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Estimating Mark-ups and the Effect of Product Market Regulations in Selected Professional Services Sectors: A Firm-level Analysis

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Abstract

In this paper we estimate mark-ups and their association with product market regulations (PMR) in professional services sectors using the Orbis firm-level database for 13 EU member states. We will concentrate on engineering and accounting. Results indicate a significant effect of PMR on mark-ups, which confirms findings based on sectoral data (cf. Thum-Thysen and Canton, 2015) but a more granular analysis on the firm level gives additional insights. Compared to estimates of mark-ups based on sectoral data, the mark-up levels in the two analysed sectors using firm-level data are found to be higher. This may be due to a more granular sectoral definition, only covering regulated professions, where firms can gain market power and charge higher mark-ups. The new empirical findings could be useful for the analytical work on estimating the impact of structural reforms.

JEL Classification: D40, E31, L51

Keywords: professional services, mark-ups, product market reforms, OECD PMR indicator

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1. INTRODUCTION

In this paper we estimate mark-ups and their association with product market regulations (PMR) in professional services sectors using the Orbis firm-level database for 13 EU member states. Using firm-level data allows exploring the link between product market regulation and mark-ups at a detailed sectoral level as the Orbis data is available at the four-digit industry classification level. This enables us to investigate mark-up levels and the responsiveness of mark-ups to changes in product market regulation for narrowly defined sectors. We will concentrate on engineering and accounting.

This paper is a follow up on previous work by Thum-Thysen and Canton (2015), who estimate mark-ups and the effect of PMR in service sectors based on more aggregate sectoral data from the EUKLEMS/World Input Output Tables database (WIOD) and PMR indicators developed by the OECD[1]. A challenge encountered by Thum-Thysen and Canton (2015) was that the sectoral classification in the WIOD database does not go beyond the two-digit level, while the OECD's PMR database provides indicators for professional services sectors at the three- or four-digit level (accounting, architecture, engineering and legal services). Furthermore, the release of the EUKLEMS/WIOD data used in Thum-Thysen and Canton (2015) provides the necessary data only up to 2007, which implies that their estimated parameters used to compute the mark-ups do not include information on more recent developments.[2] The current analysis is based on data available until 2014 and therefore allows incorporating a longer time horizon for estimation of the parameters needed for the computation of the mark-ups. Thum-Thysen and Canton (2015) find that mark-ups in professional services are in the range of 10-20% in 2013, whereas a 1 point reduction in the sectoral PMR corresponds with a decrease in mark-ups by about 5 percentage points.

Results with firm-level data reported in this paper indicate a significant effect of PMR on mark-ups in the engineering and accounting sector. Mark-ups are also substantially higher compared to mark-ups in the professional services sector based on sectoral data. This finding of higher mark-ups using firm-level data can be due to various reasons. A first explanation is differently defined sectors. The paper by Thum-Thysen and Canton (2015) uses a broader sectoral definition of professional services, including activities with various degrees of regulation. In the present analysis we have a more granular sectoral definition, only covering regulated professions. In such regulated professions, firms can gain market power and charge higher mark-ups. Other reasons are possible sample bias in the Orbis database with respect to the representativeness of small firms and a better matching of the sectors across the OECD PMR data and the Orbis firm-level database.

The results presented in this paper should be useful for the analytical work on estimating the impact of structural reforms. The remainder of the paper is organised as follows: Section 2 describes the data used, section 3 discusses the methodology, section 4 presents the results and section 5 concludes.

[1] In Section 5 Thum-Thysen and Canton (2015) mention explicitly the need to redo their analysis based on firm-level data as part of the future research agenda.
[2] Note that in forthcoming work, the authors plan to update their mark-up calculation based on EUKLEMS data as soon as a full new release is available.

2. DATA

We use two databases: the Orbis database[3] of firm-level data as well as the OECD's Product Market Regulation (PMR) indicators database[4]. As tangible fixed assets in Orbis are given after depreciation and at historical book value, capital costs are computed as the nominal long-term interest rates retrieved from the European Commission's AMECO database[5,6]. From the Orbis database we use variables for nominal turnover (TURN), material costs (MATE), the wage bill (STAF) and tangible fixed assets (TFAS) given in 1000 of Euros. A note of caution is necessary: as Molnar and Bottini (2006) describe for the Amadeus database[7], Orbis is not a representative database for small firms (small firm coverage is problematic). Furthermore, coverage across countries also varies (ibidem and OECD 2010) and changes in accounting systems may reduce consistency of variable definitions over time.

2.1. DATA CLEANING

We start out with a dataset downloaded from Orbis with 78,872 observations[8] for the four professional services sectors available in the PMR database (engineering, accounting, architecture and legal services) in the EU-28 member states. In the cleaning process we drop observations

- with capital, turnover, wage bill or material costs smaller or equal to zero;
- with log differences smaller than -0.9 or larger than 10;
- for which the sum of the labour and material cost shares is larger than 1 (i.e. the capital share is negative) or any of the labour or material cost share is smaller than 0;
- given small sample sizes in the first and the last years of the sample, we start the sample in 2006 and end in 2013;
- for countries represented by less than 500 firms in the total sample (AT, LU, LV, NL, UK);
- for countries for which the PMR indicator is only available in 2013 (BG, HR, RO, SI);
- for which we do not observe 8 consecutive years in the four key variables (turnover, total fixed assets, wage bill and material cost). We decide to conduct our analysis on a balanced panel in particular because our sample includes the years of the economic crisis and observing some firms before and some firms after the crisis could bias the results.

Applying these strict filters yields a sample of 12632 observations (1579 firms observed over 8 years in 13 EU countries[9] and the four available professional service sectors). In the Annex we report sample sizes of the cleaned data by year and for the four professional services sectors (engineering, accounting, architecture and legal services) available in the PMR database (see Table A1-A2). The tables show that the coverage varies strongly across countries and does not represent the relative weights of the member states correctly. Section 4.1 reports on sensitivity checks we conducted in this regard. Table A3 shows the average, minimum and maximum of the number of employees per firm. Summary statistics are shown in Tables A4. Note also that we winsorise the variables (based on the pooled dataset) in order to treat outliers properly (see Graphs A1 and A2).

[3] https://orbis.bvdinfo.com/
[4] https://www.oecd.org/eco/growth/indicatorsofproductmarketregulationhomepage.htm
[5] https://ec.europa.eu/info/business-economy-euro/indicators-statistics/economic-databases/macro-economic-database-ameco_en
[6] Missing values were replaced by flat extrapolation of the closest available value.
[7] Amadeus is a regional subset of Orbis; see http://www.bvdinfo.com/en-gb/our-products/company-information/international-products/orbis
[8] The download is carried out under the restriction of non-missing observations on the key indicators for turnover, total fixed assets, wage bill and material cost.
[9] BE, CZ, DE, EE, ES, FI, FR, HU, IT, PL, PT, SE, SK

3. METHODOLOGY

We apply a methodology for estimating mark-ups used in Thum-Thysen and Canton (2015), who extend a methodology developed in Roeger (1995). We follow Konings et al. (2011), Konings and Vandenbussche (2005) and Molnar and Bottini (2010), who also implement Roeger's (1995) methodology on firm-level data.

Roeger (1995) provides a method to compute mark-ups based on the idea that a positive difference between factor productivity and factor remuneration results from imperfect competition. In other words, producers extract rents by remunerating production factors below their productivity. This difference between factor productivity and factor remuneration can be pin-pointed by the primal (based on the production function) and dual (based on the cost function) productivity measures based on the Solow residual respectively. The difference between the primal and the dual Solow residual can be expressed by the net Solow residual.

To derive an expression of the net Solow residual as a function of a mark-up (see equation (11)) we proceed in line with Roeger (1995) and Thum-Thysen and Canton (2015): We assume a production technology[10] $Y_t = E_t F(K_t, L_t)$ in time t where Y_t is produced using the input factors capital K_t and labour L_t and E_t denotes technology. We also assume that the mark-up is a linear function of product market regulation denoted as PMR_t:

$$MUP_t = B(PMR_t) = b_0 + b_1 PMR_t \tag{1}$$

We then write down the relation between prices P_t, mark-ups MUP_t and marginal costs MC_t

$$\big(1 - B(PMR_t)\big)P_t = MC_t \tag{2}$$

Taking the total differential yields

$$\big(1 - B(PMR_t)\big)\Delta P_t - \frac{dB}{dPMR_t}\Delta PMR_t P_t = \big(1 - B(PMR_t)\big)\Delta P_t - b_1 \Delta PMR_t P_t = \Delta MC_t \tag{3}$$

Dividing by (2) yields and defining generically $\frac{\Delta Z_t}{Z_t} = \Delta z_t$:

$$\frac{\Delta P_t}{P_t} - \frac{b_1 \Delta PMR_t}{\big(1 - B(PMR_t)\big)} = \frac{\Delta MC_t}{MC_t} = \Delta mc_t \tag{4}$$

The difference in log marginal costs - Δmc_t - can be expressed as (see Roeger 1995:320)

$$\Delta mc_t = \left[\frac{W_t L_t}{C(.)}\right]\Delta w_t + \left[1 - \frac{W_t L_t}{C(.)}\right]\Delta r_t + \Delta e_t \tag{5}$$

Where L_t denotes labour input, W_t denotes wages, R_t denotes capital cost and $C(.)$ designates a cost function

[10] Note that we also add intermediate goods as input factor but drop this term for notational simplicity in the following exposé.

$$C(.) = C(W_t, R_t, Y_t) = \frac{\partial C_t}{\partial Y_t} Y_t = MC_t Y_t = \big(1 - B(PMR_t)\big) P_t Y_t \quad (6)$$

Where Y_t denotes output and P_t prices. Combining equations (4), (5) and (6) yields

$$\Delta p_t - \frac{b_1 \Delta PMR_t}{\big(1 - B(PMR_t)\big)} = \left[\frac{W_t L_t}{\big(1 - B(PMR_t)\big) P_t Y_t}\right] \Delta w_t + \left[1 - \frac{W_t L_t}{\big(1 - B(PMR_t)\big) P_t Y_t}\right] \Delta r_t + \Delta e_t$$

Multiplying with $\big(1 - B(PMR_t)\big)$ yields

$$\big(1 - B(PMR_t)\big)\Delta p_t - b_1 \Delta PMR_t = \frac{W_t L_t}{P_t Y_t} \Delta w_t + \left[\big(1 - B(PMR_t)\big) - \frac{W_t L_t}{P_t Y_t}\right] \Delta r_t + \big(1 - B(PMR_t)\big)\Delta e_t \quad (7)$$

Define

$$SRP_t = \frac{W_t L_t}{P_t Y_t} \Delta w_t + \left[1 - \frac{W_t L_t}{P_t Y_t}\right] \Delta r_t - \Delta p_t \quad (8)$$

SRP_t can be interpreted as the price-cost - or dual approach - Solow residual. We denote the labour shares $\frac{W_t L_t}{P_t Y_t}$ by α_L.

Using (8) to rewrite (7) yields

$$SRP_t = -B(PMR_t)(\Delta p_t - \Delta r_t) + b_1 \Delta PMR_t + \big(1 - B(PMR_t)\big)\Delta e_t \quad (9)$$

Subtracting equation (9) from the primal Solow Residual $SR_t = \Delta y_t - \alpha_L \Delta l_t - (1 - \alpha_L)\Delta k_t = B(\Delta y_t - \Delta k_t) + (1 - B(PMR_t))\Delta e_t$ (see Hall (1988) for this formulation of the primal Solow Residual) yields

$$SR_t - SRP_t = -B(PMR_t)\big(\Delta y_t + \Delta p_t - (\Delta k_t + \Delta r_t)\big) + b_1 \Delta PMR_t \quad (10)$$

Using equation (1) and adding an error term and the relevant subscripts we can re-write equation (10) per available professional service sector for firm i in country j at time t

$$NSR_{ijt} = \beta_0 D_j X_{ijt} + \beta_1 (X_{ijt} PMR_{jt} + \Delta PMR_{jt}) + \varepsilon_{ijt} \quad (11)$$

where $NSR_{ijt} = \big(\Delta y_{ijt} + \Delta p_{ijt}\big) - \alpha_{Lijt}\big(\Delta l_{ijt} + \Delta w_{ijt}\big) - \big(1 - \alpha_{Lijt}\big)\big(\Delta k_{ijt} + \Delta r_{ijt}\big)$ denotes the net Solow residual. The respective bracketed terms denote log differences (approximately growth rates) of nominal values of output and the input factors labour, capital and intermediate input. $X_{ijt} = \Big(\Delta y_{ijt} + \Delta p_{ijt} - \big(\Delta k_{ijt} + \Delta r_{ijt}\big)\Big)$ denotes capital productivity. β_0 denotes the mark-up. Finally ε_{ijt} denotes an iid error term.

For interpretation of β_1 as the effect of PMR_{jt} on Roeger's (1995) definition of the mark-up $\frac{\partial NSR_{ijt}}{\partial X_{ijt}}$, note that

$$\frac{\partial NSR_{ijt}}{\partial X_{ijt}} = \beta_0 + \beta_1 PMR_{jt}$$

$$\frac{\frac{\partial NSR_{ijt}}{\partial X_{ijt}}}{\partial PMR_{jt}} = \beta_1$$

Note also that the sectoral mark-ups per country and year are computed according to equation (1) as

$$MUP_{jt} = \beta_0 + \beta_1 PMR_{jt}$$

We estimate the model by using a least squares dummy variable (LSDV) approach with country-level fixed effects. It should be recalled that in Thum-Thysen and Canton (2015) a more efficient but also more restrictive econometric method was employed - namely the multilevel mixed model – as the macro data yielded a relatively small sample. The multilevel mixed model takes into account both the within-unit and the across-unit variation (similar to the random effects estimator) and allows avoiding loss in degrees of freedom but relies on independence assumptions. In the current analysis we use micro-data with a sufficient number of observations, and this allows us to use a less restrictive model specification. Indeed the LSDV estimator does not impose independence between random coefficients and regressors. The aim of the econometric work is to establish average mark-ups for sector-country combinations, as this indicator is most relevant from a policy perspective. As the regressions are estimated per sector, we therefore estimate country-specific slope effects. We add a control variable for the business cycle at the firm level[11]. Finally, we specify robust standard errors.

4. EMPIRICAL ANALYSIS

Table 4.1 shows the absolute and relative size in terms of value added of the four regulated professions based on Eurostat data. The largest sector in terms of value added is the engineering sector, followed by accounting and legal activities, while architecture has the smallest size. Engineering and accounting also have a reasonable coverage in the Orbis data, while fewer observations are available for architecture and legal activities (see Annex Table A1 and A2). We therefore decided to focus the econometric analysis on engineering and accounting.

Table 4.1. **Absolute and relative size of the four regulated professions**

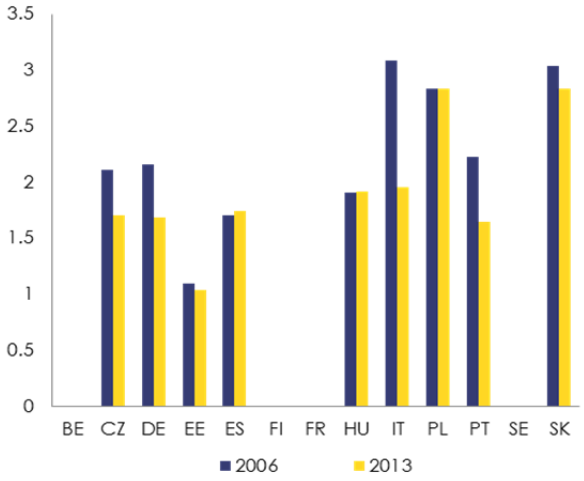
	share EU28 in 2013	value added EU28 in 2013
Engineering	36.58%	116931.5
Accounting	28.49%	91093.9
Legal	27.98%	89442.4
Architecture	6.95%	22231.6
Total	100.00%	319699.4

Source: Eurostat, Structural Business Statistics (SBS)

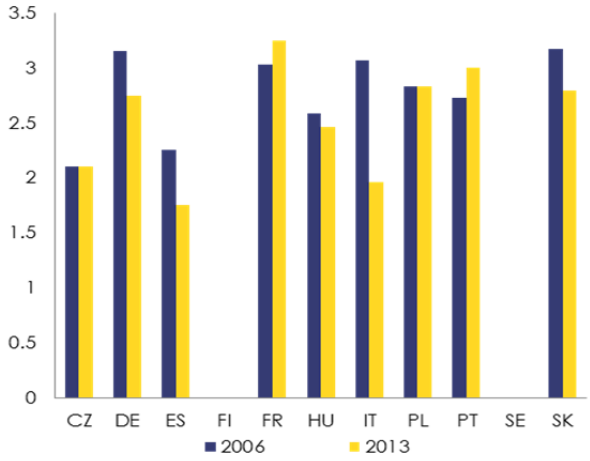
[11] Despite the relatively short time span, which complicates the use of panel variable techniques at the very lowest level of disaggregation (i.e. the firm in our case), we also estimated the model including firm-level fixed or random effects. The effect of the PMR remains significant in the case of the unbalanced panel but becomes insignificant in the case of the balanced panel. We tested whether the firm-level effects are needed based on the Breusch-Pagan test for random effects and a Wald test for fixed effects. The former test indicates that the random effects are not needed and the latter indicates that fixed effects are needed but only at a weak 5% level (i.e. the test statistic is 0.048 for the engineering sector).

Graphs 4.1-4.4 show the sectoral product market regulation (PMR) indicator for the four regulated professions for the last and first year of our sample period (i.e. 2013 and 2006). Notice that the PMR is published in 5 year intervals, so the 2006 data is retrieved from linear interpolation between the published values for 2003 and 2008. For the engineering sector (Graph 4.1) the PMR is zero for Belgium, Finland, France and Sweden (in both years). Still for the same sector, Poland and Slovakia show relatively strict product market regulation and only very modest reduction in restrictiveness between 2006 and 2013. The other countries in the sample (CZ, DE, EE, ES, HU, IT, PT) have a PMR indicator in the last year of observation between 1 and 2. For the accounting sector (Graph 4.3) it is found that Finland and Sweden have the least restrictive product market regulations in 2013, whereas stricter regulation is observed in Belgium, Poland and Portugal. In the remaining sectors (legal services, Graph 4.4; and architecture, Graph 4.2) Finland and Sweden are again the two countries with the lowest values of the PMR indicator in both years. Among the very small sample of countries for which the cleaned Orbis data is available for legal services Belgium and Spain are the countries with the highest value of the PMR indicator in 2013, whereas France and Portugal display the highest value of the PMR indictor in 2013 in the architectural sector.

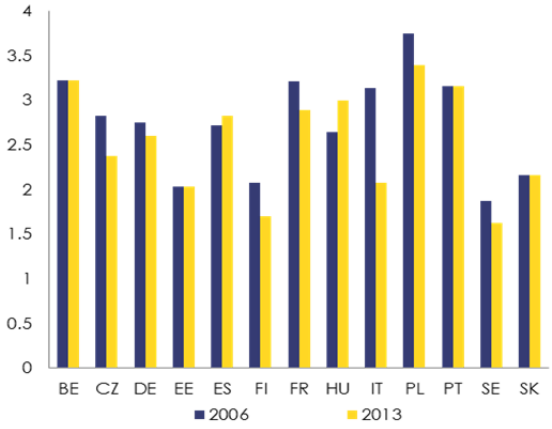
Graph 4.1 **OECD Product market regulation indicators – engineering**



Graph 4.2 **OECD Product market regulation indicators – architecture**



Graph 4.3 **OECD Product market regulation indicators – accounting**



Graph 4.4 **OECD Product market regulation indicators – legal services**

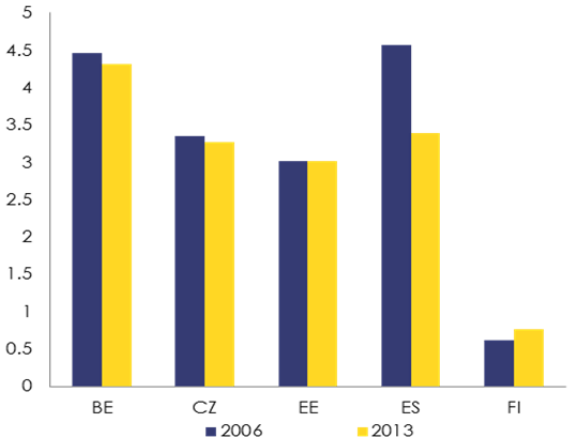


Table 4.2 shows the regression results for the engineering sector – based on an estimation of the parameters in equation (11) in section 3. The interpretation of the results presented in Table 4.2 is the following. The first regression (1) is the most basic one, where the coefficient of X denotes an estimate of the average mark-up in engineering in our sample of countries over time, i.e. a mark-up of 40%. Note that when comparing this estimate with the average of mark-ups based on a simple calculation as the ratio of turnover over the difference between turn-over and cost (see Graphs 4.5-4.8), we can see that our estimate is relatively close but has the advantage of being based on prices and marginal cost. This first model (1) also includes the growth rate of the firm's turnover as a control variable for the firm's business cycle[12], and this variable appears with a significantly positive regression coefficient.

In the second model (2) it is assumed that the mark-up is a function of the Product Market Regulation indicator (i.e. the PMR indicator for the engineering sector). This regression shows that an increase in the PMR by 1 point would correspond to an increase in mark-ups by about 5% point. This result is broadly in line with the results presented in Thum-Thysen and Canton (2015) using sectoral data (and with a more aggregated sectoral structure). These results are largely unchanged when country and year dummies are included, cf. model (3).

Models (4)-(9) present country-specific mark-ups. For example, the results in model (4) show that mark-ups in the engineering sector are relatively high in Hungary, Italy and Slovakia, and relatively low in Belgium, Spain and Sweden. Regression (4) is essentially the same model as (1), but now allowing for country-specific mark-ups. And regression (5) is essentially the same model as (2), but now allowing for country-specific mark-ups. The results in regression (5) confirm the finding that the PMR and mark-ups are positively associated.

In regression (6) we add firm size (measured by number of employees) as explanatory variable. The empirical results suggest that larger firms charge higher mark-ups. In regressions (7)-(9) we decompose the PMR for engineering into entry regulation and conduct regulation. When included simultaneously, only conduct regulation appears with a significant regression coefficient (cf. equation 7). This may be due to interdependencies between the two components. In regression (8) and (9) we include entry regulation and conduct regulation separately, and then we find evidence for a positive contribution to mark-ups for both components. The evidence for the positive influence of conduct regulation is more compelling though.

Table 4.3 shows the results for the accounting sector. Regression (1) again shows the most simple model, where an average mark-up across the sampled countries is estimated, and the firm's turnover growth is added as an additional control variable. This model suggests a mark-up level of about 43% in the accounting sector. In model (2) the estimated mark-up is allowed to vary with the PMR indicator. Also for this sector it is found that the PMR indicator is positively associated with the mark-up level. We find that an increase in the PMR by 1 point would correspond to an increase in mark-ups by about 5% point. This effect is in the same order of magnitude as for the engineering sector. This association between product market regulation and mark-ups is also found in regression (3) where country and year dummies are added, though its magnitude is somewhat lower. In models (4) and (5) country-specific mark-up levels are estimated. Model (4) does not allow the mark-up to vary with the PMR, whereas model (5) does allow for such a relationship. The obtained relationship between the PMR and the mark-up in model (5) is in the same order of magnitude as the effect reported in Thum-Thysen and Canton (2015). It should be noted that data coverage differs substantially across countries

[12] The growth rate of the firm's turnover enters the regression equation (see equation (11)) in the same way as the PMR indicator (i.e. it is multiplied by the variable X and adding its growth rate; see the derivations in section 3 for details). In order to capture the business cycle we employed an HP-filter to eliminate the trend in turnover growth. The cyclical part of the growth rate in turnover is also demeaned such that it does not need to be taken into account in the calculation of the mark-ups as it is seen as a simple control.

(see Table A1 and A2 in the annex), and therefore we did not pursue more data demanding regression analyses.

Table 4.2. **Linear regression analysis of the effect of product market regulations on mark-ups in the engineering sector**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
X	0.396***	0.356***	0.363***						
	(0.00688)	(0.00743)	(0.00801)						
X*PMR+DPMR		0.0509***	0.0466***		0.0886***	0.0762***			
		(0.00679)	(0.00690)		(0.0248)	(0.0274)			
X*entry_regulations+D_entry_regulations							0.0606	0.0672*	
							(0.0406)	(0.0406)	
X*conduct_regulations+D_conduct_regulations							0.0403***		0.0425***
							(0.0127)		(0.0127)
X*(HP_DTURN_demean)+D(HP_DTURN_demean)	0.0512***	0.0495***	0.0539***	0.0528***	0.0544***		0.0545***	0.0534***	0.0540***
	(0.00989)	(0.00968)	(0.00974)	(0.00826)	(0.00826)		(0.00825)	(0.00824)	(0.00827)
X*Belgium				0.267***	0.266***	0.234***	0.266***	0.267***	0.267***
				(0.0351)	(0.0352)	(0.0395)	(0.0352)	(0.0351)	(0.0352)
X*Czech Republic				0.395***	0.222***	0.222***	0.158	0.132	0.394***
				(0.0236)	(0.0519)	(0.0588)	(0.155)	(0.155)	(0.0236)
X*Germany				0.461***	0.303***	0.279***	0.288***	0.362***	0.373***
				(0.0329)	(0.0553)	(0.0707)	(0.0717)	(0.0685)	(0.0424)
X*Estonia				0.0551	-0.0407	0.00841	-0.0756	-0.0892	0.0544
				(0.116)	(0.118)	(0.0924)	(0.142)	(0.142)	(0.116)
X*Spain				0.240***	0.0870*	0.0560	0.0306	0.00785	0.240***
				(0.0255)	(0.0498)	(0.0593)	(0.143)	(0.142)	(0.0255)
X*Finland				0.335***	0.334***	0.320***	0.334***	0.335***	0.335***
				(0.0186)	(0.0186)	(0.0261)	(0.0186)	(0.0186)	(0.0186)
X*France				0.400***	0.400***	0.405***	0.400***	0.400***	0.400***
				(0.00867)	(0.00867)	(0.0216)	(0.00867)	(0.00867)	(0.00867)
X*Hungary				0.512***	0.346***	0.360***	0.290*	0.277*	0.501***
				(0.0463)	(0.0661)	(0.0744)	(0.150)	(0.151)	(0.0464)
X*Italy				0.644***	0.424***	0.457***	0.364**	0.381**	0.599***
				(0.0148)	(0.0628)	(0.0711)	(0.159)	(0.160)	(0.0194)
X*Poland				0.424***	0.173**	0.251***	0.0802	0.0430	0.424***
				(0.0432)	(0.0827)	(0.0872)	(0.234)	(0.234)	(0.0432)
X*Portugal				0.395***	0.226***	0.214***	0.169	0.154	0.385***
				(0.0276)	(0.0546)	(0.0624)	(0.148)	(0.148)	(0.0276)
X*Sweden				0.258***	0.257***	0.260***	0.257***	0.257***	0.257***
				(0.0195)	(0.0195)	(0.0270)	(0.0195)	(0.0195)	(0.0195)
X*Slovakia				0.518***	0.255**	0.266**	0.162	0.130	0.511***
				(0.0615)	(0.101)	(0.107)	(0.247)	(0.247)	(0.0614)
X*(log_EMPL)+D(log_EMPL)						0.0118*			
						(0.00623)			
Country dummies	no	no	yes	no	no	no	no	no	no
Year dummies	no	no	yes	no	no	no	no	no	no
Observations	6,356	6,356	6,356	6,356	6,356	4,713	6,356	6,356	6,356
R-squared	0.696	0.709	0.714	0.740	0.741	0.733	0.741	0.740	0.741

Robust standard errors in parentheses

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

Source: Own calculations on the basis of the EUKLEMS database and the OECD's Product Market Regulation indicator database

Table 4.3. **Linear regression analysis of the effect of product market regulations on mark-ups in the accounting sector**

	(1)	(2)	(3)	(4)	(5)
X	0.426***	0.285***	0.323***		
	(0.00840)	(0.0373)	(0.0552)		
X*PMR+DPMR		0.0515***	0.0385**		0.0293*
		(0.0133)	(0.0194)		(0.0150)
X*entry_regulations+D_entry_regulations					
X*conduct_regulations+D_conduct_regulations					
X*(HP_DTURN_demean)+D(HP_DTURN_demean)	0.0266	0.0294	0.0294	0.0261	0.0270
	(0.0183)	(0.0180)	(0.0183)	(0.0196)	(0.0194)
X*Belgium				0.482***	0.387***
				(0.0385)	(0.0618)
X*Czech Republic				0.361***	0.287***
				(0.0333)	(0.0472)
X*Germany				0.0716***	-0.00433
				(0.0173)	(0.0408)
X*Estonia				0.363***	0.304***
				(0.0341)	(0.0470)
X*Spain				0.302***	0.219***
				(0.0282)	(0.0506)
X*Finland				0.360***	0.308***
				(0.0228)	(0.0349)
X*France				0.398***	0.309***
				(0.0103)	(0.0457)
X*Hungary				0.590***	0.502***
				(0.0583)	(0.0734)
X*Italy				0.479***	0.401***
				(0.0130)	(0.0408)
X*Poland				0.773***	0.669***
				(0.0382)	(0.0656)
X*Portugal				0.365***	0.273***
				(0.0448)	(0.0651)
X*Sweden				0.275***	0.226***
				(0.0330)	(0.0410)
X*Slovakia				0.447***	0.383***
				(0.0260)	(0.0415)
X*(log_EMPL)+D(log_EMPL)					
Country dummies	no	no	yes	no	no
Year dummies	no	no	yes	no	no
Observations	3,654	3,654	3,654	3,654	3,654
R-squared	0.801	0.805	0.807	0.826	0.827

Robust standard errors in parentheses

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

Source: Own calculations on the basis of the EUKLEMS database and the OECD's Product Market Regulation indicator database

We find that in the two analysed sectors (engineering and accounting) mark-ups are generally higher than in Thum-Thysen and Canton (2015). One reason could be that the Orbis data suffers from a bias due to the exclusion of very small firms, and some evidence for a positive association between firm

size and mark-ups for the engineering sector has been shown in regression (6). Furthermore, this may also be due to a more granular sectoral definition, only covering regulated professions, where firms can gain market power and charge higher mark-ups. Finally, a better matching of the sectors across the OECD PMR data and the Orbis firm-level database may change results with respect to the findings obtained based on the EUKLEMS/WIOD data.

Data availability is an even more pressing issue in case of architecture and the legal sector. We therefore want to put more emphasis on the results for engineering and accounting. Also, as shown in Table 4.1 above, the engineering and accounting sector together represent more than 50% of the total share of the four regulated professions. For architecture (Table 4.4) and the legal sector (Table 4.5) we only find a positive association between the PMR and the mark-up level in the regressions without country-specific estimates for the mark-ups (i.e. models (1)-(3)).

Table 4.4. **Linear regression analysis of the effect of product market regulations on mark-ups in the architecture sector**

	(1)	(2)	(3)
X	0.453***	0.322***	0.333***
	(0.0205)	(0.0346)	(0.0423)
X*PMR+DPMR		0.0536***	0.0513***
		(0.0127)	(0.0154)
X*(HP_DTURN_demean)+D(HP_DTURN_demean)	0.108***	0.104***	0.111***
	(0.0182)	(0.0186)	(0.0189)
Country dummies	no	no	yes
Year dummies	no	no	yes
Observations	574	574	574
R-squared	0.781	0.791	0.803

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: Own calculations on the basis of the EUKLEMS database and the OECD's Product Market Regulation indicator database

Table 4.5. **Linear regression analysis of the effect of product market regulations on mark-ups in the legal services sector**

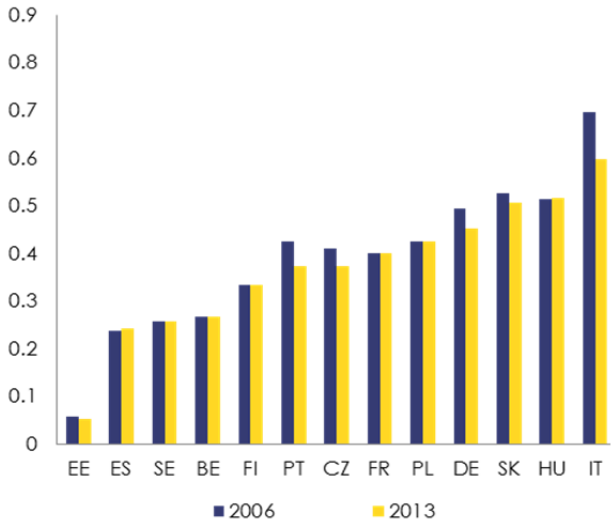
	(1)	(2)	(3)
X	0.552***	0.335***	0.345***
	(0.0251)	(0.0515)	(0.0516)
X*PMR+DPMR		0.0755***	0.0738***
		(0.0198)	(0.0206)
X*(HP_DTURN_demean)+D(HP_DTURN_demean)	0.0999***	0.112***	0.119***
	(0.0236)	(0.0227)	(0.0258)
Country dummies	no	no	yes
Year dummies	no	no	yes
Observations	469	469	469
R-squared	0.840	0.862	0.869

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

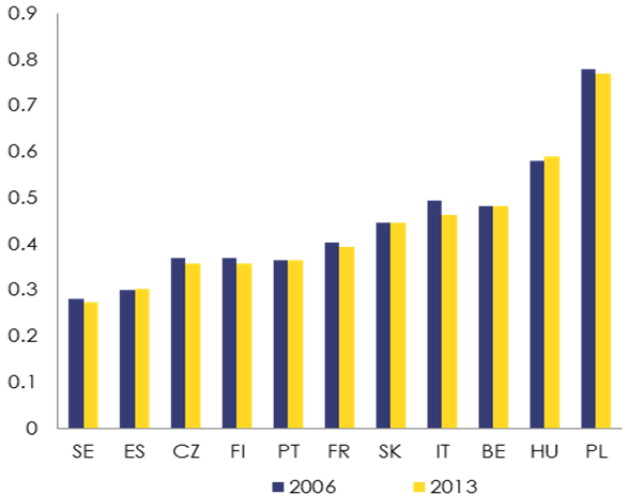
Source: Own calculations on the basis of the EUKLEMS database and the OECD's Product Market Regulation indicator database

Graphs 4.5-4.6 show the estimates of mark-ups resulting from our regression analysis for the engineering and the accounting sector. Hungary, Poland, Slovakia and Italy show up on the high side both in the engineering and in the accounting sector. These findings confirm the findings in Thum-Thysen and Canton (2015) for the professional services sector in the cases of Hungary, Poland and Slovakia. Italy shows up in the middle of the distribution in Thum-Thysen and Canton (2015). Sweden and Spain show up on the low side in both the engineering and the accounting sector. For Sweden the results confirm the findings in Thum-Thysen and Canton (2015) for the professional services. As mentioned above, differences in the present analysis and the analysis in Thum-Thysen and Canton (2015) could stem from the fact that the latter were not able to perfectly match the sectors reported in the OECD's PMR data with the sectors reported in the EUKLEMS database. When comparing our estimates with mark-ups defined as the normalised difference between turnover and costs (see Graphs 4.7-4.8), we see that the differences are not large in terms of the country rankings in both sectors but have the advantage of being computed on the basis of prices and marginal costs.

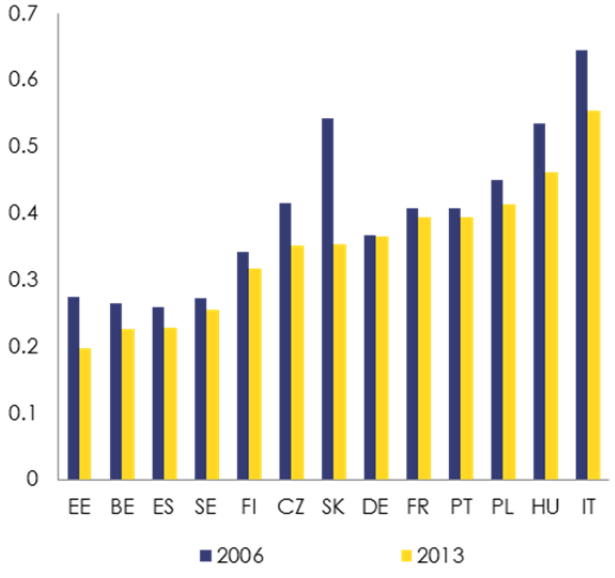
Graph 4.5 **Mark-up estimates as $MUP_t = \beta_0 + \beta_1 PMR_t$ in 2006 and 2013 (specification (5)) – engineering**



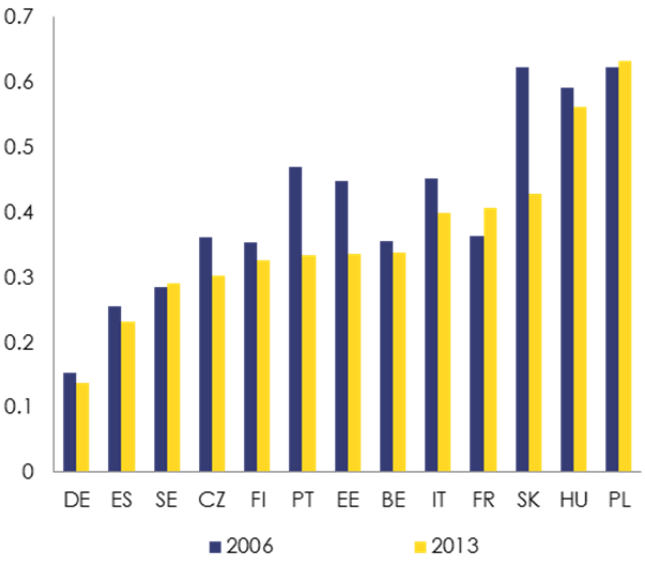
Graph 4.6 **Mark-up estimates as $MUP_t = \beta_0 + \beta_1 PMR_t$ in 2006 and 2013 (specification (5)) – accounting**



Graph 4.7 **Mark-ups defined as (turnover-costs)/turnover in 2006 and 2013– engineering**



Graph 4.8 **Mark-ups defined as (turnover-costs)/turnover in 2006 and 2013 – accounting**



4.1. SENSITIVITY CHECKS

Firstly, we ran our regressions without countries with less than 40 observations and find similar results for most sectors. For the architectural services sector we get weaker results but still pointing in the same direction.

We also tested our results against using an unbalanced instead of a balanced panel (see Annex Tables A5-A8). The results do not differ much. For example, in case of engineering the estimated country-specific mark-ups are broadly in line with the findings reported in Table 4.2, whereas the estimated relationship between the PMR and the mark-ups is much stronger in the preferred equation (model (5)). The relationship between product market regulation and mark-ups reported for the accounting sector in the preferred model (5) is more in line with the results found when using the balanced panel.

Furthermore, to address our problem of small samples in particular for some countries, we ran regressions where we weight the observations by the relative size of the populations in the included countries. This somewhat strengthened our results for the engineering sector, in the sense that in the weighted regressions we now find positive and significant regression coefficients both for the sectoral PMR indicator and for the model in which its two sub-components related with entry and conduct regulation are simultaneously included (regression (7)). However, for the accounting sector the effect of PMR on mark-ups is weakened (more specifically, significance of the coefficient of the sectoral PMR is retained only for regression (5)).

5. CONCLUSION

This paper investigates the relationship between product market regulation and mark-ups. It follows the approach in Thum-Thysen and Canton (2015), but here we use micro data from Orbis instead of sectoral data. The advantage of micro data is that we can make a better match in terms of the sectoral classification between the Orbis data and the data on product market regulation from the OECD. However, the Orbis data also have their limitations in terms of coverage. In fact we could only carry out the econometric analysis for 13 EU member states, and the samples for architecture and legal activities are relatively limited. We therefore concentrate on the engineering and accounting sectors. We have chosen an econometric specification where the average impact of changes in the PMR on mark-ups is estimated. With regard to mark-up levels, we have estimated specifications with an average mark-up across the sample and specifications where we allow the mark-up to be country-specific. Our preferred model allows for country-specific mark-ups.

A general conclusion from our analysis is that there is evidence for a relationship between product market regulations and mark-ups also based on firm-level data. The estimated relationship between product market regulation and mark-ups is in the same order of magnitude as was found in Thum-Thysen and Canton (2015), but the estimated mark-up levels are higher. A reason for these higher mark-up levels could be that we use Orbis data which enables us to estimate mark-ups for narrowly defined sectors, which are typically exposed to regulation. Another reason is sample selection bias, in the sense that small firms are underrepresented in the Orbis data base. A first inspection of this explanation for the engineering sector (through adding size of the firm as an additional control in the regression framework) reveals that indeed the larger firms tend to be able to charge higher mark-ups, so that sample selection bias can indeed play a role when interpreting the results.

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ANNEX I: DESCRIPTIVE STATISTICS

Table A.1: **Number of observations per sector and country**

	Engineering	Accounting	Architecture	Legal
BE	144	64		48
CZ	552	312	88	56
DE	384	16	16	
EE	72	8		48
ES	456	296	16	24
FI	776	144	64	72
FR	3,080	1,144	280	40
HU	160	88	8	
IT	616	1864	8	104
PL	160	64	96	128
PT	120	40	8	
SE	632	96	32	16
SK	112	40	40	
Total	7,264	4,176	656	536

Table A.2: **Number of firms per sector and country**

	Engineering	Accounting	Architecture	Legal
BE	18	8		6
CZ	69	39	11	7
DE	48	2	2	
EE	9	1		6
ES	57	37	2	3
FI	97	18	8	9
FR	385	143	35	5
HU	20	11	1	
IT	77	233	1	13
PL	20	8	12	16
PT	15	5	1	
SE	79	12	4	2
SK	14	5	5	
Total	908	522	82	67

Table A.3: **Firm sizes per sector**

Sector	Mean	Min	Max
Accounting	153.2804	1	5306
Architect	71.14706	1	2498
Engineer	132.2374	1	9904
Legal	71.38747	1	1750

Tables A.4: **Summary statistics**

Table A.4.a: **Engineering**

Variable	Observations	Mean	Std. Dev.	Min	Max
turnover growth	7,264	0.0678942	0.2651785	-0.8795204	3.233488
int. input growth	7,264	0.0733649	0.4242323	-0.8986371	4.929999
labour growth	7,264	0.0757531	0.2077554	-0.8875337	3.47297
capital growth	7,264	0.0304462	0.4953138	-0.8974249	4.656468
labour share	7,264	0.3488673	0.176507	0.0027036	0.9557517
int. input share	7,264	0.2613753	0.226255	0.0000246	0.9608749
capital share	7,264	0.3897574	0.1864809	0.0036338	0.9731927
X	7,264	0.0389354	0.5029893	-2.55973	1.797885
Y	7,264	-0.0015443	0.2522131	-1.456116	1.119252
PMR_intra	7,264	0.7634934	1.05278	0	3.083333

Table A.4.b: **Accounting**

Variable	Observations	Mean	Std. Dev.	Min	Max
turnover growth	4,176	0.0477601	0.2108091	-0.8004224	7.888761
int. input growth	4,176	0.0213373	0.3880449	-0.8994887	9.041642
labour growth	4,176	0.0573937	0.1807889	-0.7646061	3.49735
capital growth	4,176	0.0463273	0.5125266	-0.8918605	8.21118
labour share	4,176	0.507069	0.1935726	0.0084776	0.9439731
int. input share	4,176	0.0854446	0.1849045	0.0002108	0.9493312
capital share	4,176	0.4074864	0.1747386	0.0027035	0.9882212
X	4,176	0.0052114	0.4574108	-2.55973	1.797885
Y	4,176	-0.0041956	0.2224995	-1.456116	1.119252
PMR_intra	4176	2.750847	0.4269418	1.625	3.75

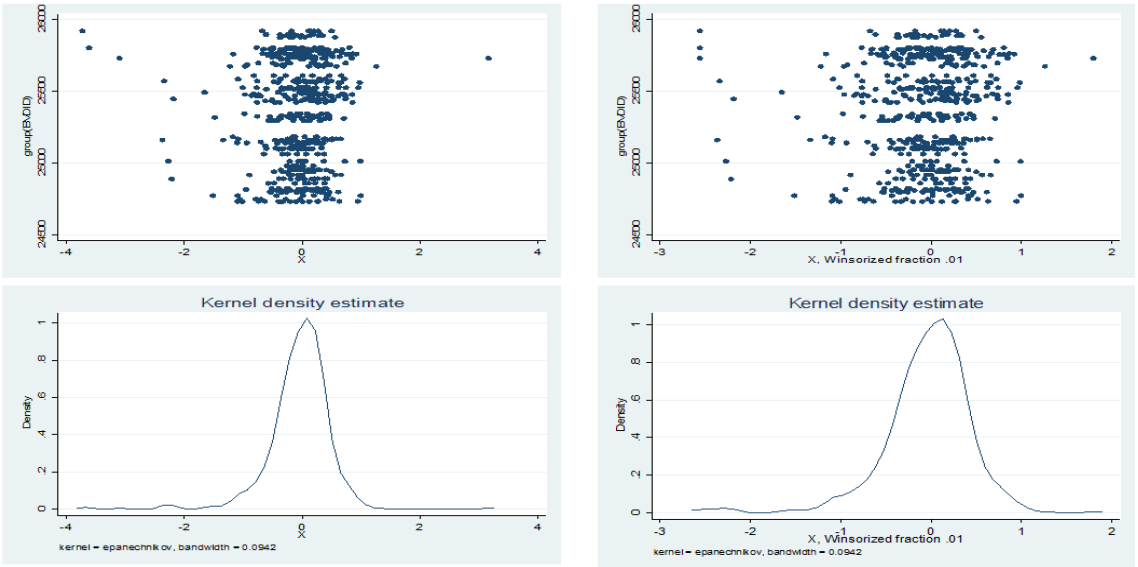
Table A.4.c: **Architecture**

Variable	Observations	Mean	Std. Dev.	Min	Max
turnover growth	656	0.0480982	0.2839893	-0.8781799	1.386782
int. input growth	656	0.0353577	0.4016347	-0.8773087	1.98508
labour growth	656	0.0573589	0.193222	-0.7476109	1.019264
capital growth	656	0.0020949	0.5502884	-0.8970642	3.295145
labour share	656	0.4079709	0.2056603	0.0272896	0.8478942
int. input share	656	0.143839	0.2217101	0.0006073	0.9103551
capital share	656	0.4481902	0.2056741	0.0115064	0.8935375
X	656	0.0474826	0.5468819	-2.55973	1.797885
Y	656	0.0098909	0.3033822	-1.456116	1.119252
PMR_intra	656	2.480291	1.103824	0	3.3125

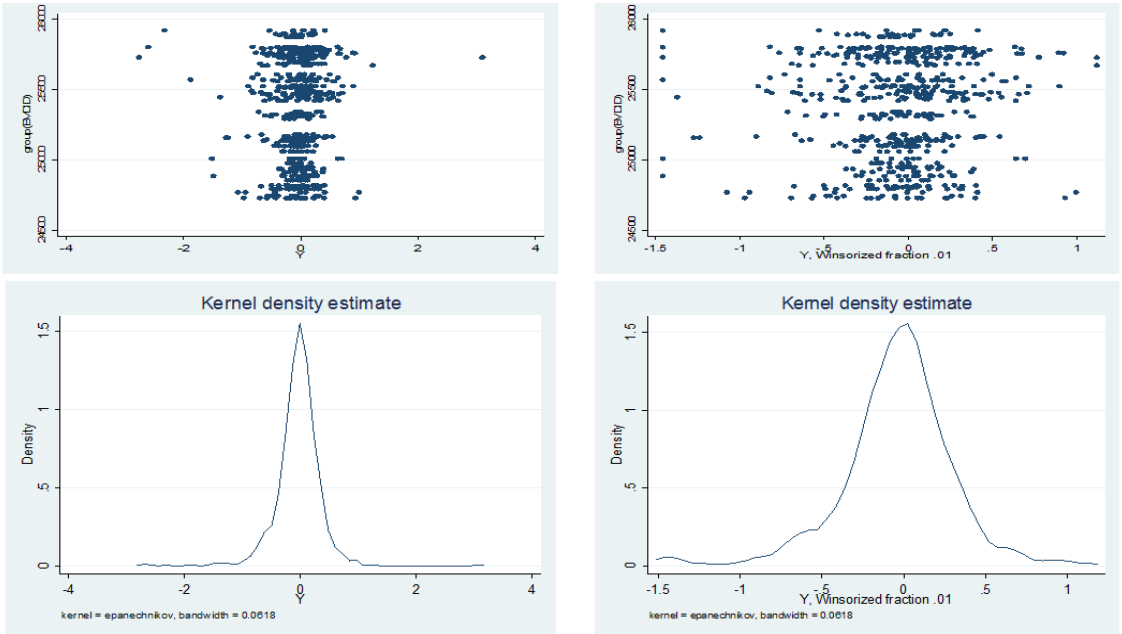
Table A.4.d: **Legal services**

Variable	Observations	Mean	Std. Dev.	Min	Max
turnover growth	536	0.0532954	0.196425	-0.6872221	1.197866
int. input growth	536	0.034693	0.3378266	-0.8472978	1.537183
labour growth	536	0.0787678	0.2575499	-0.7275361	2.730029
capital growth	536	0.0398961	0.6540703	-0.8971456	4.656734
labour share	536	0.2520117	0.156265	0.0004233	0.6946252
int. input share	536	0.1363281	0.2279426	0.0005696	0.9758001
capital share	536	0.6116602	0.2528966	0.0147277	0.9681145
X	536	0.0265646	0.5718617	-2.55973	1.184308
Y	536	0.0165941	0.3526353	-1.456116	1.027519
PMR_intra	536	3.07507	1.145638	0.5625	4.570833

Graphs A1: **Winsorising X for the engineering sector in Italy**



Graphs A2: **Winsorising Y for the engineering sector in Italy**



ANNEX II: ROBUSTNESS CHECKS - UNBALANCED PANEL[13]

Table A.5: **Linear regression analysis of the effect of PMR on mark-ups in the engineering sector; unbalanced panel**

	(1)	(2)	(3)	(4)	(5)
X	0.395***	0.357***	0.366***		
	(0.00359)	(0.00475)	(0.00489)		
X*PMR+DPMR		0.0358***	0.0308***		0.147***
		(0.00351)	(0.00356)		(0.0202)
X*(DTURN_demean)+D(DTURN_demean)	0.0201***	0.0178***	0.0188***	0.0160***	0.0161***
	(0.00413)	(0.00412)	(0.00413)	(0.00408)	(0.00406)
X*Belgium				0.346***	0.346***
				(0.0391)	(0.0391)
X*Czech Republic				0.393***	0.109***
				(0.0132)	(0.0407)
X*Germany				0.482***	0.225***
				(0.0162)	(0.0394)
X*Estonia				0.213***	0.0564
				(0.0470)	(0.0518)
X*Spain				0.263***	0.00911
				(0.00852)	(0.0357)
X*Finland				0.357***	0.357***
				(0.0146)	(0.0146)
X*France				0.432***	0.432***
				(0.00612)	(0.00612)
X*Hungary				0.604***	0.329***
				(0.0234)	(0.0443)
X*Italy				0.582***	0.229***
				(0.0128)	(0.0501)
X*Poland				0.533***	0.117*
				(0.0216)	(0.0609)
X*Portugal				0.441***	0.160***
				(0.0207)	(0.0446)
X*Sweden				0.278***	0.278***
				(0.00833)	(0.00833)
X*Slovakia				0.516***	0.0866
				(0.0232)	(0.0646)
Country dummies	no	no	yes	no	no
Year dummies	no	no	yes	no	no
Observations	24,725	24,725	24,725	24,725	24,725
R-squared	0.594	0.600	0.607	0.633	0.634

Robust standard errors in parentheses

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

[13] Note that - as we would need series without gaps for the HP-filter and we considered the amount of missing values too large for interpolation - in the tables below we base the control variable for the business cycle on the turnover series.

Table A.6: **Linear regression analysis of the effect of PMR on mark-ups in the accounting sector; unbalanced panel**

	(1)	(2)	(3)	(4)	(5)
X	0.422***	0.256***	0.275***		
	(0.00567)	(0.0311)	(0.0362)		
X*PMR+DPMR		0.0614***	0.0547***		0.0441***
		(0.0111)	(0.0129)		(0.0148)
X*(DTURN_demean)+D(DTURN_demean)	-0.000252	-0.000105	-0.000702	-0.000157	-0.000452
	(0.00990)	(0.00977)	(0.00982)	(0.00977)	(0.00975)
X*Belgium				0.263*	0.121
				(0.143)	(0.151)
X*Czech Republic				0.363***	0.254***
				(0.0153)	(0.0396)
X*Germany				0.187***	0.0723
				(0.0534)	(0.0659)
X*Estonia				0.295***	0.205***
				(0.0406)	(0.0506)
X*Spain				0.404***	0.280***
				(0.0150)	(0.0443)
X*Finland				0.331***	0.250***
				(0.0239)	(0.0354)
X*France				0.435***	0.299***
				(0.00748)	(0.0459)
X*Hungary				0.446***	0.314***
				(0.0447)	(0.0628)
X*Italy				0.498***	0.383***
				(0.0120)	(0.0412)
X*Poland				0.505***	0.348***
				(0.0284)	(0.0595)
X*Portugal				0.333***	0.193**
				(0.0711)	(0.0851)
X*Sweden				0.290***	0.217***
				(0.0280)	(0.0375)
X*Slovakia				0.474***	0.378***
				(0.0373)	(0.0493)
Country dummies	no	no	yes	no	no
Year dummies	no	no	yes	no	no
Observations	10,508	10,508	10,508	10,508	10,508
R-squared	0.690	0.694	0.697	0.705	0.706

Robust standard errors in parentheses

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

Table A.7: **Linear regression analysis of the effect of PMR on mark-ups in the architecture sector; unbalanced panel**

	(1)	(2)	(3)	(4)	(5)
X	0.478***	0.306***	0.316***		
	(0.0104)	(0.0227)	(0.0237)		
X*PMR+DPMR		0.0774***	0.0725***		0.300***
		(0.00857)	(0.00896)		(0.0685)
X*(DTURN_demean)+D(DTURN_demean)	0.0343***	0.0331***	0.0391***	0.0335***	0.0373***
	(0.0123)	(0.0118)	(0.0119)	(0.0120)	(0.0115)
X*Belgium				0.576***	-0.130
				(0.0579)	(0.171)
X*Czech Republic				0.427***	-0.206
				(0.0277)	(0.146)
X*Germany				0.484***	-0.388*
				(0.0822)	(0.218)
X*Estonia				0.156***	-0.161**
				(0.0287)	(0.0772)
X*Spain				0.449***	-0.151
				(0.0261)	(0.142)
X*Finland				0.421***	0.420***
				(0.0264)	(0.0264)
X*France				0.547***	-0.428*
				(0.0149)	(0.222)
X*Hungary				0.652***	-0.0800
				(0.0716)	(0.182)
X*Italy				0.748***	0.0361
				(0.0518)	(0.171)
X*Poland				0.582***	-0.270
				(0.0297)	(0.196)
X*Portugal				0.665***	-0.230
				(0.0416)	(0.209)
X*Sweden				0.258***	0.257***
				(0.0337)	(0.0338)
X*Slovakia				0.495***	-0.389*
				(0.0363)	(0.208)
Country dummies	no	no	yes	no	no
Year dummies	no	no	yes	no	no
Observations	2,786	2,786	2,786	2,786	2,786
R-squared	0.682	0.699	0.713	0.707	0.712

Robust standard errors in parentheses

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

Table A.8: **Linear regression analysis of the effect of PMR on mark-ups in the legal services sector; unbalanced panel**

	(1)	(2)	(3)	(4)	(5)
X	0.543***	0.337***	0.356***		
	(0.0116)	(0.0290)	(0.0321)		
X*PMR+DPMR		0.0559***	0.0501***		0.147***
		(0.00897)	(0.00981)		(0.0357)
X*(DTURN_demean)+D(DTURN_demean)	0.0459**	0.0640***	0.0630***	0.0532**	0.0747***
	(0.0188)	(0.0235)	(0.0231)	(0.0218)	(0.0221)
X*Belgium				0.337***	-0.303*
				(0.0513)	(0.160)
X*Czech Republic				0.561***	0.0746
				(0.0376)	(0.122)
X*Germany				0.371***	-0.133
				(0.0217)	(0.133)
X*Estonia				0.458***	0.0106
				(0.0294)	(0.112)
X*Spain				0.483***	-0.0862
				(0.0228)	(0.142)
X*Finland				0.489***	0.371***
				(0.0306)	(0.0407)
X*France				0.469***	-0.00682
				(0.0168)	(0.116)
X*Hungary				0.467***	-0.245
				(0.0338)	(0.175)
X*Italy				0.631***	0.194*
				(0.0360)	(0.107)
X*Poland				0.764***	0.186
				(0.0178)	(0.140)
X*Portugal				0.285***	0.188***
				(0.0318)	(0.0358)
X*Slovakia				0.734***	
				(0.0323)	
Country dummies	no	no	yes	no	no
Year dummies	no	no	yes	no	no
Observations	2,294	2,199	2,199	2,294	2,199
R-squared	0.778	0.773	0.778	0.823	0.811

Robust standard errors in parentheses

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

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