). For this reason, the 100 value is not always presented, which means that the country with the least complex regulation in the world is not among those included here.

Table VIII– Average marginal effect of different regulatory measures (country/sector level analysis, 2003-08 period)

Variables	Results based on Eq(2) with <i>Open_trade</i> variable	Results based on Eq(2) with <i>Open_tradeEU</i> variable
	coef	coef
$\left[\frac{\partial(\Delta \ln Prod)}{\partial(Reg)}\right]$	0.125***	0.113**
$\left[\frac{\partial(\Delta \ln Prod)}{\partial(All_DB)}\right]$	0.006***	0.006***
$\left[\frac{\partial(\Delta \ln Prod)}{\partial(Start-up_DB)}\right]$	0.006**	0.006**
$\left[\frac{\partial(\Delta \ln Prod)}{\partial(Bus.Operations_DB)}\right]$	0.004***	0.004***
$\left[\frac{\partial(\Delta \ln Prod)}{\partial(Inst-Env_DB)}\right]$	0.006**	0.006**

Note: * significant at 10%; ** significant at 5%; *** significant at 1%