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SERVICE REGULATION AND GROWTH: EVIDENCE FROM OECD COUNTRIES*

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We study the effects of anti-competitive service regulation by examining whether OECD countries with less anti-competitive regulation see better economic performance in manufacturing industries that use less-regulated services more intensively. Our results indicate that lower service regulation increases value added, productivity and export growth in downstream service-intensive industries. The regulation of professional services and energy provision has particularly strong negative growth effects. Our estimates are robust to accounting for alternative forms of regulation (i.e. product and labour market regulation), alternative measures of financial development and a range of other specification checks.

Do countries with less anti-competitive service regulation perform better economically? Policy makers appear to think so, as regulatory barriers have fallen in many countries, and their position is generally supported by a large empirical literature looking at the effects of entry barriers, red-tape costs or legal requirements on economic performance. Much of this literature examines the effects of regulation on the performance of the regulated sector. Less is known about the impacts on downstream manufacturing activities, which is surprising as regulation affects many key service inputs.

In this article, we study how regulation in the supply of a variety of services affects the economic performance of downstream manufacturing industries. We do so by examining whether countries with less service regulation see faster value added, productivity and export growth in manufacturing industries using services more intensively (this methodology was pioneered for financial services by Rajan and Zingales, 1998). We measure service dependence across manufacturing industries using input–output account matrices. Our measures of service regulation are OECD indicators designed to capture anti-competitive regulatory settings for the energy sector (electricity and gas), the telecommunication and the transportation sectors and for professional services. These account for barriers to entry, for the integration between *a priori* competitive activities and natural monopolies (in the case of energy) and for the existence of restrictions on prices and fees, advertising or the form of business (in professional services).

Our empirical findings indicate that lower service regulation has non-negligible positive effects on the value added, productivity and export growth rates of service-intensive users. To get a sense for the size of the regulation effect, consider the annual value-added growth differential between an industry at the 75th percentile (Pulp, paper

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and printing) relative to one at the 25th percentile (Fabricated metal products) of the distribution of service dependence. Our estimates imply that this differential is 0.7–1 percentage point higher in a country with average regulation at the 25th percentile (as Canada) than in a country at the 75th percentile (as France) of the distribution of service regulation. We find this effect is mainly driven by regulation in energy and in professional services. Also, the average effect is driven by larger economies in the sample. The results are not sensitive to how we account for other forms of regulation (i.e. product and labour market regulation) and prove robust to a number of specification checks.

Our findings have important implications for the ongoing debate surrounding service deregulation. In particular, our estimates imply that the strongest gains from deregulation would come from specific policies such as the removal of conduct regulation (i.e. of restrictions to price and tariff setting) by professions, or the complete separation of ownership between energy generation and other segments of the industry (the so-called 'unbundling'). Both measures are among those ranking highest in the current EU competition policy agenda and in policy recommendations by international organisations.[1]

Research on the economic effects of regulation has grown in recent years, in part because of the increased availability of comparable cross-country data. Empirical work has focused mainly on the *direct* effects of regulation on the regulated sector or stage of business development. Economy-wide restrictions such as barriers to entry have been shown to hamper economy-wide entrepreneurship by stifling growth in the number of firms (Klapper *et al.*, 2006), by increasing industry concentration (Fisman and Sarria-Allende, 2004) and by reducing responsiveness to global demand and technology shifts (Ciccone and Papaioannou, 2007). Sector-specific restrictions, such as those prevailing in utilities and services, have been shown to decrease investment (Alesina *et al.*, 2005), employment (Bertrand and Kramartz, 2002) and to increase prices (Martin *et al.*, 2005) in the regulated sectors. Yet, regulation may also have relevant *indirect* effects on the allocation of resources among downstream industries, in particular when affecting the production of key non-tradable inputs.

In theoretical models of industry interdependence, the under-development of markets for non-tradable inputs has been shown to constrain (or even prevent) the diffusion of input-intensive technologies, thus affecting the patterns of resource allocation and international specialisation (Okuno-Fujiwara, 1988; Rodriguez-Clare, 1996). Empirical research into the relationship between upstream markets development and the allocation of resources across downstream industries has, however, been largely confined to the case of finance.

Rajan and Zingales (1998) test of the finance-growth nexus using country-industry data represents a major contribution to this literature. The authors exploit industry

[1] The reduction and harmonisation of legal and administrative barriers is the main goal of the recent EU Services Directive, implemented at the end of 2009 and motivated by the concern for the knock-on effects that barriers in services may trigger 'given the integration of services into manufacturing'. The Third Legislative Package on Energy Markets is a controversial recent set of Directives by the Commission, promoting the unbundling of network operation from supply and generation in energy. Similarly, the OECD recently recommended revising the energy regulatory framework in most member countries and indicated the liberalisation of professional services as a priority policy area for six European countries (including France, Germany and Italy), and Canada (OECD, 2009, *Going for Growth*).

heterogeneity in financial dependence (i.e. the need for external funds) to show that in countries with better developed financial markets, financially dependent industries experience faster value-added growth than less dependent industries. Their findings, confirmed by many subsequent studies, point to financial development as one relevant determinant of the patterns of international specialisation. One contribution of our work is to show that the growth effects of service regulation can be just as large. As in the case of finance studies, our main explanatory variable is obtained as the interaction of an industry characteristic (service dependence) with a country characteristic (service regulation). The coefficient for this variable measures whether countries with lower service regulation grow relatively more in industries that depend more intensively on regulated services. Following Rajan and Zingales, we use country and industry-fixed effects to deal with various concerns arising in standard growth analysis (e.g. reverse causation and omitted variables).

By highlighting the relevance of service regulation for both value added and export growth our work closely relates to a growing literature on the relevance of institutions and policies for resource allocation and comparative advantages. Recent works focused on the ability to enforce written contracts. Nunn (2007) showed that countries with better contract enforcement specialise in contract intensive industries, those for which relationship-specific investment is more important. Levchenko (2007) found these countries also tend to export goods that, by requiring a large variety or range of inputs, are more institutionally dependent. In an earlier contribution, Claessens and Laeven (2003) explored the nexus between property rights protection and growth in industries that are more intensive in intangible assets, whose returns are more exposed to the actions of competitors. Looking at labour market institutions, Caballero *et al.* (2006) found that, in countries with strong rule of law, higher job security is associated with slower adjustment to shocks and lower productivity growth. Cuñat and Melitz (2007) found that countries with light regulation of employment relationships specialise in high-volatility industries. Against this background, our results emphasise the role of regulatory settings that are on top of competition policy agendas.

Two recent papers combined indexes of service regulation with input–output coefficients to estimate the impact of regulation and productivity growth (Conway *et al.*, 2006; Arnold *et al.*, 2008). Differently from our study, they focus on the relevance of regulation for the transfer of technology to firms behind the productivity frontier, estimated exploiting the time-series relationship between productivity in frontier and non-frontier countries. Their results indicate that regulation significantly slows technology transfers and suggest that this happens, in particular, because it increases the costs of absorbing new technologies (as ICTs). Our interest on the patterns of specialisation and trade requires that we focus on different specifications and outcomes. In line with the literature of reference, we also employ a different measure of regulatory impact (both papers use the recently issued OECD Regulation Impact Indicators (*RII*), see Conway and Nicoletti, 2006). As we will see, such change turns out to have relevant empirical implications.[2]

[2] Three other papers used input–output linkages to study the consequences of upstream markets inefficiencies but focused on specific countries. Allegra *et al.* (2004) looked at competition problems (as measured by the number of anti-trust cases) and exports in Italian manufactures. Faini *et al.* (2006) focused on the link between regulation of network industries and productivity growth in Germany, Italy and the UK. Arnold *et al.* (2007) showed that barriers to FDI in services slowed TFP growth by Czech manufacturing firms.

Our results indicate that service efficiency matters for growth even in a restricted sample of high-income countries, for which the relationship between financial development and growth has previously been shown to be weak (Manning, 2003). We argue that this difference can be traced to our use of value-added data at constant rather than current prices. To illustrate the point we use a simple theoretical framework in which countries produce differentiated goods and lower regulation raises output in service-intensive industries by reducing the service component of production costs. In this case, there are two countervailing effects of lower regulation on nominal value added of service-intensive industries: a positive effect due to higher output and a negative effect due to lower prices. Estimates of the combined effect will therefore understate the impact of service regulation on production. We find empirical support for this hypothesis: lower regulation and higher financial development reduce the growth rate of (implicit) prices relatively more in service-intensive manufacturing industries. Accordingly, we do not find any significant effects of regulation or financial development on nominal value-added growth.

1. Background

In this Section, we introduce a simple framework relating service regulation to the costs of production in downstream industries and illustrate why regulation might affect industry specialisation by using insights from the recent trade literature. We start by considering an economy with access to two production technologies $j = 1, 2$ combining labour (L) and an intermediate input Z, $y_j = Z_j^{\gamma_j} L_j^{1-\gamma_j}$. We assume that industry 1 is relatively more intensive in input Z: ($\Delta\gamma = \gamma_1 - \gamma_2 > 0$). The intermediate input is a composite of different production services $x(i)$,

$$Z_j = \left[\int_0^1 x(i)^{\sigma} \mathrm{d}i\right]^{\frac{1}{\sigma}},$$

where $\sigma \in (0, 1)$ determines the elasticity of substitution $\chi = 1/(1-\sigma)$ between varieties. Each variety is produced using one unit of labour, priced w. The price index of the composite service can be obtained from maximisation conditions as

$$p_z = \left[\int_0^1 p(i)^{-\frac{\sigma}{1-\sigma}} \mathrm{d}i\right]^{-\frac{1-\sigma}{\sigma}},$$

where $p(i)$ is the price of the *ith* service.

Service regulation is introduced assuming that only a fraction $\varphi \in (0, 1)$ of varieties can be bought at competitive prices, while the share $(1 - \varphi)$ is available in regulated markets, where inputs are sold at monopolistic prices. This assumption implies that $p(i) = w$ if $i \in (0, \varphi)$, and $p(i) = w/\sigma$ when $i \in (\varphi, 1)$ and regulation grants monopoly profits to producers of service varieties.

The equilibrium price of the composite service becomes

$$p_z = w\left[\varphi + (1-\varphi)\sigma^{\frac{\sigma}{1-\sigma}}\right]^{-\frac{1-\sigma}{\sigma}} = wC(\varphi),$$

where $C'(\varphi) < 0$, $C(\varphi) = 1/\sigma > 1$ if $\varphi = 0$ (fully regulated services) and $C(\varphi) = 1$ if $\varphi = 1$ (fully competitive services). The expression above implies that, given the unit

cost function $c_j = p_z^{\gamma_j} w^{1-\gamma_j}$, the relative cost in the service-intensive industry is a decreasing function of the fraction of deregulated markets φ:

$$c_1/c_2 = p_z^{\Delta\gamma} w^{-\Delta\gamma} = C(\varphi)^{\Delta\gamma}.$$

To see how regulation can affect the equilibrium allocation of production and trade consider first the case of a small open economy taking world relative prices of final goods $p = p_1/p_2$ as given. In this case, the condition for diversification

$$C(\varphi)^{\Delta\gamma} = p$$

identifies a threshold level of regulation $\varphi^*(p)$ such that any country would in general be fully specialised in production. If $\varphi^* \in (0, 1)$, regulatory reforms raising the share of liberalised input markets above the threshold φ^* would imply a dramatic shift in the country production structure, from full specialisation in labour intensive industries to full specialisation in service-intensive industries.

Less extreme predictions can be obtained following the modern trade literature to think of firms within each industry as supplying varieties of imperfectly substitutable goods (see Helpman and Krugman, 1985). For simplicity, varieties will be differentiated by country of origin (as in Armington, 1969). In this case, producers of country c in industry j will face a downward sloping world-demand curve $q_{j,c} = p_{j,c}^{-\varepsilon}\Omega_{j,c}$, where $p_{j,c}$ is the domestic price, and $\varepsilon > 1$ is the constant elasticity of substitution across varieties. The scale variable $\Omega_{j,c}$ includes the amount of domestic and foreign expenditures allocated to industry j, which can be considered exogenous to the producer. Prices are set applying a constant mark up over marginal costs ($p_j = \mu p_z^{\gamma_j} w^{1-\gamma_j}$), so that the equilibrium relative production of the service-intensive variety will be an increasing function of the share of liberalised service markets φ:

$$q_{1,c}/q_{2,c} = \Theta C(\phi)^{-\varepsilon^{(*)}\Delta\gamma}$$

(recall that $C'(\varphi) < 0$). The elasticity of relative production to regulation is $\varepsilon_q = -\Lambda\varepsilon$, where ε is the price elasticity of demand and $\Lambda = \Delta\gamma[1/(1-\chi)]$ measures the impact of a change in regulation on relative prices. In this framework, service deregulation would therefore imply an increase in the service-intensive industry share of total production, driven by shifts in both domestic and foreign demand. From profit maximisation one can derive that relative labour productivity in the service-intensive industry is also increasing in the extent of deregulation.

Notice that if the value of production is measured at current prices (i.e. $r_{j,c} = p_{j,c}q_{j,c}$) the above relation becomes $r_{1,c}/r_{2,c} = \tilde{\Theta} C(\phi)^{(1-\varepsilon)^*\Delta\gamma}$. Because of the counteracting effects on prices, the elasticity of relative production to regulation $\varepsilon_r = \Lambda(1-\varepsilon)$ is therefore lower when production is measured at current rather than constant prices (and tends to zero as the substitutability across varieties – ε – decreases). Hence, an empirically interesting implication of this framework is that detecting the effects of regulation on the structure of industrial production would be easier using real as opposed to nominal measures of value added, as they allow insulation of the industry accounts from the offsetting effects of deregulation on industry prices.

The framework above suggests that the process of service liberalisation many developed countries started in the early 1990s should have implied a shift in the long run

composition of production towards service-intensive industries.[3] In the empirical part, we will check whether such reallocation reflected in industry growth differentials by testing whether service-intensive industries grew more in low regulation countries relative to less intensive service users. One reason for looking at growth rates is that production reallocation across industries is likely to be a lengthy process. A second reason is that such specification eases comparison of the results with those in the financial development literature, an important benchmark when studying the consequences of service underdevelopment.

2. Data and Sample

All the data needed to perform our exercise are available from the OECD. Information on value added, export and employment at the country-industry-year level is obtained from the STructural ANalysis (STAN) dataset. STAN has been assembled by the OECD complementing member countries' Annual National Accounts with information from other sources, such as national business surveys and censuses. The data are classified according to the International Standard Industrial Classification (ISIC) Rev. 3 industry list; they cover 17 countries and 15 manufacturing industries.[4]

2.1. *Measuring Service Regulation*

Exposure of manufacturing industries to service regulation is measured combining country-level information on service regulation and industry-level data on service dependence. Specifically, our main indicator is the weighted average

$$SERVREG_{j,c} = \sum_{s} \left(w_{j,s} X_{c,s} \right),$$

where $X_{c,s}$ is an index of service regulation in sector s and country c, and $w_{j,s}$ captures industry j dependence on regulated services.

Cross-country measures of service regulation ($X_{c,s}$) are obtained from the OECD Product Market Regulation (PMR) database. We focused on four upstream service activities: energy (electricity and gas), communication (telecommunication and postal services), transportation (air, road, rail transportation services) and professional services (including accountants, architects, engineers and legal services). For each sector, the OECD codes a large amount of basic information on regulatory settings into quantitative scores increasing in the amount of restrictions to competition (see Conway and Nicoletti, 2006). Following Alesina *et al.* (2005), we only considered those scores designed to measure *ex ante* anti-competitive restrictions: barriers to entry, vertical

[3] An alternative way to model the role of services would be thinking of regulation as limiting the number of available input varieties in a model featuring increasing returns from specialisation. Rodriguez-Clare (1996), Ciccone and Matsuyama (1996) and Rodrik (1996) are examples of papers showing that, with heterogeneous industry-intensity in non-traded intermediate inputs, the long run industry composition of a small open economy will significantly vary with the amount of locally produced inputs. As in the framework presented here, this occurs because the relative cost of service-intensive industries will decrease as the intermediate sector develops.

[4] See the Data Appendix for detailed variable definition and sources.

integration and market conduct.[5] While the OECD-PMR database covers regulation in energy, communication and transports since 1975, only two observations (in 1996 and 2003) are available for professions.

Two measures of industry j dependence on each service ($w_{j,s}$) were recovered from input–output account matrices. The first measure, capturing direct dependence, is obtained as the ratio between the cost of service inputs and the value of industry output (the so-called 'technical coefficients'). The second is recovered from the inverse Leontief matrix, whose coefficients account for both direct and indirect contributions of service s to the value of production in industry j.[6] In our baseline specification, service dependence will be computed based on the US input–output tables (i.e. $w_{j,s} = w_{j,s}^{\mathrm{US}}$). As in the rest of the literature following Rajan and Zingales (1998), we therefore start assuming that US input–output coefficients reflect technological differences rather than country-specific determinants, as the level of regulation itself.[7] Accordingly, the US is excluded from the sample. In the robustness section, however, we will exploit the availability of country-specific weights taken from the OECD input–output database to construct an alternative measure of service dependence not reflecting input intensities that are specific to a country or a level of regulation (Ciccone and Papaioannou, 2006). As we will see, the two approaches produce very similar results.

2.2. *Alternative Measures*

The OECD has recently made available a measure of the relevance of service regulation (the *RII*) constructed in a way similar to *SERVREG*. Specifically, the *RII* is obtained as $RII_{j,c} = \sum_s w_{j,s}^c X_{c,s}^{RII}$, where $w_{j,s}^c$ are country-specific input–output coefficients and $X_{c,s}^{RII}$ are measures of service regulation from the PMR database. Service sectors s include energy, communication, transportation and professional services (as in our measure) and retail trade. Recent papers used the *RII* to study the relation between regulation and technology transfer (Conway *et al.*, 2006; Arnold *et al.*, 2008). Despite the obvious similarities, there are several reasons to expect the *RII* would be less appropriate than *SERVREG* to study the relevance of service regulation in our framework. First, as already discussed, the Rajan and Zingales approach requires that input–output coefficients should be a measure of technological determinants of service dependence. Such condition would be hardly met using country-specific input–output coefficients as they might reflect unobserved determinants of service dependence at the country level, introducing potentially relevant sources of bias. If, in particular, country-specific

[5] Entry barriers include measures distorting the structure of markets relative to a competitive outcome, as the conditions for third party access to electricity and gas transmission grids, the existence of legal limitations on the number of competitors in communications or to the number services each profession has an exclusive right to provide. Vertical integration measures whether *a priori* competitive activities (as electricity generation or the final supply of energy) are separated from natural monopolies such as the national grid. Finally, conduct regulation includes restrictions on prices and fees, advertising, the form of business etc. in professional services.

[6] These weights thus account for potential effects of anti-competitive service regulation working through industry j linkages with other, possibly non-regulated, industries in the economy. See the Data Appendix for more information on how the direct and indirect weights are obtained from the available input–output accounts.

[7] In our data, the US is the country featuring the lowest average level of service regulation for the longest time period (see Figure S1 in online Technical Appendix).

weights are a combination of technological service dependence and country-specific shocks that are independent of other model determinants, then they would tend to distort the estimated coefficients towards zero (attenuation bias).[8] Second, given the focus on the relevance of services as input providers, unlike the *RII* our indicator excludes retail trade from the list of regulated services. Because it does not cover wholesale activities, the OECD measure of retail regulation is in fact based on information that is unlikely to matter for downstream performance.[9] Finally, while the index $X_{c,s}^{RII}$ accounts for all regulatory areas covered by the OECD regulation database, including for example the extent of public ownership, we focused on measures capturing *ex ante* anti-competitive practices (as barriers to entry). As we will see, comparing the results obtained using the two measures confirm our concerns regarding the appropriateness of using the *RII* in our framework.

Assembling the data imposes constraints on the number of available observations: in particular, we are forced to restrict the analysis to a relatively limited growth period, starting in 1996. The reason is twofold: first, indicators of regulation in professional services are available at earlier dates; second, the number of missing entries in value-added data significantly increases shifting to earlier dates, due to both the reduction in the number of available countries and to changes in industry classification within each country.[10]

The main variables used in the empirical part are summarised in Table 1, and described in detail in the Data Appendix (see Tables A1 and A2).

3. Results

3.1. *Regulation and Output Growth*

Table 2 reports the results obtained from our baseline value-added growth regression

$$\hat{V}A_{j,c} = \alpha + \beta SERVREG_{j,c} + \phi SHARE_{j,c} + \mu_c + \mu_j + \varepsilon_{j,c},$$

where $\hat{V}A_{j,c}$ is the average (1996–2002) real value-added growth in industry j and country c, $SHARE_{j,c}$ is the beginning-of-period value-added industry share, and μ_c and μ_j are country and industry-specific fixed-effects. As explained above, $SERVREG_{j,c}$ captures differences in the relevance of service regulation in country c for each manufacturing industry j. Regulation indicators are measured in 1996. There is a negative link between regulation and growth if $\beta < 0$.

The coefficient reported in column 1 of Table 2 indicates that lowering beginning-of-period anti-competitive regulation in the provision of services has a significant and positive effect on growth. One way to get a sense for the size of this effect is thinking of

[8] On the other hand, if country-specific weights respond to country-level regulation, the error in measurement could be non-classical and the direction of the bias undetermined *a priori* (Ciccone and Papaioannou, 2006).

[9] The retail trade indicator covers restrictions as the existence of barriers to entry in food distribution, limits to shops opening hours and price controls on products as food, pharmaceutical, tobacco and gasoline. Such retail activities have a very low relevance as input to manufactures: according to the 1997 US 'use' matrix their purchase represented 0.1% of manufacturing production (against 5.7% of wholesale trade). Notice also that the OECD input–output matrices we use throughout the article do not separate retail from wholesale trade, and would thus have provided an inappropriate weight for trade regulation.

[10] For example, as early as in 1990 the number of observations falls by nearly 25% with respect to 1996.

Table 1

Summary Statistics

Variable	Obs.	Mean	SD	Min.	Max.
Country-industry level					
Value-added growth 1996–2002 (real) [$GROWTH_{j,c}$]	220	0.018	0.034	−0.081	0.204
Value-added growth 1996–2002 (nominal) [$NGROWTH_{j,c}$]	220	0.032	0.038	−0.123	0.221
Labour productivity growth 1996–2002 [$LPGROWTH_{j,c}$]	220	0.025	0.026	−0.051	0.162
Export growth 1996–2002 [$EXGROWTH_{j,c}$]	205	0.050	0.050	−0.094	0.194
Implicit deflator growth 1996–2002 [$DEFGROWTH_{j,c}$]	220	0.014	0.030	−0.095	0.189
Value-added share in 1996 [$SHARE_{j,c}$]	220	0.069	0.047	0.001	0.234
Log labour productivity in 1996 [$LLP_{j,c}$]	220	3.864	0.481	2.821	6.932
Export share in 1996 [$EXSHARE_{j,c}$]	220	0.068	0.068	0.000	0.364
Service regulation [$SERVREG_{j,c}$]	220	0.246	0.109	0.070	0.628
Change in service regulation 1996–2002 [$DSERVREG_{j,c}$]	220	0.080	0.054	0.001	0.291
Alternative regulation impact indicator [$OECD\text{-}RII_{j,c}$]	220	0.123	0.035	0.043	0.194
Industry level					
Dependence on energy [$w_{j,ENERGY}$]	15	0.018	0.010	0.007	0.039
Dependence on communications [$w_{j,TLCPOST}$]	15	0.004	0.001	0.002	0.007
Dependence on transports [$w_{j,TRANSP}$]	15	0.030	0.014	0.011	0.063
Dependence on professional services [$w_{j,PROSERV}$]	15	0.027	0.011	0.013	0.055
External financial dependence [ED_j]	15	0.697	1.595	−0.450	6.200
Country level					
Regulation in energy in 1996 [$X_{c,ENERGY}$]	16	4.475	1.338	1.808	6.000
Regulation in communications in 1996 [$X_{c,TLCPOST}$]	16	2.868	1.614	0.000	5.680
Regulation in transports in 1996 [$X_{c,TRASP}$]	16	2.949	1.062	1.530	5.133
Regulation in professional services in 1996 [$X_{c,PROSERV}$]	16	2.464	1.160	0.830	4.178
Financial development [FD_c]	16	0.718	0.272	0.304	1.141
Financial disclosure [$ACCSTAN_c$]	16	0.647	0.122	0.420	0.810

Notes. The Table reports statistics for the key variables used in the article. All variables and data sources are defined in detail in the Data appendix.

the annual value-added growth differential between an industry with overall service-dependence ($D_j = \sum_s w_{j,s}$) at the 75th percentile (Pulp, paper and printing) and an industry at the 25th percentile (Fabricated metal products). The coefficient estimated in column 1 implies this differential would rise by approximately 0.75 percentage point if regulation were to be uniformly lowered in the four services by an amount corresponding to the difference in average regulation between the 75th (France) to the 25th (Canada) most regulated countries. For comparison, the median value-added growth rate in our sample is 1.8%. This finding is confirmed irrespective of which of the two available measures of industry dependence on regulated services ($w_{j,s}$) we use. This can be seen in column 2 where we replicate the previous regression using the so-called Leontief transformation of the technical coefficients, thus accounting for both direct and indirect inter-sectoral relationships. While the point estimate is unchanged, the implied effect of service deregulation would be slightly larger (about 1 percentage point) in this case.[11]

[11] The positive coefficient we estimate on initial shares, indicating that countries tend to experience relatively faster growth in those industries they are more specialised in, is in contrast with results obtained by most of the comparable literature. While apparently puzzling, this finding can be explained by the large weight Western European countries have in our sample. The recent intense process of economic and monetary integration seems in fact to have resulted in increased industrial specialisation in these countries (Midelfart *et al.*, 2003).

Table 2

Service Regulation and Growth

	(1)	(2)	(3)	(4)	(5)	(6)
	Baseline, direct weights	Baseline, indirect weights	Financial development (credit)	Financial development (acc. stand.)	Average 1996–2002 regulation	Deregulation (1996–2002)
Service regulation [$SERVREG_{j,c}$]	−0.172**	−0.170**	−0.176***	−0.158**	−0.198***	−0.287***
	(0.069)	(0.072)	(0.068)	(0.071)	(0.075)	(0.080)
Financial dev. × external dep. [$FD_c \times ED_j$]			0.010**		0.011**	0.009**
			(0.004)		(0.004)	(0.004)
Accounting stand. × external dep. [$ACCSTAN_c \times ED_j$]				0.013*		
				(0.007)		
Change in service regulation [$DSERVREG_{j,c}$]						0.320***
						(0.116)
Initial industry share [$SHARE_{j,c}$]	0.189***	0.198***	0.169**	0.187***	0.174***	0.163***
	(0.071)	(0.069)	(0.067)	(0.072)	(0.066)	(0.062)
Constant	0.037	0.048*	0.006	−0.001	0.005	0.014
	(0.023)	(0.025)	(0.019)	(0.020)	(0.019)	(0.019)
Observations	220	220	220	220	220	220
R^2	0.66	0.66	0.67	0.67	0.68	0.69

Notes. *Significant at 1%,**significant at 5%, ***significant at 10%.

The dependent variable is the annual compounded growth rate of real value added at the country-industry level for the period 1996–2002 ($GROWTH_{j,c}$). $SERVREG_{j,c}$ measures exposure to service regulation at the country-industry level as a weighted average ($\Sigma_s w_{j,s} X_{c,s}$) of country-level anti-competitive regulation indexes from the OECD-PMR databases. Service regulation ($X_{c,s}$) is measured in 1996 except in column (5) where it is the 1996–2002 average value. Interaction weights $w_{j,s}$ are ('direct') technical coefficients of dependence between service sector s and manufacturing industry j computed on the 1997 US Input–Output matrix, except for column (2) where they are measured to account for both direct and indirect dependence (see the Data Appendix for computational details). Financial development is measured as Private Credit by Deposit Money Banks over GDP in 1996 (FD_c column 3) and as accounting standards in 1983 ($ACCSTAN_c$ column 4). It is interacted with External dependence (ED_j), an industry-level measure of reliance on external finance obtained from US firm-level data. Both interactions follow Rajan and Zingales (1998). $DSERVREG_{j,c}$ measures exposure to service deregulation obtained as $\Sigma_s w_{j,s} \Delta X_{c,s}$, where $\Delta X = X_{1996} - X_{2002}$ is the 1996–2002 change in regulation of service s in country c. $SHARE_{j,c}$ indicates the industry share in total value added in manufacturing in 1996. All regressions include country and industry-fixed effects and use (employment) weighted least squares as estimation method. Robust standard errors are reported in parentheses.

A first important robustness check for the above findings consists in accounting for the well-documented empirical nexus between finance and industry growth. This is obtained augmenting the baseline specification with two alternative measures of financial development, both proposed by Rajan and Zingales (1998). Column 3 focuses on the ratio of bank credit to GDP, while column 4 considers accounting standards. In both cases, the interaction term is US industry external finance dependence. Neither of the two variables affects the relevance of service regulation. On the other hand, financial development confirms as a significant growth determinant. The coefficient estimated in column 3, for example, implies the growth differential between an industry at the 75th percentile and one at the 25th percentile of external finance dependence (Plastic products and Pulp and paper, respectively) would increase of approximately 0.2 percentage point moving from a country with private credit at the 25th percentile to a country close to the 75th percentile of financial development (Norway and the Netherlands, respectively).

The last two columns in Table 2 test the robustness of our estimate to changes in the regression specification. In column 5 we focus on the relationship between industry growth and average (as opposed to initial) service regulation in 1996–2002 using initial regulation as instrument, an approach recently followed in the financial development literature. Results are slightly stronger than in previous specification. Finally, in column 6 we account for the possibility that our estimates are at least in part capturing the effects of changes in regulation occurred between 1996 and 2002. This would be the case if countries with high initial regulation implemented relatively stronger subsequent deregulation processes, and regulation has level-effects on value added. We checked for this possibility augmenting the regression with a measure ($DSERVREG = SERVREG_{96} - SERVREG_{02}$) that is increasing in the extent of deregulation. The positive and significant coefficient attracted by *DSERVREG* does in fact indicate that, holding beginning-of-period regulation constant, value-added growth in service-intensive industries benefits from higher deregulation.[12] But our baseline estimate is, if anything, larger than in previous specifications.

3.2. *Output and Price Effects*

Several works adopting the Rajan–Zingales approach noticed that the empirical relevance of the finance-growth nexus is subject to strong variability depending on the countries included in the sample (Favara, 2003), and loses statistical significance as developing countries are omitted (Carlin and Mayer, 2003; Manning, 2003).[13] Building on time-series results as those in Rousseau and Wachtel (1998), one proposed explanation for this finding is that alternative financial instruments (as equity, debt and

[12] To get a sense for the size of this effect, consider the annual growth rate differential between an industry at the 75th and one at the 25th percentile of service-intensity. Our estimate implies this differential would increase by 1 percentage point when they operate in a country having experienced a high deregulation process (as Germany) rather than in a country with little deregulation (as Japan).

[13] Using the same dataset (UNIDO Industrial Statistics) and regression specification of Rajan and Zingales (1998) we found, for example, that their baseline estimate (0.118, with a standard deviation of 0.037, see col. 2 of table 4 in Rajan and Zingales, 1998) falls to −0.004 (0.019) when the analysis is restricted to OECD countries, and to −0.021 (0.017) when further focusing on the sub-sample of developed countries we use here.

derivative markets) may substitute for credit availability in advanced economies. But the significant coefficients we estimated in Table 2, obtained examining a sample of OECD countries, suggest we should look for a different explanation.

In a world where high-income countries tend to produce differentiated goods, one way to reconcile our findings with the literature is thinking of a possible counteracting role of prices. While we look at the growth of output (as measured by value added at constant prices), most of the existing cross-country cross-industry papers use nominal value-added data. As shown at the end of Section 2, if lower regulation raises output in service-intensive industries by lowering the service component of the cost of production, then there are two countervailing effects on nominal value added: a positive effect due to higher output and a negative effect due to lower prices. Their combination will tend to weaken the relation between service underdevelopment and industry output when this is measured in nominal terms.

We explore this issue in greater detail in Table 3, estimating the effects of regulation on industry prices. We do in fact find that, among OECD countries, lower regulation and higher financial development translate into lower prices in service-intensive manufacturing industries (Table 3, columns 1–3). As a result, when we replicate the real value-added analysis of Table 2 using nominal value added the effect becomes, as

Table 3

Financial Development, Prices and Nominal Growth

	Prices			Nominal growth		
	(1)	(2)	(3)	(4)	(5)	(6)
	Service regulation	Financial development	Regulation and fin. dev.	Service regulation	Financial development	Regulation and fin. dev.
Service regulation [$SERVREG_{j,c}$]	0.210*** (0.072)		0.211*** (0.070)	−0.004 (0.078)		−0.006 (0.078)
Financial dev. × external dep. [$FD_c \times ED_j$]		−0.009** (0.005)	−0.009** (0.004)		0.005 (0.005)	0.005 (0.004)
Initial industry share [$SHARE_{j,c}$]				0.027 (0.049)	0.017 (0.048)	0.017 (0.050)
Constant	0.015 (0.014)	0.056*** (0.006)	0.019 (0.013)	0.037** (0.016)	0.036*** (0.012)	0.037** (0.016)
Observations	220	220	220	220	220	220
R^2	0.62	0.60	0.63	0.64	0.64	0.64

Notes. ***Significant at 1%, **significant at 5%, *significant at 10%. In columns 1–3 the dependent variable is the annual compounded growth rate of value added implicit deflator at the industry-country level for the period 1996–2002 ($DEFGROWTH_{j,c}$); in columns 4–6 the dependent variable is the annual compounded growth rate of nominal value added at the industry-country level for the period 1996–2002 ($NGROWTH_{j,c}$). $SERVREG_{j,c}$ measures exposure to service regulation at the country-industry level as a weighted average ($\Sigma_s w_{j,s} X_{c,s}$) of country-level anti-competitive regulation indexes from the OECD-PMR databases. Service regulation ($X_{c,s}$) is measured in 1996. Interaction weights $w_{j,s}$ are ('direct') technical coefficients of dependence between service sector s and manufacturing industry j computed on the 1997 US Input–Output matrix. Financial development is measured as Private Credit by Deposit Money Banks over GDP in 1996 (FD_c) and is interacted with External dependence (ED_j), an industry-level measure of reliance on external finance obtained from US firm-level data. $SHARE_{j,c}$ indicates the industry share in total value added in manufacturing in 1996. All regressions include country and industry-fixed effects and use (employment) weighted least squares as estimation method. Robust standard errors are reported in parentheses.

in above mentioned works, largely insignificant (Table 3, columns 4–6). Even so, the issue remains of why using nominal output does allow estimating significant effects when the sample includes a large share of less developed countries. According to the above argument, one possibility is that less developed countries produce more homogeneous commodities relative to advanced countries, facing a higher elasticity of demand. In this case, the counteracting effect of prices would become less and less relevant, on average, as the share of developing countries in the sample increases allowing us to recover significant estimates even with nominal data.

3.3. *Regulation, Productivity and Exports*

Does lower regulation improve productive efficiency or are the estimated value-added growth differentials absorbed by offsetting shifts in industry employment? Despite its relevance, the interaction between service regulation and labour productivity has so far received relatively little empirical attention. Our cross-country and industry results indicate that service regulation has a significant impact on the growth rate of value added per worker in service-intensive industries (see Table 4, panel *a*). This finding is robust to accounting for financial development or by changing the regression specification, as in Table 2. To get a sense for the economic relevance of the estimated coefficients, consider the annual productivity growth differential between Pulp and paper and Fabricated metal products (the two industries at the 75th and 25th percentile of the distribution of service-dependence, respectively). The coefficient in column 1 implies this growth differential is approximately 0.9 percentage point larger in a low than in a high regulation country (respectively Canada and France). For comparison, the median productivity growth rate in our sample is 2.2%.

Finally, we exploited the availability of industry data on exports to explore whether the sectoral reallocation patterns implied by our value-added results correspond to changes in international specialisation. Results reported in panel *b* of Table 4 indicate that service regulation is an important determinant of comparative advantages. Throughout all the empirical specifications adopted in the previous Tables, we find that exports by service-intensive industries tend to grow disproportionately more in countries with low levels of service regulation. The usual thought experiment yields an increase of about 1 percentage point in the 25th–75th industry growth differential following a reduction in regulation.

All in all, our empirical findings point to the existence of non-negligible indirect effects of lack of competition in upstream markets for the patterns of international specialisation and comparative advantages.

4. Robustness

Having established our baseline findings, we proceeded to a number of robustness checks considering the potential confounding role of regulation in other markets, the appropriateness of US weights as a measure of service dependence, the role of influential observations and the suitability of our measure of regulation impact compared to other possible measures.

Table 4

Service Regulation, Productivity and Export Growth

	(1)	(2)	(3)	(4)	(5)	(6)
	Baseline, direct weights	Baseline, indirect weights	Financial development (credit)	Financial development (acc. stand.)	Average 1996–2002 regulation	Deregulation (1996–2002)
Panel (a): Productivity growth						
Service regulation [$SERVREG_{j,c}$]	−0.201** (0.081)	−0.218** (0.100)	−0.202** (0.080)	−0.194** (0.085)	−0.228** (0.090)	−0.280*** (0.106)
Financial dev. × external dep. [$FD_c \times ED_j$]			0.009 (0.006)		0.010 (0.006)	0.008 (0.005)
Accounting stand. × ext. dep. [$ACCSTAN_c \times ED_j$]				0.006 (0.006)		
Change in service regulation [$DSERVREG_{j,c}$]						0.228 (0.158)
Initial labour productivity [$LLP_{j,c}$]	0.031*** (0.012)	0.032** (0.012)	0.028** (0.012)	0.031*** (0.012)	0.030*** (0.011)	0.030*** (0.011)
Constant	−0.079* (0.047)	−0.062 (0.048)	−0.069 (0.047)	−0.082* (0.047)	−0.073 (0.046)	−0.066 (0.045)
Observations	220	220	220	220	220	220
R^2	0.58	0.58	0.59	0.58	0.60	0.60
Panel (b): Export growth						
Service regulation [$SERVREG_{j,c}$]	−0.213* (0.108)	−0.249** (0.111)	−0.215** (0.106)	−0.202* (0.108)	−0.242** (0.119)	−0.297** (0.121)
Financial dev. × external dep. [$FD_c \times ED_j$]			0.005 (0.007)		0.006 (0.007)	0.005 (0.006)
Accounting stand. × ext. dep. [$ACCSTAN_c \times ED_j$]				0.010 (0.013)		
Change in service regulation [$DSERVREG_{j,c}$]						0.229 (0.179)
Initial industry export share [$EXSHARE_{j,c}$]	−0.013 (0.054)	−0.007 (0.053)	−0.017 (0.052)	−0.015 (0.055)	−0.016 (0.052)	−0.024 (0.050)
Constant	0.060*** (0.018)	0.081** (0.025)	0.059*** (0.018)	0.055*** (0.019)	0.007 (0.023)	0.070*** (0.019)
Observations	205	205	205	205	205	205
R^2	0.72	0.72	0.72	0.72	0.72	0.72

Notes. ***Significant at 1%, **significant at 5%, *significant at 10%. In Panel (*a*) the dependent variable is the annual compounded growth rate of labour productivity (value added per employed worker) at the industry-country level for the period 1996–2002 ($LPGROWTH_{j,c}$). In Panel (*b*) the dependent variable is the annual compounded growth rate of exports at the industry-country level for the period 1996–2002 ($EXPGROWTH_{j,c}$). $SERVREG_{j,c}$ measures exposure to service regulation at the country-industry level as a weighted average ($\Sigma_s w_{j,s}X_{c,s}$) of country-level anti-competitive regulation indexes from the OECD-PMR databases. Service regulation ($X_{c,s}$) is measured in 1996 except in column (5) where it is the 1996–2002 average value. Interaction weights $w_{j,s}$ are ('direct') technical coefficients of dependence between service sector *s* and manufacturing industry *j* computed from the 1997 US Input–Output matrix, except for column (2) where they are measured to account for both direct and indirect dependence (see the Data appendix for computational details). Financial development is measured as Private Credit by Deposit Money Banks over GDP in 1996 (FD_c, column 3) and as accounting standards in 1983 ($ACCSTAN_c$, column 4). It is interacted with External dependence (ED_j), an industry-level measure of reliance on external finance obtained from US firm-level data. Both interactions follow Rajan and Zingales (1998). $DSERVREG_{j,c}$ measures exposure to service deregulation obtained as $\Sigma_s w_{j,s}\Delta X_{c,s}$, where $\Delta X = X_{1996} - X_{2002}$ is the 1996–2002 change in regulation of service *s* in country *c*. $LLP_{j,c}$ indicates the log of labour productivity in 1996. $EXSHARE_{j,c}$ indicates the industry share in total exports in manufacturing in 1996. All regressions include country and industry-fixed effects and use (employment) weighted least squares as estimation method. Robust standard errors are reported in parentheses.

4.1. *The Role of Product and Labour Market Regulation*

We first considered the possibility that our estimates are driven by omitted country-industry shocks not captured by either country or industry-fixed effects and correlated with service regulation. If regulation is a countrywide phenomenon, our findings might in particular be capturing anti-competitive measures targeting other markets, such as the labour or the product market. We checked for this possibility, augmenting the baseline specification with regulation-related variables, which have been shown to affect industry growth significantly. In columns 1 and 2 of Table 5 we accounted for country-level measures of employment protection and administrative (red-tape) barriers to entrepreneurships (Djankov *et al.*, 2002; Nicoletti and Scarpetta, 2003; Bassanini *et al.*, 2009). Both variables are negatively related to industry growth, although the relationship is statistically significant only in the case of labour market regulation. On the other hand, the estimated impact of services regulation is unaffected. The next two columns show that our results are robust to accounting for alternative forms of regulation in services, as restrictions to foreign direct investment (column 3), or the extent of public ownership in energy, transport and communication services (column 4). Finally, column 5 shows robustness to accounting for all regulation variables simultaneously. The online Technical Appendix reports further robustness checks to alternative channels highlighted by the literature on the determinants of international specialisation and comparative advantages.[14]

4.2. *The Appropriateness of US Weights*

We next dealt with the possibility that using input–output weights from a benchmark country does not allow correct measurement of technological dependence on service inputs because country-specific weights differ from 'true' weights by a idiosyncratic component. Such a component could be unrelated to other determinants of industry growth, a case in which our estimates would be subject to standard attenuation bias, or depend on the level of regulation itself, so that using a benchmark country would induce *a priori* ambiguous biases in the estimated coefficients (Ciccone and Papaioannou, 2006). These considerations suggest that neither choosing a different benchmark country nor using an average of input–output weights recovered from multiple sources would solve the measurement problems. An alternative procedure consists of recovering a measure of average service-dependence not reflecting input intensities specific to a country or to a level of regulation, and to use it as an instrument for the benchmark-country index of service-dependence. Following Ciccone and Papaioannou (2006), one such measure was estimated for each service sector s in two steps. First, we regressed country-industry weights $w_{j,c}$ on country dummies, industry dummies and industry dummies interacted with country-level regulation in sector s, to estimate the marginal effect of regulation on industry dependence: $w_{j,c} = \mu_j + \mu_c + \delta_j X_c + \varepsilon_{j,c}$.[15] In this

[14] In particular, we show our estimates are unaffected when accounting for the role of human and physical capital (as in Ciccone and Papaioannou, 2007) and property rights (Claessens and Laeven, 2003) in value-added growth regressions; and for the role of institutional quality and contract enforcement in export regressions (we used the same specifications as in Levchenko (2007) and Nunn (2007), respectively).

[15] The regressions account for the fact that the dependent variable is fractional (Papke and Wooldridge, 1996).

Table 5

Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Other regulation measures					Weights		Influential obs.	
	Empl. Protect.	Red tape	FDI regulation	Public Own.	All	IV-US	IV-lowest country	Most/least dependent industries	Most/least regulated countries
Service regulation	−0.191***	−0.203***	−0.182***	−0.232***	−0.272***	−0.193**	−0.218**	−0.274***	−0.180**
[$SERVREG_{j,c}$]	(0.071)	(0.067)	(0.068)	(0.074)	(0.073)	(0.087)	(0.105)	(0.088)	(0.072)
Fin. dev. × external dep.	0.011***	0.010**	0.011***	0.010***	0.012***	0.010**	0.010**	0.008**	0.013***
[$FD_c \times ED_j$]	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Lab. market reg. × lab. int.	−0.400				−0.578*				
[$LMR_c \times LABINT_j$]	(0.323)				(0.304)				
Red-tape costs × gr. opp.		−1.449*			−1.599*				
[$COST_c \times GROP_j$]		(0.871)			(0.871)				
FDI restrictions [$FDIREG_{j,c}$]			0.879		0.807				
			(0.794)		(0.806)				
Public ownership [$POWN_{j,c}$]				0.084*	0.059				
				(0.047)	(0.047)				
Initial industry share	0.182***	0.135*	0.167**	0.152**	0.135**	0.167**	0.165**	0.155**	0.184**
[$SHARE_{j,c}$]	(0.067)	(0.069)	(0.067)	(0.063)	(0.066)	(0.068)	(0.068)	(0.071)	(0.073)
Constant	0.019	0.015	−0.009	0.003	0.020	0.039	0.014	0.055***	0.035
	(0.024)	(0.019)	(0.022)	(0.019)	(0.025)	(0.025)	(0.026)	(0.027)	(0.024)
Observations	220	220	220	220	220	220	220	188	193
R^2	0.68	0.68	0.68	0.68	0.70	0.67	0.67	0.67	0.69

Table 5
(Continued)

Notes. ***Significant at 1%, **significant at 5%, *significant at 10%. The dependent variable is the annual compounded growth rate of real value added at the industry-country level for the period 1996–2002 ($GROWTH_{j,c}$). $SERVREG_{j,c}$ measures exposure to service regulation at the country-industry level as a weighted average ($\Sigma_s\ w_{j,s}X_{c,s}$) of country-level anti-competitive regulation indexes from the OECD-PMR databases. Service regulation ($X_{c,s}$) is measured in 1996. Interaction weights $w_{j,s}$ are ('direct') technical coefficients of dependence between service sector s and manufacturing industry j computed on the 1997 US Input–Output matrix. Financial development is measured as Private Credit by Deposit Money Banks over GDP in 1996 (FD_c) and is interacted with External dependence (ED_j), an industry-level measure of reliance on external finance obtained from US firm-level data. Labour market regulation (LMR_c) is an indicator of employment protection in 1988–95 and is interacted with labour intensity ($LABINT_j$) computed as the ratio between employees and total assets in the US in 1996. Red-tape costs ($COST_c$) are direct start-up costs of obtaining legal status to operate a firm as a share of per capita GDP in 1999; this variable is interacted with growth opportunities ($GROP_j$) measured as the growth rate of real value-added growth in industry j in US over the 1996–2002 period. FDI restrictions in services ($FDIREG_{j,c}$) is an index of exposure of each manufacturing industry j to the degree of FDI regulation in four service sectors (electricity, telecommunications, transport and professional services). It is computed as $\Sigma_s w_{j,s}Z_{c,s}$ where s = *ELECTRICITY, TLCPOST, TRASP, PROSERV* where $Z_{c,s}$ are FDI restriction indicators on a 0–1 scale (increasing with the degree of restrictiveness). Weights $w_{j,s}$ are the technical coefficients computed on the US 1997 input–output matrix (see also the Data Appendix). Public ownership ($POWN_{j,c}$) is an index of exposure of industry j to the degree of public ownership in services. It is computed as $\Sigma_s w_{j,s}\ POWN_{c,s}$ where $POWN_{c,s}$ is an index measuring on a 0–6 scale (increasing with the role of public sector) the degree of public ownership in 1996 and s = *ENERGY, TLCPOST* and *TRASP*. Columns 6 and 7 report IV estimates obtained using $\Sigma_s \hat{w}_{j,s}X_{c,s}$ as instrument for $SERVREG_{j,c}$. $\hat{w}_{j,s}$ is the estimated industry j's dependence on service s net of regulation and country-specific determinants of factor demand. See the Data Appendix Table A1 and Section 5 in the main text for more information on the IV approach. Results in columns 8 and 9 are obtained removing from the sample the most and least intensive industrial users of regulated services ('Other non-metallic mineral products' and 'Machinery and equipment N.E.C.') and the most and least service-regulated countries (Greece and Sweden), respectively. $SHARE_{j,c}$ is the industry share in total value added in manufacturing in 1996. All regressions include country and industry-fixed effects and use (employment) weighted least squares as estimation method. Robust standard errors are reported in parentheses.

regression, the most deregulated country $\bar{c}$ is excluded from the sample. Second, we estimated $\hat{w}_{j,\bar{c}}$ as the fitted values of $w_{j,c}$ when regulation is set at the minimum observed value ($X_{\bar{c}}$) and country-specific averages are set to zero: $\hat{w}_j = \hat{\mu}_j + \hat{\delta}_j X_{\bar{c}}$. The fitted weights $\hat{w}_{j,\bar{c}}$ will therefore not reflect input intensities that are regulation or country-specific and can be used as instruments for US weights in the empirical specification.

The results obtained following this procedure are reported in columns 6 and 7 of Table 5 and confirm the negative role of anti-competitive service regulation for growth. The only difference between the two columns consists in the choice of the country excluded from the service-specific first stage regressions. In column 6, we excluded the US, the country with the lowest levels of regulation from an historical perspective. In column 7, we excluded the least regulated country in each service sector in 1996 (the US for communications, the UK for energy and transportation, Finland for professional services).

4.3. *The Role of Influential Observations*

The last two columns of Table 5 report results obtained removing from the sample the most and the least service-intensive industries (Other non-metallic mineral products and Machinery and equipment, respectively; column 8), and the most and the least regulated countries (Greece and Sweden, respectively; column 9). The estimated coefficient on the growth effect of service regulation is robust to both exercises.

4.4. *Alternative Definitions of Regulation Impact*

Two recent papers used the OECD *RII* described in Section 3 to estimate the effect of regulation on productivity growth in a time-series framework (Conway *et al.*, 2006; Arnold *et al.*, 2008). In their analyses, productivity growth in an industry is expressed as a function of regulation and of the industry 'technological distance' from the frontier (i.e. from the country with the highest productivity level). The latter variable, a measure of the potential for technology transfer, allows estimation of the speed of convergence to the productivity leader. In this context, regulation is allowed for both direct and indirect (i.e. through the speed of convergence) effects on growth. Both papers find that higher regulation hinders productivity growth by slowing the speed of convergence to the technological frontier. In the sub-sample of ICT intensive (mainly service) industries they also find evidence of direct effects of regulation on growth.

Despite the two works differing from our study in many dimensions, it is important to assess the relevance and robustness of previous findings empirically against the OECD *RII*. In the online Technical Appendix we report results obtained when the *RII* replaces *SERVREG* in our baseline specifications and when the *RII* is added to our baseline specifications. The results suggest that the OECD indicator tends to understate the relevance of service regulation for industry growth, thus confirming our concerns regarding its appropriateness in our framework (see Section 3). On one hand, using the *RII* as main explanatory variable yields estimates of non-significant effects of regulation on two out of three of the outcomes we focus on (productivity and exports). When significant, the coefficient estimated using the *RII* implies much lower gains

from deregulation with respect to what we obtained using *SERVREG*. In particular, the implied effect of a one standard deviation reduction in regulation on value-added industry growth would be nearly 50% lower. Finally, all estimates obtained using *SERVREG* are robust to contemporaneously adding the *RII*, whose impact on growth is not statistically significant (or even positive).[16]

5. Extensions

To qualify the role of service regulation further in the next Sections we focus on two potential dimensions of heterogeneity in the estimated average coefficient: by size of the regulated market and by regulated service.

5.1. *Service Regulation and Country Size*

The benefits from lower regulation might vary with the extent of the regulated market. Recent cross-country evidence by Hoekman *et al.* (2004) showed, for example, that the positive relation between entry barriers and average mark-ups in manufacturing is substantially higher in large than in small countries. In a world with imperfect competition and fixed costs of production this would happen if the level of existing regulatory barriers (e.g. licences) is such that there is greater scope for profitable entry in larger than in smaller economies. In our setting, the positive effects of lower service regulation could therefore be stronger in countries characterised by a larger extent of demand by downstream industries.

We checked for this possibility by splitting the sample into two groups of large and small OECD countries. Large countries account for nearly 90% of total manufacturing employment in our data.[17] Table 6 reports the results obtained estimating alternative specifications of the value-added growth regression in the two sub-samples and compares them to the average coefficient. In all cases, our evidence indicates that previous results are determined by the positive growth effects of lower regulation in the sub-set of larger countries, suggesting these economies should expect substantial payoffs from competition policies. For example, the coefficient estimated in column 8 implies that the annual growth differential between Pulp and paper and Fabricated metal products (the two industries at the 75th and 25th percentile of the distribution of service-dependence, respectively) would rise by nearly 1.4 percentage points if

[16] The online Technical Appendix also reports results obtained considering a third measure of regulation impact, computed to highlight the relevance of using benchmark-country (or 'global') indicators of service dependence. Such measure is obtained interacting the *ex ante* anti-competitive regulation index we use throughout the article ($X_{c,s}$) with country-specific input–output weights ($w^c_{j,s}$), as in the *RII*. Using this 'mixed' regulation index yields statistically significant effects on value added and productivity but not on export growth. The implied effects of a one standard deviation reduction in regulation is slightly higher than in the case of *RII* but still nearly half of what would be obtained using *SERVREG*. Finally, the estimates obtained using *SERVREG* are robust to adding the 'mixed' regulation indicator, which in turn has very little statistical significance in all specifications.

[17] The sample of large countries is Canada, France, Germany, Italy, Japan, the Netherlands, Spain and the UK; small countries are Austria, Belgium, Denmark, Finland, Greece, Norway, Portugal and Sweden. The cross-country variability of our measure of service regulation is very similar in the two sub-samples (and close to the value for the whole sample).

Table 6

Service Regulation, Growth and Country Size

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Baseline			Including financial development			Including all controls		
	All countries	Large countries	Small countries	All countries	Large countries	Small countries	All countries	Large countries	Small countries
Service regulation [$SERVREG_{j,c}$]	−0.172**	−0.191**	0.019	−0.176***	−0.182**	0.096	−0.272***	−0.313***	0.107
	(0.069)	(0.080)	(0.131)	(0.068)	(0.078)	(0.141)	(0.073)	(0.086)	(0.174)
Initial industry share [$SHARE_{j,c}$]	0.189***	0.262***	0.072	0.169**	0.226**	0.090	0.135**	0.200**	0.048
	(0.071)	(0.098)	(0.055)	(0.067)	(0.092)	(0.055)	(0.066)	(0.092)	(0.047)
Constant	0.037	0.051**	0.026	0.006	0.049**	0.021	0.020	0.036	0.033
	(0.023)	(0.023)	(0.018)	(0.019)	(0.022)	(0.016)	(0.025)	(0.038)	(0.030)
Observations	220	113	107	220	113	107	220	113	107
R^2	0.66	0.70	0.52	0.67	0.72	0.55	0.70	0.75	0.59

Notes. The dependent variable is the annual compounded growth rate of real value added at the country-industry level for the period 1996–2002 ($GROWTH_{j,c}$). $SERVREG_{j,c}$ measures exposure to service regulation at the country-industry level as a weighted average ($\Sigma_s w_{j,s}{}^* X_{c,s}$) of country-level anti-competitive regulation indexes from the OECD-PMR databases. Service regulation ($X_{c,s}$) is measured in 1996. Interaction weights wj,s are ('direct') technical coefficients of dependence between service sector s and manufacturing industry j computed on the 1997 US Input–Output matrix. Specifications in columns 4–9 include (unreported) controls for financial development [$FD_c \times ED_j$]. In columns 7–9 further account for (unreported) LABOUR market regulation [$LMR_c \times LABINT_j$], Red-tape costs [$COST_c \times GROP_j$], FDI restrictions [$FDIREG_{j,c}$] and Public ownership [$POWN_{j,c}$] (see the Data appendix Table A1 for the definition of these variables). Large countries are Canada, France, Germany, Italy, Japan, the Netherlands, Spain and the UK; small countries include Austria, Belgium, Denmark, Finland, Greece, Norway, Portugal and Sweden. All regressions include country- and industry-fixed effects and use (employment) weighted least squares as estimation method. Robust standard errors are reported in parentheses.

regulation in a large and highly regulated country such as France was lowered to the level of Canada. On the other hand, the estimates are largely insignificant in the case of smaller economies.[18]

5.2. *Service-Specific Effects*

We allow for service-specific effects focusing on the unrestricted specification

$$\hat{V}A_{j,c} = \alpha + \sum_s \beta_s \left(w_{j,s} X_{c,s}\right) + \phi\, SHARE_{j,c} + \mu_c + \mu_j + \varepsilon_{j,c}.$$

The coefficients β_s are easier interpreted by recalling they represent a second derivative $\beta = \partial \hat{V}A / \partial w \partial X$. Hence, $\beta_s < 0$ indicates that, other things equal, intensive users of service s fare better in those countries where the provision of such service is relatively less regulated.

Our results, reported in Table 7, point to the existence of significant sectoral heterogeneity underlying the aggregate estimates presented in previous tables. This can be

[18] In the online Technical Appendix we show these findings extend to productivity and, although to a lesser extent, exports.

Table 7

Service-Specific Effects

	(1)	(2)	(3)	(4)	(5)	(6)
	Energy services	Prof. services	Commun. services	Transp. services	All services	Robs. to GLOPP
Energy Regulation × Energy dependence	−0.482***				−0.540**	−0.530**
$[X_{c,ENERGY} \times w_{j,\ ENERGY}]$	(0.147)				(0.232)	(0.232)
Prof. Serv. Regulation × Prof. Serv.		−0.286**			−0.254**	−0.259**
dependence $[X_{c,PROSERV} \times w_{j,\ PROSERV}]$		(0.124)			(0.118)	(0.114)
Communications Regulation × Comm. dep.			−0.417		0.115	0.206
$[X_{c,TLCPOST} \times w_{j,TLCPOST}]$			(1.193)		(1.147)	(1.100)
Transport Regulation × Transport				−0.231	0.101	0.112
dependence $[X_{c,TRANSP} \times w_{j,\ TRANSP}]$				(0.160)	(0.247)	(0.246)
Energy Regulation × Global opportunitie						0.038
(energy) $[X_{c,ENERGY} \times GLOPP_{j,\ ENERGY}]$						(0.072)
Prof. Serv. Regulation × Global opp. (prof. serv.)						−0.343***
$[X_{c,PROSERV} \times GLOPP_{j,\ PROSERV}]$						(0.131)
Financial dev. × external dep. $[FD_c \times ED_j]$	0.010**	0.011***	0.010**	0.011**	0.011***	0.011***
	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)	(0.004)
Initial industry share $[SHARE_{j,c}]$	0.171**	0.156**	0.169**	0.167**	0.159**	0.182***
	(0.067)	(0.073)	(0.069)	(0.069)	(0.069)	(0.062)
Constant	0.004	0.014	−0.007	0.004	0.021	0.039
	(0.017)	(0.020)	(0.022)	(0.020)	(0.030)	(0.031)
Observations	220	220	220	220	220	220
R^2	0.69	0.68	0.67	0.67	0.70	0.71

Notes. *Significant at 1%, **significant at 5%, ***significant at 10%. The dependent variable is the annual compounded growth rate of real value added at the industry-country level for the period 1996–2002 ($GROWTH_{j,c}$). Variables $X_{c,s} \times w_{j,s}$ are interaction terms between country-level measures of regulation in energy, professional services, communications, transports in 1996 ($X_{c,s}$) and the corresponding industry-level indicators of dependence ($w_{j,s}$). Interaction weights $w_{j,s}$ are ('direct') technical coefficients of dependence between service sector s and manufacturing industry j computed on the 1997 US Input–Output matrix. Financial development is measured as Private Credit by Deposit Money Banks over GDP in 1996 (FD_c) and is interacted with External dependence (ED_j) an industry-level measure of reliance on external finance obtained from US firm-level data. $GLOPP_{j,\ ENERGY}$ and $GLOPP_{j,\ PROSERV}$ are the estimated industry value-added growth in the US. For each of the service sector *ENERGY* and *PROSERV*, global opportunities ($GLOPP_{j,s}$) are obtained according to the following two-step procedure: (*i*) Regress $GROWTH_{j,c}$ on country dummies, industry dummies and industry dummies interacted with country-level regulation in sector s; US is excluded from the regression. (*ii*) Obtain $GLOPP_j$ as the predicted values of $GROWTH_{j,c}$ for the US. $SHARE_{j,c}$ indicates the industry share in total value added in manufacturing in 1996. All regressions include (unreported) controls for labour market regulation and red-tape costs (see the Data appendix Table A1 for the definition of these variables). All regressions also include country- and industry-fixed effects and use (employment) weighted least squares as estimation method. Robust standard errors are reported in parentheses.

seen in columns 1–4 where we separately considered the role of energy, professional services, communication and transportation services, respectively. All estimated coefficients are negative but only the first two are statistically significant, a result confirmed when all regressors are jointly considered (column 5). In both cases, the implied effect of regulation is considerable. Consider, for example, the annual value-added growth differential between an industry with an intensity in professional services at the 75th percentile (Textile and textile products) and an industry at the 25th percentile (Transport equipment). The estimated coefficient in column 5 implies this growth differential is approximately 0.8 percentage point higher in a country with regulation of professions at the 25th percentile (as the UK) than in a country close to the 75th percentile (as Spain). This effect is large relative to the median industry value-added growth rates in our sample (1.8%) and represents more than one-third of the observed 25th–75th difference in industry growth rates. In the case of energy, moving from a heavily regulated (e.g. Italy) to a deregulated (e.g. Finland) country would imply an even larger effect on the industry growth differential (1.4 percentage points).[19]

All specifications already account for the possibility of contemporaneous effects from labour and product market regulation. In column 6, we further checked for the potential confounding role of short run shocks. This amounts to distinguishing whether low regulation induces faster growth by service-intensive industries or rather facilitates downstream firms exploiting industry-level worldwide short run shocks. While still of interest, evidence in favour of the second mechanism would imply that absent these shocks, deregulation would have no effects on growth. Fisman and Sarria-Allende (2004) raised this point in the case of finance, suggesting a test for robustness to short run shocks obtained interacting the country-level variable of interest with a direct measure of worldwide industry-specific shocks (see Table 7 note for a detailed description of how we obtained such measure). The underlying idea is simple: if estimates in column 5 were to reflect short run shocks, they should be dominated by direct measures of the opportunities of expansion faced by different industries. Interestingly, our results indicate that lower regulation of professional services (but not of energy) does help accommodating short run shocks. On the other hand, however, our previous findings are unaffected and still statistically significant.[20]

Data limitations (e.g. the lack of comparable data on prices, the quality or efficiency of each of the four services etc.) prevent a thorough analysis of the reasons why regulation is more relevant in some services than others. Interestingly, however, our results highlight the relevance of two sectors (energy and professional services) that have

[19] Unlike the case of professional services, the OECD measure of energy regulation is available before 1996, allowing in principle to focus on a longer growth period. Unfortunately, as we go back in time the number of missing observations on the dependent variables rapidly increases, complicating the comparison of estimates. As an example, the Technical Appendix shows the results obtained when the specification in column 1, Table 7 is considered, and growth rates are computed starting in various years from 1980 to 1996. We always estimate negative coefficients which become statistically insignificant starting in the mid-1980s, when the number of observations becomes nearly a half with respect to those available in 1996.

[20] In the Technical Appendix, we show that our previous results on the aggregate effect of regulation (see Table 2) are also robust to accounting for a measure of global opportunities.

recently attracted increasing attention by policy makers in many developed economies.[21] Our findings can therefore be used to infer the potential growth effects of competition policies that are high in the current policy agenda: those addressing barriers to entry in energy and conduct regulation in professional services. Our estimates imply that the complete removal of the two main determinants of conduct regulation, that is bans to comparative or price advertising; and the regulation of price and tariffs, would imply the Textiles-Transport equipment growth differential to rise by 0.3 and 0.5 percentage point, respectively.[22] As to the energy market, our findings imply the industry growth differential associated with creating a liberalised wholesale market for electricity; allowing third party access to the electricity and gas transmission grid; or imposing the separation of ownership between energy production (or import) and its distribution would increase by 0.3, 0.7 and 0.9 percentage point per year, respectively.

6. Conclusions

Growing concerns that high levels of regulation might not reflect public interest have motivated a number of academic and policy-oriented researches aimed at evaluating the impact of regulatory barriers on the performance of regulated firms. We contribute to this debate highlighting the non-negligible indirect effects of anti-competitive regulation on downstream industries, focusing on the case of service inputs. Our results indicate that service regulation has a significant negative impact on the growth rate of value added, productivity and exports of service dependent industries. Interestingly, the impact of regulation appears to be particularly relevant in the case of those service activities (energy supply and professional services) the recent competition policy debate has been focusing on most intensively, both in Europe and in other developed countries. Also, our findings suggest the payoffs from lower service regulation would be more significant the larger the extent of the domestic market.

Our results leave several interesting questions open to future research. On one hand, the increased availability of detailed firm-level data should allow us to distinguish whether the aggregate growth effects we estimated here are mainly due to entry and exit of firms, to the performance of existing firms, or both. On the other, it is important to look deeper into the mechanisms underlying our findings, focusing on how regulation affects the industrial organisation of services (for example, in terms of number and size of firms, of turnover rates etc) on how this shapes service market outcomes and, eventually, the patterns of international specialisation and comparative advantages.

[21] See the European Commission 'Third Legislative Package on Energy Markets' (July 2009), promoting among other things the unbundling of network operation from supply and generation in energy, and the Commission report on 'Competition in Professional Services' (February 2004), urging 'the reform of unjustified restrictions in the professional services sector'. See also the chapter on Structural Policy Priorities in 'Going for Growth' (OECD, 2009).

[22] For each service sector, the OECD regulation index $X_{c,s}$ is obtained as the weighted average of several sub-indexes measuring the extent of regulation in different areas (see the Data Appendix). The thought exercises reported in the text are obtained considering the change in the $X_{c,s}$ implied by the maximum possible variation of each of the sub-indexes. In the case of regulation of prices and fees in professions, for example, this would correspond to moving from having 'minimum prices in all services' (as in the case of legal service in Italy) to 'no regulation' (as in the case of accounting service in Canada).

Data Appendix

Table A1

Variables Definition and Sources

Variable	Definition and sources
Country-industry level	
$GROWTH_{j,c}$	Annual compounded growth rate of real value added in industry j in country c over the 1996–2002 period. *Source.* OECD STAN database
$NGROWTH_{j,c}$	Annual compounded growth rate of nominal value added in industry j in country c over the 1996–2002 period. *Source.* OECD STAN database
$DEFGROWTH_{j,c}$	Annual compounded growth rate of the value added implicit deflator in industry j in country c over the 1996–2002 period. *Source.* OECD STAN database
$LPGROWTH_{j,c}$	Annual compounded growth rate of labour productivity (value added at constant prices per employee) in industry j in country c over the 1996–2002 period. *Source.* OECD STAN database
$EXGROWTH_{j,c}$	Annual compounded growth rate of exports at constant prices (current exports are deflated with the value-added deflator) in industry j in country c over the 1996–2002 period. *Source.* OECD STAN database
$SHARE_{j,c}$	Share of industry j in total value added in manufacturing in country c in 1996. *Source.* OECD STAN database
$EXSHARE_{j,c}$	Share of industry j in exports in manufacturing in country c in 1996. *Source.* OECD STAN database
$LLP_{j,c}$	Natural logarithm of labour productivity (value added at constant prices per employee) in industry j in country c in 1996. *Source.* OECD STAN database
$SERVREG_{j,c}$	Index of exposure of manufacturing industry j to regulation in four service sectors (energy, communications, transport and professional services). It is computed as $\sum_s w_{j,s} X_{c,s}$ where $s = ENERGY$, $TLCPOST$, $TRASP$, $PROSERV$. *Source.* OECD Product market Regulation database and US 1997 input–output accounts
$DSERVREG_{j,c}$	Difference between $SERVREG_{j,c}$ in 1996 and in 2002. *Source.* OECD Product market Regulation database and US 1997 input–output accounts
$POWN_{j,c}$	Index of exposure of manufacturing industry j to the degree of public ownership in three service sectors (energy, communications, transport). It is computed as $\sum_s w_{j,s} POWN_{c,s}$ where $POWN_{c,s}$ is an index measuring on a 0–6 scale (increasing with the role of public sector) the degree of public ownership in 1996 and $s = ENERGY$, $TLCPOST$ and $TRASP$. *Source.* OECD Product Market Regulation database and US 1997 input–output accounts
$FDIREG_{j,c}$	Index of exposure of manufacturing industry j to restriction to foreign investment in four service sectors. It is computed as $\sum_s w_{j,s} Z_{c,s}$ where $Z_{c,s}$ are FDI restriction indicators in electricity, telecommunications, transport and professional services. *Source.* Koyama and Golub (2006) and US 1997 input–output accounts
Country level	
$X_{c,s}$	Regulation indexes on a 0–6 scale (from least to most restrictive conditions) in 1996 in four non-manufacturing industries. $X_{c,s}$ includes $X_{c,\ ENERGY}$, $X_{c,\ TLCPOST}$, $X_{c,TRANSP}$, $X_{c,PROSERV}$ referring to energy (electricity and gas), communications (posts and telecommunications), transports (air, rail and road), professional services (legal, accounting, engineering and architects). *Source.* OECD Product Market Regulation (PMR) database. $X_{c,\ ENERGY}$ takes into account entry barriers and the degree of vertical integration in electricity and gas supply; $X_{c,\ TLCPOST}$ accounts for entry barriers in postal and telecommunications services; $X_{c,TRANSP}$ accounts for entry barriers in air, rail and road services and on vertical integration in rail; $X_{c,PROSERV}$ accounts for entry barriers and the regulation of market conduct in legal services, accounting services, engineers and architects (See Conway and Nicoletti (2006) for a complete description of the OECD-PMR data)
FD_c	Financial development in country c measured as Private Credit by Deposit Money Banks over GDP in 1996. *Source.* World Bank's financial development and structure database (based on IMF's Financial Statistics)
$ACCSTAN_c$	Indicator of financial disclosure in 1983. *Source.* Rajan and Zingales (1998)
LMR_c	Indicator of employment protection in 1988–95. *Source.* Fonseca and Utrero (2005)
$COST_c$	Direct start-up costs of obtaining legal status to operate a firm as a share of per capita GDP in 1999. *Source.* Djankov *et al.* (2002)

Table A1
(*Continued*)

Variable	Definition and sources
Industry level	
$w_{j,s}$	Industry dependence on service s, computed on 1997 US Input–Output accounts. It includes energy ($w_{j,ENERGY}$), telecommunications and post ($w_{j,TLCPOST}$), transports ($w_{j,TRANSP}$) and and professional services ($w_{j,PROSERV}$). *Source.* Our calculations (details below in the Appendix)
ED_j	Industry dependence on external finance, defined as capital expenditure minus internal funds. *Source.* de Serres *et al.* (2006) on Thomson Financial Worldscope database
$LABINT_j$	Industry labour intensity measured as the ratio between employees and total assets in the US in 1996. *Source.* OECD STAN database (total assets are computed from investment data using the perpetual inventory method with a 15% depreciation rate)
$GROP_j$	Annual compounded growth rate of production in real terms in industry j in US over the 1996–2002 period. *Source.* OECD STAN database
$\hat{w}_{j,s}$	Industry dependence on service s net of regulation and country-specific determinants of inputs demand. For each of the four service sectors $\hat{w}_{j,s}$ have been estimated according to the following two-step procedure (see also Ciccone and Papaioannou, 2006): (*i*) Regress country-specific input–output coefficients $w_{j,s,c}$ on country dummies, industry dummies and industry dummies interacted with country-level regulation in sector s; the most deregulated country $\bar{c}$ is excluded from the regression and the estimation follows Papke and Wooldridge (1996) to account for the fact that the dependent variable is fractional. (*ii*) Obtain $\hat{w}_{j,s}$ as the fitted values of $w_{j,s,c}$ when regulation is set at country $\bar{c}$ levels and country fixed effects are set to zero. Country $\bar{c}$ is set to either the US sectors (Table 5, column 6) or Great Britain (for energy and transport), US (*TLCPOST*) and Finland (*PROSERV*) for *ENERGY* and *TRANSP*, *TLCPOST* and *PROSERV*, respectively (Table 5, column 7)
$GLOPP_{j,s}$	Estimated world-average industry growth opportunities. For each of the four service sectors global opportunities ($GLOPP_j$) are the estimated industry value-added growth over the period 1996–2002 obtained according to the following two-step procedure (see also Ciccone and Papaioannou, 2006): (*i*) Regress $GROWTH_{j,c}$ on country dummies, industry dummies and industry dummies interacted with country-level regulation in sector s; the US is excluded from the regression. (*ii*) Obtain $GLOPP_j$ as the predicted values of $GROWTH_{j,c}$ for the US

Table A2
Correlation between Regulation Indicators in Four Service Sectors in 1996

	Energy [$X_{c,ENERGY}$]	Communications [$X_{c,TLCPOST}$]	Transport [$X_{c,TRANSP}$]	Prof. serv. [$X_{c,PROSERV}$]
Energy [$X_{c,ENERGY}$]	1.000			
Communications [$X_{c,TLCPOST}$]	0.549	1.000		
Transport [$X_{c,TRANSP}$]	0.801	0.541	1.000	
Professional services [$X_{c,PROSERV}$]	0.497	0.519	0.645	1.000

Country Sample
Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, the UK and the US.

Industry Sample
'Food products, beverages and tobacco' (Isic Rev. 3 = '15–16'), 'Textiles and textile products' (Isic Rev. 3 = '17–18'), 'Leather, leather products and footwear' (Isic Rev. 3 = '19'), 'Wood and products of wood and cork' (Isic Rev. 3 = '20'), 'Pulp, paper, paper products, printing and publishing' (Isic Rev. 3 = '21–22'), 'Coke, refined petroleum products and nuclear fuel' (Isic Rev. 3 = '23'), 'Chemicals and chemical products' (Isic Rev. 3 = '24'), 'Rubber and plastics products' (Isic Rev. 3 = '25'), 'Other non-metallic mineral products' (Isic Rev. 3 = '26'), 'Basic

metals' (Isic Rev. 3 = '27'), 'Fabricated metal products, except machinery and equipment' (Isic Rev. 3 = '28'), 'Machinery and equipment, N.E.C.' (Isic Rev. 3 = '29'), 'Electrical and optical equipment' (Isic Rev. 3 = '30–33'), 'Transport equipment' (Isic Rev. 3 = '34–35'), 'Manufacturing N.E.C., recycling' (Isic Rev. 3 = '36–37').

Dependence of Manufacturing Industries on Service Inputs

Throughout most of the article we use weights $w_{j,s}$ computed as the technical coefficients derived from the 1997 US Input–Output matrix. They are given by the elements of the matrix $\boldsymbol{T} = \boldsymbol{M}\,\mathrm{diag}\,(\boldsymbol{y})^{-1}$ where $\boldsymbol{M}$ is the industry-by-industry (44 × 44) input–output matrix, y is the (44 × 1) vector of industry output. In Table 2, column 2, weights are computed as the product of the elements of the inverse Leontief matrix by a vector of the industry value added-to-output ratios. More specifically, let $\boldsymbol{v}$ be the (44 × 1) vector of industry value added. The inverse Leontief matrix is $\boldsymbol{F} = (\boldsymbol{I} - \boldsymbol{T})^{-1}$ and satisfies $\boldsymbol{\iota}' = \boldsymbol{q}'\boldsymbol{F}$, where $\boldsymbol{q} = \mathrm{diag}\,(\boldsymbol{y})^{-1}\boldsymbol{v}$ is the vector of industry value added-to-output ratios. According to the last relation, the value of production in each sector (normalised to one) is decomposed in the contribution of value added produced in all the sectors ($\boldsymbol{q}$) weighted with the (direct and indirect) measure of intersectoral dependence ($\boldsymbol{F}$). For each industry, the relation can be written as $1_j = \sum_{k=1}^{44} q_k f_{k,j}$ with $k = 1, \ldots, 44$. The indirect weights used in Table 2, col. 2 are given by the elements $q_k f_{k,j}$.

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Additional Supporting Information may be found in the online version of this article:

Figure S1. Service Regulation in the USA and in Other OECD Countries.
Table S1. Alternative Determinants of International Specialisation and Comparative Advantages.
Table S2. Alternative Measures of Regulation Impact.
Table S3. Global Opportunities and Average Regulation.
Table S4. Service Regulation and Country Size.
Table S5. Sector-specific Effects over Longer Horizons: Energy.

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