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Total Factor Productivity in the EU – Direct and Indirect Impact of Labor Market Institutions

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Abstract: Total factor productivity is an essential determinant of long-run growth. Given the dissatisfactory evolution of TFP in member states of the EU, determination of key factors of productivity growth is essential for better economic performance of member states. The goal of the paper is to quantify direct and indirect impact of labor market institutions and knowledge on total factor productivity growth in member states of the European Union with emphasis on their interactions. By means of least square dummy variables panel data regression, the impact of R&D, human capital and five institutions on total factor productivity growth is estimated. Empirical analysis is conducted on dataset covering observations for 28 member states over 1998-2016. Regression results approve the theoretically expected productivity enhancing effect of knowledge and indicate significantly negative impact of labor market institutions on TFP growth. Besides direct effects, labor market institutions negatively influence productivity growth via their impact on human capital and R&D. Therefore, policy measures that support knowledge accumulation and reform current institutional set up on labor markets are essential for boosting productivity growth in the EU.

Keywords: labor market institutions; total factor productivity; the European Union

JEL Classification: C33; I25; O43

1. Introduction

Total Factor Productivity (TFP) is considered as key determinant of long-run growth and cross-country differences in income. It shows how productively all the inputs are used. Given the considerable slowdown in potential growth in member states of the European Union and persisting productivity gap between EU and US, the issue to enhance total factor productivity is in front of academic and policy debates. Among others, we can mention The Council´s recommendation to create National productivity Boards (The Council of the European Union 2016). However, economic policy measures would not improve TFP and decrease productivity gap without determination of key determinants.

Since the emergence of endogenous growth theories, research and development (R&D) and human capital (HC) has been considered as two leading determinants of economic growth through their positive impact on productivity (Romer 1990; Lucas 1988). An evidence of productivity enhancing effect of R&D can be found in numerous empirical studies (Coe and Helpman 1995; Frantzen 2000; Bronzini and Piselli 2009; Edquist and Henrekson 2017, etc.). Later studies extended the analysis of impact of knowledge by inclusion of human capital in empirical analysis (Coe et al. 1997; Engelbrecht 1997; Männasoo et al. 2018, Barcenilla et al. 2019, etc.).

Persisting differences in performance among countries raised a claim that knowledge accumulation is an important but not only source of growth. New theories tried to explain growth through structural parameters, including those related to institution (Aghion and Howitt 1992; Acemoglu et al. 2010; etc.). Acemoglu and Robinson (2010) suggested that economic institutions are key sources of economic growth and prosperity because they shape incentives of economic agents to invest in physical capital, human capital and technology and influence organization of production. In the context of endogenous theories, institutions determine productivity growth mainly via their impact on innovations and human capital accumulation (Barro and Sala-i-Martin 1997).

As Freeman (1993) pointed out, recent research in labor market policies is dominated by two contradicting intuitions: distortionism (institutions impede economic growth) and institutionalism (institutions reduce costs, enhance productivity or moderate crises). A large body of current empirical

works is oriented on strictness of labor market regulations with predominantly negative conclusions about its impact on productivity (Bassanini et al. 2000, Gust and Marquez 2004, Bassanini and Venn 2008, Bassanini et al. 2009, etc.). A positive, but weak and sensible to model specification, effect of stricter regulation on labor productivity and TFP in the OECD countries was estimated by Nickell and Layard (1999) and Koeninger (2005). Later, Belot et al. (2007) suggested that stricter employment protection legislation leads to productivity gains if workers invest in firm-specific skills.

Even less studies exist in the case of other labor market institutions. Positive effect of minimum wage on long-run labor productivity and TFP was found out by Bassanini and Venn (2007). However, generous unemployment benefits system could reduce that positive effect of minimum wage by reducing the opportunity cost of remaining unemployed. Alternatively, an increase of minimum wage may lead to more efficient reallocation of sources and productivity gains (Del Carpio et al. 2015). Negative impact of generous unemployment benefits was found out by Dolenc and Laporšek (2013). At the same time, they suggested a positive impact of active labor market policies on productivity. The productivity enhancing effect of ALMP was supported also by Parello (2011) or Égert (2016). Therefore, an unambiguous answer on the role of labor market institutions in determining total factor productivity cannot be fined even in empirical literature. Moreover, empirical studies rarely consider more than one labor market institution leading to only partial conclusions about the impact of institutional set-up on labor markets. Further empirical research could enrich the current state of knowledge and serve as basis for appropriate policy recommendations.

The main goal of this paper is to quantify the direct and indirect impact of labor market institutions and knowledge on total factor productivity growth in member states of the European Union with emphasis on their interactions. More precisely, we are interested in the effect of research and development, human capital and five labor market institutions (active labor market policies, employment protection legislation, minimum wage, trade unions, unemployment benefits). Based on review of theoretical and empirical works, we suppose that the direct effects of labor market institutions on TFP is likely to be combined with indirect effects mainly via knowledge accumulation. Therefore, labor market institutions may increase or decrease the productivity enhancing effect of research and development and human capital.

The paper is organized as follows. After a short introduction to research question and its theoretical background, the second section describes methodology of the empirical analysis. The subsections present derivation of regression model, estimation methods and data. The section three includes empirical results and their interpretations. Consequently, discussion on research findings, limits of empirical analysis and proposals for future research are presented in section 4. Main conclusions are summarized in the last section.

2. Methodology

The main assumptions behind our empirical specification is an endogenous determination of total factor productivity. Therefore, TFP growth can be explained in line with endogenous growth theory as a product of knowledge accumulation and residual set of factors including institutions (Aghion and Howitt 2009). Moreover, we assume that the direct effects of LMI on TFP are combined with indirect effects as institutions influence knowledge accumulation via their impact on human capital and research and development.

2.1. The regression model

To derive the empirical model we apply, beside the aforementioned assumptions, a standard approach of production function with labor and capital as inputs and a parameter that reflects the state of technology. Assuming Hicks-neutral technological change, the production function has the following form:

$$Y_{it} = TFP_{it} L_{it}^{\alpha} K_{it}^{\beta} \tag{1}$$

where Y denotes total output, K stands for total factor productivity, L is labor input (number of hours worked), K is capital input (capital stock), α_t, β_t represents the shares of labor and capital

incomes in the total income (labor and capital compensation) and i, t are indexes for units and time. In turn, relying on current endogenous theories, total factor productivity is determined by research and development (R&D), human capital (HC), institutional variable (I) and other unmeasurable factors (A).

$$TFP_{it} = A_{it} R\&D_{it} HC_{it} I_{it} \tag{2}$$

As we are interested in a specific effect of selected labor market institutions on total factor productivity growth, our empirical model takes a form of productivity equation augmented by institutions as follows:

$$\Delta lnTFP_{it} = \alpha_i + d_t + \beta R\&D_{it} + \gamma HC_{it} + \sum_l \delta_l LMI_{lit} + \mu_{it} \tag{3}$$

where the growth rate of total factor productivity ($\Delta \ln TFP_{it}$) is explained by country- and time-specific effects (α_i,d_t) research and development (R&D), human capital (HC) and a set of five labor market institutions (LMI). The last term μ_{it} is an iid error term.

Based on equation (3) we can estimate the average direct effect of included explanatory variables on productivity growth. However, our research question is oriented also to indirect effect of labor market institutions on TFP via their impact on human capital and research and development. To estimate these effects, we extend the baseline model (3) with pairwise interaction terms of R&D with LMI and HC with LMI, respectively. The interaction terms are modelled according to methodology of Bassanini and Duval (2010) as products of deviations of variables from their sample mean (over units and time periods).

In the case of human capital and one labor market institution, the augmented productivity equation takes the following form:

$$\Delta lnTFP_{it} = \alpha_i + d_t + \beta R\&D_{it} + \gamma HC_{it} + \sum_l \delta_l LMI_{lit} + \theta_{HC} (HC_{it} - \overline{HC})(LMI_{it} - \overline{LMI}) \tag{4}$$

where *bar* stands for sample mean over countries and years. In this specification, coefficients can be interpreted as marginal productivity effect of corresponding variables, when all other co-variates kept constant at their sample means. The overall productivity effect of human capital is given by sum of parameter estimates γ (direct effect) and θ (account for impact of LMI). Formally, partial derivative of TFP growth with respect to human capital variable is given as:

$$\partial \Delta lnTFP_{it} / \partial HC = \gamma + \theta \left(LMI_{it} - \overline{LMI}^h \right) \tag{5}$$

For productivity enhancing institutions (positive sign of coefficient δ_l), if parameter estimate of interaction term θ has positive sign, the marginal productivity effect of HC will be larger the larger the value of LMI. Then, the negative sign for the interaction coefficient θ would provide an evidence of reform complementarity.

Similarly, the baseline model (3) extended by interaction of research and development and one labor market institutions becomes as follows:

$$\Delta lnTFP_{it} = \alpha_i + d_t + \beta R\&D_{it} + \gamma HC_{it} + \sum_l \delta_l LMI_{lit} + \theta_{RD} (R\&D_{it} - \overline{R\&D})(LMI_{it} - \overline{LMI}) \tag{6}$$

Notice that we cannot include all possible interactions into single estimation as it will lead to substantial loss of degrees of freedom and raise the issue of perfect multicollinearity.

2.2. Methods of estimation and corresponding tests

In order to estimate equations (4) and its extensions (5) and (6) we use a panel data model with country and period fixed effects (LSDV).

By application of fixed effect estimator, we can control for country specific differences through individual intercepts and thereby solve the problem of omitted variables. In empirical analysis, we focus on specific set of member states of the EU and the interference is restricted on the behavior of these countries. At that case, is reasonable to assume the presence of unobserved (individual)

heterogeneity (see e.g. Johnston and Dinardo 1997). The correctness of this specification and its estimation is tested by Hausmann specification test (Hausman 1978).

Moreover, productivity growth can be sensitive to shocks that could have impact on all the Europeans countries in a specific year. Therefore, we include time dummies in regression model to control for common aggregate shocks.

A potential issue in the case of institutional variables is endogeneity of regressors. It means, that the observed relationship between productivity growth and the institutional variable may reflect the impact of institution on productivity growth but also the reverse causality (from productivity change to institutional change). To control for endogeneity, we use lag values of institutional variables in interference. Another essential requirement is stationarity of time series. Before the estimation, we test the presence of unit roots for all explanatory variables.

To be aware the reliability of our interferences, we executed standard residual tests for heteroskedasticity (Panel Period and Cross-section Heteroskedasticity LR Tests), autocorrelation (Durbin-Watson Statistic) and normal distribution of standard errors (Histogram – Normality test).

2.3. Data

The empirical analysis is carried out on unbalanced panel data set that includes observations on 28 member states of the European Union from 1995 to 2017. We decided to not collect data from the first half of 1990s for two reasons. First, availability of data and their quality for this period are limited, especially in the case of new member states. Second, the early 1990s were marked by post-transitionary shocks in certain countries (with substantial deviations from equilibrium conditions in the economies). However, due to large number of missing values, observations for 1995-1997 and 2017 were dropped out from the full sample. Therefore, the choice of sample period was determined by availability of data and the baseline estimation was executed on the sample covering period of 1998-2016 and re-estimated on the reduced sample 2004-2016.

In total, the dataset includes 7 regressors and total factor productivity growth as dependent variable:

- ΔlnTFP - total factor productivity growth proxied by log difference of broad measure of TFP, calculated via growth accounting method
- HC - human capital proxied by population with secondary and tertiary education as percentage of total population aged 15-64
- R&D - research and development proxied by total R&D personnel and researchers as % of active population
- ALMP –active labor market policies proxied by participants in active measures (cat. 10-70) as portion of unemployed
- EPL – employment protection legislation proxied by strictness of employment protection on temporary contracts (index 0-6)
- MW – statutory minimum wage at monthly rate converted to PPS (via PPP, EU28=1)
- TU – trade unions proxied by union density rate (share of workforce with membership in trade unions)
- UB – unemployment benefits proxied by full unemployment benefits per unemployed person in PPS

The choice of the variables was determined by the followings: a) the research question, b) theoretical foundations, c) estimation techniques, d) availability of data. As we are interested in the impact of knowledge accumulation and labor market institutions on TFP growth, the dependent variable is explained by two variables for knowledge accumulation (HC, R&D) and five institutional variables (ALMP, EPL, MW, TU, UB) representing key labor market institutions. We use own estimations of TFP growth rates as we need the broadest measure of TFP (not accounting for the quality of labor and capital). Instead of human capital stock (usually proxied by average years of schooling), we prefer an alternative indicator, also frequently used in empirical literature, that represent accumulation of knowledge in line with the theoretical assumption of Lucas (1988). The similar is true

for research and development variable where we prefer indicator based on the number of employees in R&D departments to alternative one based on the number of patents. Note that we didn´t apply R&D expenditures relative to GDP as we tried to avoid the problem of endogeneity by not including right-hand side variables expressed as a ratio of GDP (TFP growth is itself a portion of GDP growth). In the case of institutional variables, we use standard indicators proposed by theoretical and empirical works and available in international databases. As before, we did not use indicators based on expenditures relative to GDP for active labor market policies and unemployment benefits.

For more detailed information on data sources and main descriptive statistics consult Table 1. Note that we present descriptive statistics of reduced dataset 2004-2016 as majority of regressions were conducted on this sample (see the next section for more details).

Table 1. Dataset –references to source and descriptive statistics of reduced sample (2004-2016).

Variable	Data Source	Descriptive statistics				
		Mean	**Median**	**Max**	**Min**	**Std. Dev.**
ΔlnTFP	Own Calculation	0,005	0,009	0,162	-0,153	0,032
HC	Eurostat	71,03	74,30	88,00	26,00	12,58
R&D	Eurostat	1,031	0,908	2,264	0,292	0,506
ALMP	Eurostat	0,548	0,365	2,401	0,005	0,482
EPL	OECD.Stat	1,705	1,563	3,750	0,375	0,889
MW	Eurostat, WSI, MLWSI,	610,1	557,2	1640	0,000	455,2
TU	OECD.Stat, ICTWSS 5.1	29,95	23,65	76,44	4,487	19,19
UB	Eurostat	5127	2866	17088	113,2	4880

Note: Data for MW in Cyprus were obtained on request from Ministry of Labor, Welfare and Social Insurance.

The stationarity requirement of included time series was tested by panel unit root tests via Levin-Lin-Chu test (Levin, Lin and Chu 2002). The outputs indicated the presence of unit root only for minimum wage. For the rest of regressors, we could reject a null hypothesis of common unit root process at conventional significance level. As solution, first difference of levels of minimum wages were used in the regression models.

3. Empirical Results

The regression results of the baseline model (3) are presented in Table 2. The estimations were provided on the full sample (3a) and on the adjusted one with sample period reduced to 2004-2016 (3b). Comparison of adjusted R^2 indicates that bigger portion of the variance in the total factor productivity growth is explained by regressors in (3b). Moreover, Durbin-Watson Statistic indicates positive autocorrelation in the residuals in the regression model (3a). Therefore, we interpret our findings in line with results from regression on adjusted sample.

The result of baseline model suggests that the number of employees in research and development departments, and human capital represented by the portion of total population with secondary and tertiary education have had significantly positive effect on the growth rate of total factor productivity. On the contrary, employment protection regulation, minimum wage and unemployment benefits have had significantly negative impact on the dependent variable. The remaining two labor market institutions have not indicated statistically significant effect at any reasonable significance level. It means that total factor productivity growth in member states of the EU over the period 2004-2016 have been positively influenced by knowledge accumulation, while at the same time strictness of employment protection on temporary contracts, level of minimum wage and generosity of national unemployment benefit systems impeded its growth rate.

The last three columns of Table 3 present the regression results for extended versions of the empirical model by including pairwise interaction terms for human capital (4) and research and development (6), respectively. Note that we conducted separate regressions for all possible pairwise interactions, but we present only those with statistically significant coefficient of interaction terms. The regressions were conducted on adjusted sample (observations for 23 cross-sections over 2004-2016).

Table 2. Regression results of baseline model and its extensions.

	(3a)	**(3b)**	**(4a)**	**(4b)**	**(6)**
cons	-0,095	-0,158	-0,226	-0,154	-0,194
	(-2,227)	(-2,381)	(-3,431)	(-2,338)	(-2,912)
R&D	0,031***	0,0295**	0,030**	0,027*	0,022
	(2,776)	(2,062)	(2,171)	(1,858)	(1,500)
lag_HC	0,001	0,002**	0,003***	0,027*	0,002**
	(1,229)	(2,059)	(3,141)	(1,963)	(2,280)
lag_ALMP	-0,004	-0,001	-0,001	-0,002	0,002
	(-0,804)	(-0,222)	(-0,234)	(-0,309)	(0,247)
lag_EPL	-0,005	-0,012**	-0,016***	-0,014**	-0,020***
	(-1,45)	(-2,168)	(-2,946)	(-2,472)	(-3,169)
lag_d_MW	-7,87e-06	-0,12e-03**	-0,105e-03*	-0,125e-03**	-0,107e-03*
	(-0,046)	(-2,112)	(-1,960)	(-2,242)	(-1,948)
lag_TU	0,001	0,001	0,001	0,001	0,003**
	(1,400)	(1,261)	(1,472)	(1,469)	(2,294)
lag_UB	-1,85e-06*	-3,42e-06**	-4,02e-06***	-2,58e-06	-2,77e-06*
	(-1,819)	(-2,154)	(-2,631)	(-1,556)	(-1,750)
lag_HC*lag_EPL	-	-	-0,001***	-	-
			(-3,905)		
lag_HC*lag_MW	-	-	-	-1,76e-06*	-
				(1,675)	
R&D*lag_EPL	-	-	-	-	-0,034**
					(-2,545)
Observations	259	202	202	202	202
Periods	19	13	13	13	13
Cross-sections	23	23	23	23	23
Fixed effects	yes	yes	yes	yes	yes
R^2	0,61	0,66	0,69	0,67	0,68
Adjusted R^2	0,52	0,58	0,61	0,58	0,59
F Statistic	6,70	7,69	8,53	7,65	7,91
P-value (F)	0,00	0,00	0,00	0,00	0,00

[1] Note: 5 cross-sections (BG, HR, CY, MT, RO) were dropped out from regression due to large number of missing values for EPL; regressions provided by EViews 10.

The regression results of the model with pairwise interactions of human capital and employment protection legislation (4a) approves the previous findings on the statistically significant direct effect of 5 regressors on TFP growth - positive effect of R&D and HC and negative effect of EPL, MW and UB. Their effect size only slightly changed giving an evidence that the results of baseline model are robust to inclusion of pairwise interaction. The negative sign of coefficient for interaction term means that the marginal productivity enhancing effect of human capital will be larger the smaller the level of employment protection regulation. Therefore, an implementation of less strict regulations on temporary contracts would enhance total factor productivity growth both directly and indirectly through its impact on human capital accumulation.

The next pairwise interaction with statistically significant effect on TFP growth is combination of human capital and minimum wage (4b). As before, the inclusion of additional regressor have not

substantially changed the results for knowledge variables, except lower significance levels. In the case of labor market institutions, only two variables indicate significantly negative impact on TFP growth, namely EPL and MW. In comparison to corresponding estimates from the baseline model (3b), the negative effects of regulation on temporary contracts and year-on-year differences in minimum wages were estimated as slightly larger. The negative sign of interaction coefficient leads to similar conclusions as in the case of pairwise interaction of EPL with HC – the marginal productivity enhancing effect of human capital will be larger the smaller is an increase of minimum wages. It means that policy measures leading to increase in statutory minimum wages would impede productivity growth in the EU member states directly and indirectly via their impact on human capital accumulation.

In the case of research and development (6), only the pairwise interaction with employment protection legislation have been estimated as statistically significant with negative impact on TFP growth. However, the marginal direct effect of research and development did not indicate significant impact on productivity growth at any reasonable significance level. As before, we can conclude that stricter regulation on temporary contracts, in average, impedes productivity growth in the EU member states itself and after controlling for its interaction with R&D. Regarding the direct effects of institutions, besides EPL, MW and UB, trade unions proxied by union density rate also indicate statistically negative effect on TFP growth in 23 member states of the EU over the period of 2004-2016.

4. Discussion

Our findings about the significant role of human capital and R&D in explaining total factor productivity growth approve the theoretical consensus on the productivity enhancing impact of knowledge accumulation. The results support the importance of policy measures to increase the portion of population with secondary and tertiary education and the number of employees in R&D departments in the EU member states. As long as these indicators can be considered as good proxies for knowledge accumulation embodied in human capital and research and development, policy measures of national authorities and the EU institutions would be oriented to improve the quantity and quality of human capital and R&D in the member states.

Building knowledge-based economies is even more important given the estimated negative impacts of labor market institutions on TFP growth in the analyzed sample. The empirical results suggest that the direct effects of strictness of employment protection on temporary contracts, year-on-year difference in statutory minimum wages, unemployment benefits per unemployed person and the share of workforce with membership in trade unions on TFP growth were significantly negative. These findings are in line with theoretical expectations about negative impact of wage-setting institutions (UB and MW), strict employment regulations and generous unemployment benefits, as well as, with our previous research findings. It implies that the current institutional set-up of European labor markets creates barriers to productivity growth and requires adequate policy measures to increase labor market flexibility. More precisely, the combination of less strict regulations on temporary contracts, minimum wage freeze (as wages are rigid downward), less generous unemployment benefit systems and smaller concentration of workforce in trade unions would enhance total factor productivity growth in the member states.

It is important to mention that we use strictness of employment protection on temporary contracts as proxy for EPL. The choice is determined by our preliminary results. They did not indicate statistically significance role of strictness of employment protection on regular contracts in explaining productivity growth (same findings can be found in Aiginger 2004). It can be explained by the development in the 21st century: a) only small-scale decline in the strictness of regulations on regular contracts in majority of the EU member states, b) rising differences between regulations for temporary and permanent contracts (see e.g. Sloane et al. 2013 for more detailed discussion on the topic).

Moreover, we found out that beside the direct effects of institutional variables, their indirect effect on knowledge accumulation are also decisive. According to the presented results, the direct productivity enhancing effect of knowledge variables represented by human capital and R&D are reduced by level of employment protection regulations on temporary contracts and year-on year

change in statutory minimum wages. Therefore, we can conclude that less strict regulation on temporary contracts and lower increase in statutory minimum wage would be also implemented in order to promote the positive effect of human capital/ R&D on TFP growth.

However, these findings have their limits and have to be interpreted with caution. Given the nature of panel data estimation method, the findings are valid only in average for the group of analyzed member states. The impact of selected variables and consequent policy recommendations would vary given the national contexts. Note that the analysis includes only 23 member states – 5 cross sections were dropped out due to large number of missing values for EPL. Therefore, we cannot make any conclusion for Bulgaria, Croatia, Cyprus, Malta and Romania. Moreover, any policy measure requires evaluation of its impact on other economic and social indicators. The main obstacle regarding the indirect effects of labor market institutions is that the pairwise interactions do not assess the impact of overall institutional arrangement. It is not possible to include all interaction terms into single estimation as it will lead to substantial loss of degrees of freedom and raise the issue of perfect multicollinearity. Finally, our empirical model was derived based on endogenous growth theories emphasizing the role of knowledge accumulation and extended by institutional variables. Given our research question, we analyzed the impact of labor market institutions and we abstracted from other potential institutional variables (property rights, product market regulations or ease of doing business are commonly proposed by current empirical literature).

Therefore, further empirical analysis is required. First, it would be useful to assess the impact of institutional arrangement on labor markets for the whole EU by re-estimation of the proposed empirical model with inclusion of only those institutions for which data are available for all cross-sections. Second, the impact of recommended measures on employment, unemployment, economic growth, etc. would be assessed. Third, methodology to investigate the impact of overall institutional set-up of European labor markets on productivity growth would be derived. Finally, the empirical model would be re-estimated by controlling for other institutional variables.

5. Conclusions

Total factor productivity is an essential determinant of long-run growth and overall economic performance. Given the dissatisfactory evolution of TFP in the EU member states, the creation of adequate policy measure to promote productivity growth is essential for better economic performance of member states. While the economic theory gives relatively straightforward answer on the role of human capital and research and development in determining productivity, theoretical views on the role of labor market institutions are unambiguous (on both direct and indirect effects).

The aim of the paper was to quantify the direct and indirect impact of labor market institutions and knowledge on total factor productivity growth in member states of the European Union with emphasis on their interactions. We supposed that labor market institutions may increase or decrease the productivity enhancing effect of research and development and human capital. The empirical results for 23 member states over the period 2004-2016 suggest that the effect of knowledge accumulation and labor market institutions on TFP growth is just opposing. While the direct impact of human capital (proxied by the portion of population with secondary and tertiary education) and R&D (proxied by the number of employees in R&D departments as percent of active population) has been estimated as positive; strictness of regulations on temporary contracts, year-on-year differences in statutory minim wages, trade union density rates and unemployment benefits have had significantly negative effect on total factor productivity growth. Moreover, we found out that besides the direct effects, labor market institutions negatively influence productivity growth via their impact on human capital and R&D. Pairwise interactions of employment protection regulation with human capital and R&D, and minimum wage with R&D has been estimated as statistically significant with negative coefficients.

To sum up, policy measures that support knowledge accumulation and reform current institutional set up on labor markets are essential for boosting productivity growth and thus improving long-run economic performance of the EU member states. More precisely, the combination of less strict regulations on temporary contracts, minimum wage freeze, less generous unemployment benefit systems and smaller concentration of workforce in trade unions would enhance total factor

productivity growth in the member states. Moreover, less strict employment protection regulation and lower increase in statutory minimum wage would be also implemented in order to promote the positive effects of human capital and research and development on TFP growth.

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