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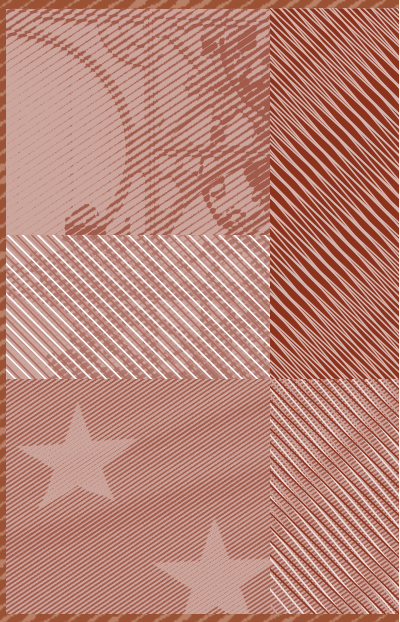

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SERVICE REGULATIONS, INPUT PRICES AND EXPORT VOLUMES: EVIDENCE FROM A PANEL OF MANUFACTURING FIRMS (*)

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Abstract

Using a panel of firm-level data from Spanish manufacturers, this study shows that better service regulation reduces the price of intermediate inputs paid by downstream firms. The beneficial cost effects of services reforms extend to both large and small-to-medium sized corporations (SMEs), but the former tend to enjoy greater gains. This feature also manifests itself in international markets. We identify an input cost channel through which service regulations affect the volume of exports of large manufacturers, while the evidence of such channel is weaker for SMEs. Our estimates indicate that, from 1991 till 2007, large firms increased their volume of exports by an average of 22% as a result of the direct input cost effect of services reforms, such that the firms that benefited the most typically belonged to industries more dependent on service inputs. Furthermore, convergence to the "best practice" regulatory framework in services would have raised exports at least by an additional 10%. We conclude that firm size is relevant for the connection between services reforms, intermediate input prices and export volumes.

Keywords: service regulations, intermediate input prices, exports, firm size.

JEL classification: L11, L43, F14.

Resumen

Utilizando datos de panel, este trabajo muestra que una mejor regulación en el sector servicios reduce el precio de los consumos intermedios que soportan las empresas de manufacturas, especialmente aquellas de mayor tamaño. El beneficio de un marco regulatorio que fomenta la competencia en el sector servicios se extiende a los mercados internacionales. Entre 1991 y 2007, las reformas en servicios habrían permitido a las grandes compañías industriales españolas incrementar sus exportaciones reales de bienes alrededor de un 22 % en términos acumulados, a lo largo de este período, frente a un hipotético escenario sin reformas. Más aun, si se hubiera producido la convergencia en materia regulatoria al marco de mejores prácticas en 2007, el volumen de exportación de las grandes empresas hubiera sido un 10 % superior, en términos acumulados, frente al valor observado. No obstante, no se observa evidencia robusta de este efecto en el caso de las pymes. El estudio muestra que el tamaño de la empresa es relevante para estudiar el vínculo que existe entre las reformas regulatorias, los precios de los consumos intermedios y el volumen de exportación.

Palabras clave: regulación en servicios, precios de los consumos intermedios, exportaciones, tamaño de empresa.

Códigos JEL: L11, L43, F14.

1. Introduction

The study of the effects of anti-competitive service sector regulation on economic performance has gained recent attention in the literature. Among OECD countries, regulation in services remained high for much of the second-half of the past century, until the 1990s when a decisive move to deregulate gathered momentum. This process involved the progressive removal of the rules preventing competition in those service markets that could operate in more competitive environments. Within this framework, new studies have focused on the impact of service regulation on downstream activities, especially on manufacturing (e.g., Barone and Cingano, 2011, and Arnold *et al.*, 2011). Given their direct and increasing dependence on key service inputs, it seems reasonable to hypothesize that the performance of manufacturing firms might be particularly affected by an anti-competitive regulatory set-up in services. Furthermore, the consumption of an expanded variety of intermediates as part of the manufacturing global value-added chain inevitably raises the economic relevance of service regulation (OECD *et al.*, 2013). For example, Barone and Cingano (2011) find that countries with better service regulations experience faster value added, productivity and export growth in those manufacturing industries that use services more intensively. Arnold *et al.* (2011) conclude that foreign entry into services is the channel through which services liberalization contributes to the improved TFP performance of manufacturing firms. Bourlès *et al.* (2013) show that the lack of competition in upstream services curbs productivity improvements across all downstream sectors, especially in those that are close to the technological frontier. Very recently, Arnold *et al.* (2015) use a panel of Indian firms to find a significant empirical link between progress in services reforms and manufacturing productivity. Similarly, Maican and Orth (2015) evaluate the influence of local market entry regulations in the productivity of Swedish retail industry at the store level.

Theoretically, one of the connections of service sector regulation and firm performance may operate via the negotiated terms and conditions of exchange between service suppliers and manufacturing producers or, more specifically, via the price of intermediate inputs. If deregulation brings more competition to upstream markets and/or shifts the distribution of bargaining power in favor of downstream firms, theory suggests that the associated fall in equilibrium input prices would produce a pro-competitive cost effect that otherwise would be absent (e.g., Horn and Wolinsky, 1988). Empirically, however, it remains to be shown that service sector deregulation influences the price of intermediate consumption paid by manufacturing firms.[1] The existence of such empirical connection

[1] The two related analyses in the literature have focused on production prices at the industry level, where transmission channels are not disentangled. Barone and Cingano (2011) estimate the effects of regulation on industry prices among OECD countries and find that lower service regulation translates into lower prices in manufacturing industries that are service intensive. Similarly, a simulation exercise in Cette *et al.* (2014) shows a positive and significant correlation between changes in production prices and changes in service regulations using OECD country-industry data.

would raise at least two important questions. First, does the impact of service sector regulation on input prices depend on downstream firm characteristics? And, second, does the beneficial cost effect of service deregulation show up in downstream outcomes uniformly across firms? The first question is concerned with the differential impact of deregulation in the presence of heterogeneous firms and the second with the distinct strategic response of firms to the benefits brought about by deregulation.

The aim of this paper is to address these issues and, in so doing, contribute to the literature in three relevant ways. First, taking advantage of an unusually rich database with detailed price information reported by manufacturing firms in Spain, we test the theoretical prediction that service sector deregulation reduces the price of intermediate inputs paid by firms. Second, we explore whether, in the face of deregulation, firm size is relevant for the link between services reforms and intermediate input prices. That is, we consider the possibility of, for example, services providers competing more (or less) intensively to secure larger manufacturing contracts. Third, since the beneficial cost effect of deregulation may show more evidently where the competitiveness strength of firms is most tried, we investigate the connection between service sector regulation and manufacturing exports at the firm level. We do so in an empirical framework whose aim is to identify the effect of regulation on exports that operates through the price of intermediate consumption. Once again, we address the potentially distinct response to deregulation of firms of heterogeneous size. Throughout the analysis, we bring out the relevance of firm size for the link between services reforms and manufacturing firm performance. Thus, one of the ultimate goals of the paper is to inform international trade models of firm heterogeneity by gathering robust evidence on the economic mechanisms that underlie trade flows (e.g., Melitz and Ottaviano, 2008).

The manufacturing firms in our dataset are classified in 10 industries for the period 1991-2010. For each manufacturing firm, we have information on intermediate input prices, production prices, size, investment, financial health, export sales and a rich set of other variables that, among other things, allow the estimation of TFP at the firm level. We construct an annual indicator of service sector regulation that proxies the impact on manufacturing industries of anti-competitive restrictions in the markets for energy, transport, communication and professional services. The indicator combines information on service regulations, from the OECD Non-Manufacturing Regulation (NMR) databases, and on service dependence by manufacturing industry, from the input-output account matrices.[2] We devise a two-step econometric approach that, in the first step, explores the connection between the price of intermediate inputs and service sector regulation and, in the second, identifies the impact of regulation on exports that works through the price of intermediate consumption. The identification method uses the regulatory impact indicator as an external instrument in the export equation and adopts an incremental estimation approach that

[2] The methodological approach to construct the service sector indicator is consistent with Barone and Cingano (2011) and Bourlès *et al.* (2013).

addresses endogeneity concerns. Finally, we carry out quantitative simulation exercises and extensive robustness checks.

At this stage, two methodological points are worth mentioning. First, unlike previous studies, we use a measure of real exports at the firm level. This is critical in order to correctly estimate the economic impact of service regulation since the combined effect of lower regulation on prices and quantities will tend to understate its impact on nominal values (Barone and Cingano, 2011).[3] Second, as the estimation period spans over fifteen years, we also control for lagged export volumes in the export equation which, together with the inclusion of input prices and firm level attributes, raises important concerns regarding endogeneity. We address this potential endogeneity problem estimating a System GMM and testing the validity of our instruments, as recommended in Roodman (2009).[4]

Overall, by examining the experience of Spanish manufacturers over the 1990s and 2000s, we assess whether removing anti-competitive barriers to the provision of key services has a non-negligible, beneficial impact on the price of intermediate inputs paid by firms and on their volume of foreign sales. In this respect, Spain is an interesting case to study since it is not only one of the OECD countries that reformed the most over the sample period, but it recorded a remarkably stable share of exports in GDP at the back of an unprecedented expansion of construction and real estate activities. This domestic-driven expansion drew on a large quantity of domestic resources and underpinned competitiveness losses. Services reforms may have held the key to support export performance during the boom years. In a wider macroeconomic context, this is a very relevant and timely topic as the recommendations to improve market functioning in advanced economies have consistently ranked high in the policy portfolio of international institutions during the recent crisis (OECD, 2014).

Considering that Spain undertook major services reforms in the period of study, our results provide compelling evidence that the removal of barriers to competition in services reduced the inflation rate of intermediate consumption faced by manufacturing producers. Furthermore, we find that firm size is relevant for the link between services reforms and intermediate input prices, such that deregulation produces more benefits when downstream firms are large. Similarly, we find robust evidence of an input cost channel through which service regulations affect the volume of exports of large firms, while the evidence is lacking when firms are small or medium-sized. The relevance of this channel is economically meaningful: simulation exercises of our full empirical model

[3] As already noted, our database provides unusually detailed price information at the firm level which makes it possible to compute real exports by deflating nominal export values with a price index of output. Most empirical studies on firm heterogeneity and trade use a measure of either nominal exports, export shares or nominal exports deflated by an industry-wide deflator (see, e.g., Berman and Héricourt, 2010, Minetti and Zhu, 2011, Bas, 2014, and Lodefalk, 2014). Compositional effects make deflating firm's exports with an industry-wide price index clearly suboptimal while using export shares in the main specification would address the differential impact of the explanatory variables on domestic sales vis-à-vis export sales, which is not the focus of our paper.

[4] We also report the results of other panel estimators, such as OLS with fixed effects, and discuss methodological issues related to sample selection bias.

suggest that, from 1991 till 2007, large firms increased their volume of exports by an average of 22 per cent as a result of the input cost effect of services reforms, such that the firms that benefited the most typically belonged to industries more dependent on service inputs. In addition, if Spain had converged to the 'best practice' service regulations by the end of the sample period, the volume of exports of large corporations would have been raised by a further 9.8 per cent, on average. The results are robust to the inclusion of other industry-level explanatory factors considered in the literature, e.g., the level of financial depth and trends in world manufacturing exports.

The rest of the paper is organized as follows. Section 2 discusses the theoretical channels through which service sector regulation affects intermediate input prices and export performance from the perspective of the firm. This section also presents evidence on the level of regulation observed in OECD countries over the 1990s and 2000s. Section 3 describes the data and the empirical strategy, while Section 4 discusses the empirical results. Section 5 provides a number of illustrative simulations carried out on the basis of the preferred specifications. Section 6 presents robustness analysis and the last section concludes.

2. Theoretical mechanisms and the OECD experience

2.1 Anti-competitive service regulations, intermediate input prices and downstream firms' foreign sales

Starting with the early work of Horn and Wolinsky (1988), the industrial organization literature has explored the effects on industry equilibrium of the lack of competition in the market for inputs. Market imperfections in the form of entry barriers lead to non-competitive solutions in upstream markets, where input prices are often determined by a bargaining process between suppliers and producers. Furthermore, as a result of irreversible investments, downstream firms may be locked into bilateral monopoly relations with providers, which may make pro-competitive reforms more challenging to deliver. In this context, the literature has shown that the equilibrium input price varies with the structure of the upstream industry. In their classic paper, Horn and Wolinsky (1988) established that more competition in the market for inputs yields lower bargained input prices when downstream firms compete in imperfect substitutes. Several papers in this tradition have deepened our understanding of the consequences on downstream firms' outcomes of an imperfectly competitive set-up in input markets (see, e.g., Correa-López and Naylor, 2004, and Correa-López, 2007).

Due to an increased interest on the functioning of services economies, the literature has placed a renewed effort to explore the economic impact of vertical relations articulated around the link between service providers and downstream producers. For example, Barone and Cingano (2011) develop a simple framework where lower regulation increases the share of service inputs whose price is determined under perfect competition while it

reduces the share of service inputs whose price is set unilaterally by a monopolist. In a model with two production technologies, the relative cost advantage of lower service regulation shifts the equilibrium allocation of production and trade in favor of those industries that use services more intensively. In addition to the direct impact on the upstream market structure, lower regulation may influence the distribution of bargaining power in input price negotiations. Blanchard and Giavazzi (2003) incorporate this transmission channel in an imperfectly competitive macroeconomic model to study the effect of labor market deregulation on real wages and employment. Bourlès *et al.* (2013) present a 'neo-Schumpeterian' growth model where regulations that curb market competition upstream alter the incentive structure for efficiency improvements downstream, as the expected rents from innovation would have to be shared with intermediate input suppliers. Thus, the higher the bargaining power of upstream firms, the larger the share of the downstream rents appropriated by suppliers via higher negotiated input prices. In their framework, the bargaining power of suppliers decreases with the intensity of competition in upstream sectors, and so does the negotiated input price. The relationship between regulations, prices and productivity is further explored in Cette *et al.* (2014).

Analytically, it is well-established that removing upstream barriers to competition lowers equilibrium input prices, providing downstream producers with a pro-competitive cost effect that otherwise would be absent. Furthermore, lowering regulatory barriers in, for example, services may generate spillover effects to the price of other manufacturing inputs, such as raw materials and intermediate goods, whose production and trade rely heavily on services. This compound beneficial effect on input prices may prove relevant for firm performance in foreign markets, where competition pressures are often at their highest. Therefore, from an empirical perspective, the first hypothesis that we test is whether a more competitive input market environment reduces the price of intermediate inputs paid by downstream firms, and the second is whether it increases their volume of exports.

Furthermore, for a given level of regulation, the distribution of bargaining power in input price negotiations may be influenced by downstream firm characteristics. Large firms, for example, may be able to secure better terms and conditions in their negotiations with input suppliers while SMEs may encounter more restrictions on bargaining conditions or may even have to act as price-takers. In this context, deregulation would shift the distribution of bargaining power in favor of large manufacturers, as upstream suppliers compete more intensively to secure sizeable contracts. Hence, the beneficial cost effect of lower service regulation would be more evident when downstream firms are large. By splitting the sample in two separate size categories, we effectively test whether the impact of deregulation varies with firm size.

2.2 Service sector reform in OECD countries

In the late 1980s, the service sectors of advanced economies remained highly sheltered from competition, with some notable exceptions such as the US case. Competitive pressures were halted by a set of regulations preventing entry into key non-manufacturing input markets which could have otherwise operated in more competition-prone environments. In the 1990s and 2000s, service sector deregulation gathered momentum and countries engaged on a deregulatory path at a varying pace. To facilitate the study of the economic consequences of an anti-competitive regulatory framework in services, the OECD has recently produced a quantitative measure of its knock-on effects.[5] In particular, the OECD Regulation Impact Indicator (*RII*) measures "the potential costs of anti-competitive regulation in selected non-manufacturing sectors on sectors of the economy that use the output of non-manufacturing sectors as intermediate inputs in the production process". The *RII* combines country-specific information on both the level of regulation in various service activities and the extent and composition of service dependence across manufacturing, to produce an indicator that is specific to each manufacturing industry.[6]

For a sample of 20 OECD countries, Figure 1 illustrates the level of the *RII* of four manufacturing sectors in two points in time. Note that a higher value of the indicator captures higher potential costs of anti-competitive service regulation. Albeit the extent and composition of service dependence may vary somewhat across advanced economies, the figure shows that Spain is one of the countries that deregulated the most since 1991.[7]

[5] See Conway and Nicoletti (2006).

[6] The vintage of the *RII* that we use is available at an annual frequency for the period 1975-2007. Service dependence is obtained from country-specific input-output tables for the year 2000. The database, together with a methodological note on its construction, can be found at: http://www.oecd.org.

[7] A similar pattern is observed for the remaining manufacturing industries not shown in the figure. Next section presents a variant of the OECD *RII* that is more suitable for our estimation purposes and provides further details on the construction of the indicators.

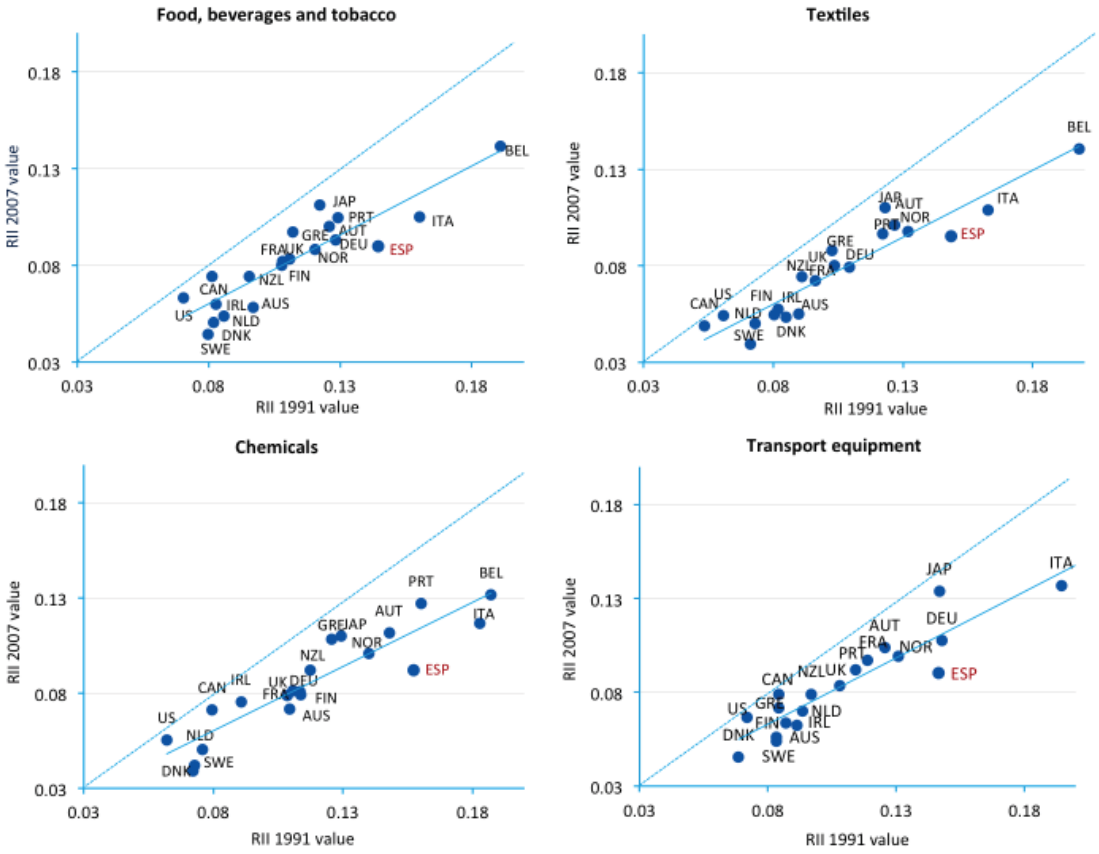

Figure 1: *The OECD Regulation Impact Indicator, selected manufacturing sectors, 1991-2007.*

3. Data and econometric strategy

3.1 Firm-level dataset and sample

The source of firm-level data is the *Encuesta sobre Estatregias Empresariales* (ESEE), an annual survey conducted by the *Fundación SEPI*. This provides detailed information on companies that have operated in the Spanish manufacturing sector since the launch of the survey in 1990. In the base year, all firms that employed more than 200 employees (large firms) were asked to participate while firms with 10 to 200 employees (SMEs) were surveyed according to a random sampling scheme. Participation rates reached approximately 70% of the population of large firms and close to 5% of the population of SMEs. The same selective sampling scheme was applied to each industry in the base year. In subsequent years, entry of newly created firms and recorded exits have maintained the initial sample properties. Using this data, Huergo and Jaumandreu (2004) study the influence on productivity growth of process innovation at different firm ages while Cassiman *et al.* (2010) explore how the relationship between productivity and entry into exporting is mediated by product and process innovation.

The manufacturing firms in our dataset are classified in 10 industries during the period 1991-2010.[8] For each manufacturing industry, we obtain a firm-level TFP estimate using the Levinsohn and Petrin's (2003) control function approach. Before TFP estimation, we follow a number of steps to clean the sample. We exclude firms with only one year of data available. We drop firm-year observations that do not have a complete record of the variables needed to estimate TFP. In addition, we remove observations where the ratios of labor cost to sales or material cost to sales are larger than unity and, finally, we exclude firms at the top and bottom 1% of the capital-output and the capital-labor distributions.[9] The total sample comprises 29,137 observations covering information on 3,540 firms arranged in an unbalanced panel observed annually with an average of 8 observations per firm. Of the total 29,137 observations, 8,980 correspond to firms of large size and 20,157 to firms of small to medium size. In the Appendix, Table A.1 contains detailed information on sample distribution by size and Table A.2 summarizes the results of the TFP estimation.

Table 1 provides descriptive statistics of the firm-level variables of interest. The period of analysis is 1991-2007 since the availability of the regulation indicator will restrict the information we draw from our sample to that period.[10] The variable exports is measured by the ratio of foreign sales over a firm-specific price index of output. At this point, it is worth noting how individual firms report both input and output prices in the survey. Information on prices is expressed in growth rates from which we back out a price index with the base year of 1989.[11] Nominal values are then deflated by the corresponding price index to obtain a proxy measure for real (constant price) values. Capital intensity refers to the capital-labor ratio and size is proxied by the number of employees. The rate of price variation of intermediate consumption encompasses the prices of energy, services, raw materials and other components. A self-reported measure of market power in the main market (to a large extent, the domestic market) is given by the market share variable. Financial health is captured by the leverage ratio, computed as the value of long-term debt with financial institutions divided by own funds. Foreign ownership is measured as foreign participation in a firm's equity while age refers to the number of years since the establishment of the firm. Table 1 shows that, on average, large firms export more, are more efficient and capital intensive, and are less leveraged and older than SMEs. They also face a lower inflation rate in intermediates, and have more market power and foreign presence in their ownership structure.

[8] The ordered names of the industries figure in Table A.1 of the Appendix.

[9] Typically, these cleaning rules are used to eliminate outliers from the data due to, e.g., very large mergers, extraordinary firm shocks or coding errors. Note that, after applying these exclusion rules, the representativeness of the sample by industry remains virtually unchanged.

[10] At the time of estimation, the vintage of the OECD NMR database run annually until 2007. For futher details, see the text further below.

[11] Price data is available in the survey since 1990.

Table 1. Summary statistics, 1991-2007

	Total sample		Large firms		SMEs	
Variables	Mean	S.D.	Mean	S.D.	Mean	S.D.
Exports (in logs)	14.45	2.66	16.21	1.81	12.89	2.31
TFP (in logs)	2.52	1.31	2.69	1.50	2.44	1.20
Capital intensity (in logs)	9.92	1.05	10.54	0.85	9.61	1.00
Size (in logs)	4.34	1.51	6.13	0.71	3.46	0.91
Price of intermediate consumption (%)	3.88	6.61	3.33	6.14	4.15	6.80
Market share in main market (%)	12.31	20.32	20.25	22.94	8.71	17.89
Leverage ratio	2.72	299.64	0.63	12.83	3.73	364.64
Age (in logs)	2.83	0.94	3.27	0.86	2.62	0.91
Foreign ownership (%)	18.40	37.21	40.77	46.87	7.74	25.40

Note: See the text and the notes to Table A.2 for a further description of the variables.

Source: Authors' calculations based on ESEE, Fundación SEPI.

3.2 Industry-level regulation indicators

The indicator that measures the impact of the regulatory environment in the upstream market for service inputs on downstream manufacturing (REG_{jt}) is constructed from two data sources, combined as follows:

$$REG_{jt} = \sum_{s=1}^{4} \omega_{js} Z_{st}, \tag{1}$$

where j refers to the manufacturing industry, t denotes the year and s refers to the upstream service input.

In Eq. (1), Z_{st} encompasses the regulatory indexes of four upstream service activities: energy (electricity and gas), transport (air, road and rail), communication (telecom and post) and professional services (accountancy, architecture, engineering and legal), drawn from the OECD NMR databases.[12] The index on the regulatory environment of each service activity quantifies information on *ex-ante* anti-competitive restrictions in the market for that particular service, measured by the extent of entry barriers, the degree

[12] The regulatory indexes of energy, transport and communication are used, at an annual frequency, for the period 1975-2007. The indicator of professional services is available for three years: 1996, 2003, 2008. In this case, we have assumed constancy of the index at its 1996 value for the 1991-1995 period and we have linearly intrapolated the missing observations for the rest of the sample. Note that, unlike the OECD *RII*, REG_{jt} does not include retail trade, as a relevant service input provider to downstream manufacturing, and banking.

of vertical integration and market conduct.[13] A lower value of the regulatory index Z_{st} indicates a service market environment more exposed to competitive pressures.

The weight ω_{js} in Eq. (1) captures industry j dependence on each regulated service s. Based on information obtained from the OECD Input-Output database, we produce two measures of ω_{js} that differ in the extent of the direct and indirect linkages of service s to industry j accounted for in each measure. Our benchmark of 'direct' dependence is given by the technical coefficients of the input-output table, which are computed as the ratio of the cost of each service input s to the value of output produced in industry j. 'Direct and indirect' dependence is retrieved from the inverse Leontieff matrix and the industry shares of value added in production, and accounts for both the direct and indirect contributions of service s to the value of output produced in industry j.[14] Since the measure of service dependence should reflect the true technological requirements of each manufacturing industry (Rajan and Zingales, 1998), we choose as a benchmark the input-output table of the US economy for the year 2000. Adopting the input-output structure of a second country with a low level of anti-competitive service regulation is often done in the literature to address an important source of endogeneity that emerges from domestic regulatory policy (Bourlès *et al.*, 2010; Barone and Cingano, 2011).[15] For comparative purposes, we also construct a measure of REG_{jt} that uses the direct weights of Spain's input-output matrix for the year 2000.

[13] Barriers to entry hinder competition in a market that otherwise could operate in a competitive environment. There are barriers to entry when: (i) restrictions apply on the number of firms that may operate in a market (e.g., the telecom sector, the post service, the freight transport rail market, or the domestic airline service); (ii) licensing policies may limit industry capacity (e.g., road freight transport, professional services); (iii) third party access to the electricity and gas transmission grids is limited; (iv) there is no liberalised wholesale market for electricity; (v) consumer choice of electricity and gas suppliers is hampered by consumption thresholds; (vi) etc. Vertical integration is mainly concerned with the degree of market separation between the generation/import and the supply/distribution segments of the electricity and gas industries, as competitive pressures can be higher if each segment constitutes a separate market. Market conduct applies to professional services and refers to restrictions on prices and fees, advertising, the form of business and inter-professional cooperation. Finally, notice that, unlike the OECD RII, REG_{jt} excludes measures concerned with the *ex-post* enforcement of regulation and privatization policies, such as the extent of public ownership and the prevailing market structure. For a detailed description of the OECD NMR indicators, see Conway and Nicoletti (2006).

[14] Due to intersectoral dependence, a unit of final demand in industry j will have direct and indirect repercussions on the production of other sectors, which in turn make use of service inputs. Anti-competitive service regulation thus has direct and indirect channels through which to affect industry j production. For further details on how to obtain the direct and indirect weights from the input-output tables, see Barone and Cingano (2011).

[15] In this case, the measuremente error could be non-classical and the endogeneity bias could be of either sign (Ciccone and Papaioannou, 2006). Note that even adopting the input-output table of a country with no anti-competitive regulation would not preclude the possibility of other relevant sources of bias. Bias may result from service dependence being determined by other factors in addition to technological ones, e.g., country-specific shocks, that are unrelated to firm exports ("attenuation" bias). For the period 1975-2007, the US economy exhibited, on average, the lowest level of regulation among OECD countries, which potentially minimizes measurement error. Finally, notice that, unlike REG_{jt}, the weights of the OECD RII are constructed from the domestic country input-ouput table and that, in so doing, the direct and indirect measure is used.

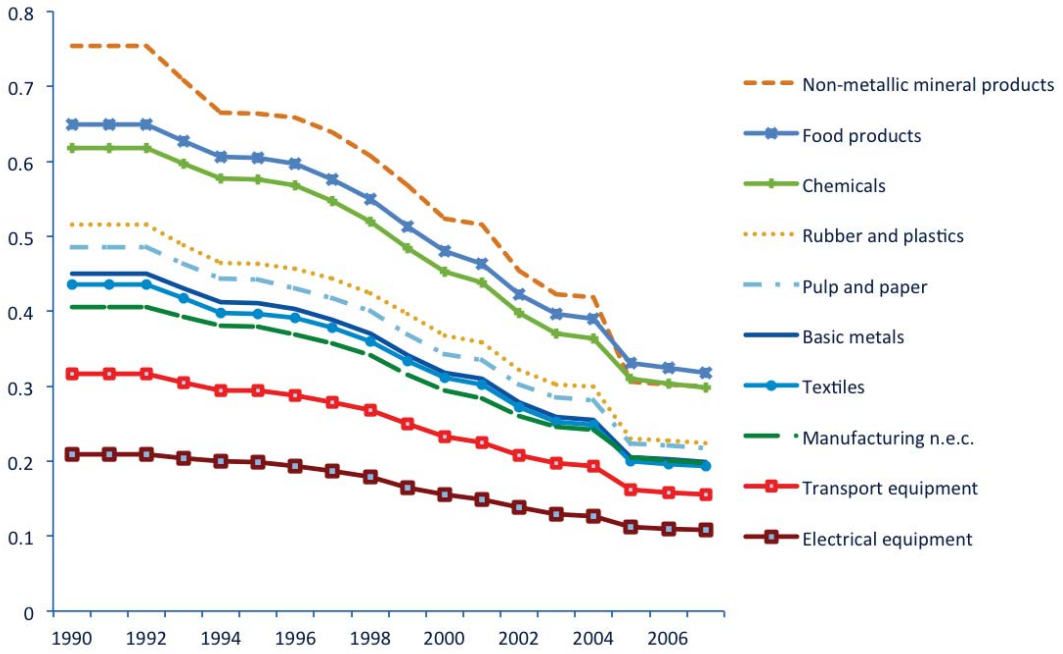

Figure 2: *Spain: REG_{jt} by manufacturing sector (based on US I/O Table for year 2000, direct dependence).*

Figure 2 depicts the evolution of the benchmark REG_{jt} for each manufacturing sector. The variability shown across sectors and over time reflects differences in the extent of service sector dependence of each industry, in the composition of the input services used, and in the initial level and pace of deregulation of each service. As noticed from Figure A.3. in the Appendix, deregulation was especially pronounced in the energy sector, followed by transport, communication and, to a lesser extent, professional services, while manufacturing dependence on professional services and transport has become increasingly relevant.

3.3 Econometric strategy

We implement a two-step econometric approach in order to identify the effect of regulation on exports that works through the price of intermediate consumption. In the first step, we thoroughly explore the connection between the price of intermediate consumption paid by the firm and service sector regulation. As we shall see below, we estimate two types of price specifications, in levels and differences. This step allows us to evaluate whether service regulation might be considered as a strongly informative instrument for intermediate input prices in the system GMM estimated in the second step. Throughout the analysis, services reforms are treated as exogenous and brought forward from EU-wide directives and initiatives. In the second step, we regress the firm's foreign sales on the price of intermediate consumption. In light of the results of the first step, we instrument the price of intermediate consumption with the regulatory impact indicator. We check for

instrument validity and informativeness by adopting an incremental approach whereby the baseline specification is extended with additional determinants and estimated using alternative methods while addressing endogeneity issues.

In the first step, we regress the annual rate of variation in the price of intermediate consumption paid by manufacturing firms (g_{it}^{PIC}) on the change of the regulatory impact indicator (ΔREG_{jt}) and a set of controls:

$$\begin{aligned} g_{it}^{PIC} &= \beta_0 + \beta_1 \Delta REG_{jt} + \beta_2 g_{jt}^{PIC\_US} + \beta_3 g_{jt}^{X\_WORLD} + \beta_4 g_{jt}^{PMIG} + \beta_5 recession_{it} \\ &\quad + \eta_j + \lambda_t + \mu_i + \varepsilon_{it}, \end{aligned} \tag{2}$$

where subscript i refers to the firm and subscripts $\{j, t\}$ are defined as in Eq. (1). Notice that parameter β_1 would capture the overall effect of deregulation on the price of intermediate consumption, that is, the direct effect on services and energy prices and the indirect effect on raw materials and other components prices. To improve identification, Eq. (2) controls for three industry-level determinants whose variation may drive the price of intermediate consumption, especially of its raw materials and other intermediates components.[16] To proxy for the evolution of exogenous technological factors, we use the rate of change in the price of intermediate inputs recorded in US manufacturing ($g_{jt}^{PIC\_US}$). The influence of global demand pressures is controlled for by the world's growth rate of real exports in manufacturing ($g_{jt}^{X\_WORLD}$). Import price inflation of intermediate goods (g_{jt}^{PMIG}) accounts for external and domestic drivers pertaining to Spanish manufacturing. Alternatively, we use the price of imported raw materials as a control.[17] Cyclical factors at the firm level are captured by a dummy variable ($recession_{it}$) that takes the value of 1 if the firm reports a recessionary main market in year t and 0 otherwise. The specification also includes industry dummies (η_j), time dummies (λ_t), firm-level fixed effects that account for unobserved heterogeneity (μ_i) and an idiosyncratic error component (ε_{it}). We use the fixed effects and the random effects estimators to derive results that exploit all sources of variability in the data. We start by running regressions on the total sample and, then, we work separately with the observations of large firms and SMEs.

The second price specification regresses the logarithm of the price index of intermediate consumption on the same set of variables considered above, as given by:

$$\begin{aligned} \ln P_{it}^{IC} &= \alpha_0 + \alpha_1 REG_{jt\_b89} + \alpha_2 \ln P_{jt}^{IC\_US} + \alpha_3 \ln X_{jt\_b89}^{WORLD} + \alpha_4 \ln P_{jt}^{MIG} \\ &\quad + \alpha_5 recession_{it} + \eta_j + \lambda_t + \mu_i + \varepsilon_{it}, \end{aligned} \tag{3}$$

[16] Due to data limitations, the list is not exhaustive. For example, recent trends in offshoring, global competition and product quality upgrading may not be fully captured by our technology-, demand- and supply-driven proxies, which may overstate the impact of regulation on intermediate input prices. We interpret the results with this caveat in mind.

[17] The data sources used to construct the three industry-level variables are World KLEMS, OECD, WTO and Spain's Ministry of Economy, Industry and Competitiveness.

where the price indexes are referenced to the base year of 1989, the regulatory impact indicator is written in terms of the absolute change since 1989 and world's exports are expressed as a ratio to the corresponding 1989 value. The rest of the controls are defined as in Eq. (2) as well as the estimators and the estimation samples.

In the second step, we explore the link between service sector regulation and manufacturing firm's foreign sales. The aim is to identify whether regulatory reform affects firms' exports through a cost channel on intermediate input prices. The full empirical model takes the following form:

$$\ln x_{it} = \alpha + \beta \ln x_{it-1} + \gamma \ln P_{it}^{IC} + \delta \Pi_{it} + \eta_j + \lambda_t + \mu_i + \varepsilon_{it}, \tag{4}$$

where x denotes deflated exports. In Eq. (4), the lagged dependent variable accounts for past export performance at the firm level and $\ln P_{it}^{IC}$ is the logarithm of the price index of intermediate consumption.[18] Π_{it} is a vector of controls for firm characteristics that may include TFP, size, capital intensity, market share, leverage, age of the firm and a dummy that takes the value of 1 if the firm is fully owned by a foreign multinational corporation in year t (and 0 otherwise).[19] Eq. (4) also includes industry dummies (η_j) and time dummies (λ_t). Finally, the composite disturbance has two orthogonal components: fixed effects (μ_i) that control for unobserved firm-level heterogeneity and an idiosyncratic error (ε_{it}).

In Eq. (4), our identification strategy consists of evaluating how the use of the regulatory impact indicator as an external instrument influences the coefficient on the price of intermediate consumption (γ). We check for changes in coefficient size and significance both in a baseline model that omits firm attributes and in the full empirical model. As an illustrative starting point, we first report the results of the OLS fixed-effects estimator. Then, we employ the system generalized method of moments (GMM) estimator due to Arellano and Bover (1995) and Blundell and Bond (1998) as a better estimation strategy in our case. The system GMM estimator effectively controls for the potential endogeneity of introducing lagged export volumes, input prices and firm-level characteristics in the specification.[20] A common problem of applying system GMM is that of instrument proliferation. Too many instruments can overfit endogenous variables and fail to remove their endogeneous components. To limit the risk of instrument proliferation, we carefully

[18] As it will become clear later, the discussion of the results is done in terms of short-run impacts or elasticities, unless otherwise specified.

[19] Notice that we assume exogeneity of multinational corporation status to the level of regulation. The motives that lead a company to shift production abroad are varied and have been extensively addressed in the literature: models of vertical FDI emphasize the factor prices advantage (e.g., Helpman, 1984, and Yeaple, 2003), while models of horizontal FDI consider the proximity-concentration trade-off (e.g., Markusen and Venables, 2000, and Helpman *et al.*, 2004) or the relevance of labor market institutions (Mukherjee, 2008).

[20] The firm-level attributes that are considered potentially endogenous in the exports equation are TFP, size, capital intensity, market share and leverage. We use the xtabond2 command in Stata 14 to implement the System GMM. This command allows us to separately specify how the external instrument enters the equation in differences and the equation in levels, hence we exploit the results of the estimation of Eqs. (2) and (3) to inform how REG_{jt} instruments the model of Eq. (4).

restrict the number of lags to use as instruments for each endogenous variable and we collapse the instrument matrices, as proposed by Roodman (2009). Note that because Eq. (4) includes the dependent variable lagged once, the estimation sample covers the years 1992-2007.

We run separate regressions for two subsamples of exporters: large firms and SMEs. Exporters are defined as those firms that exported in all the years in which they are present in the sample.[21] This definition is in line with the *continuous exporters* definition used in Greenaway *et al.* (2007).[22] The total number of exporters' observations (11,339) is reduced due to the combined attrition exercise from size status and sample years. In the baseline model, the subsample of large exporters contains 4,498 observations and the subsample of exporting SMEs comprises 3,877 observations. Note that a relevant source of sample selection bias may arise from the omission of firms that report zero export values. Given that the majority of large manufacturing firms are exporters, this source of bias may be confined to the case of exporting SMEs. According to our transmission mechanism, a bias would exist if, in the context of services reforms, the determination of the price of intermediates is mediated by the export status of the firm, aside from, and independently of, its size. If present, however, the sign of the bias is an open question as exporting SMEs may not unequivocally benefit more from deregulation if compared to non-exporting SMEs.

4. Empirical results

4.1 Service regulations and the price of intermediate inputs

Table 2 presents the results obtained from the estimation of Eqs. (2) and (3) in our panel of manufacturing firms. For the total sample, the results suggest a positive and a very significant relationship between the rate of variation in the price of intermediate inputs and the change in the regulatory impact indicator. Considering that Spain undertook major services reforms in the period of study, the estimates indicate that the removal of barriers to competition in services reduced the inflation rate of intermediate consumption faced by manufacturers. Likewise, the regulatory reforms in services exerted a downward pressure in the price level of intermediate consumption. In terms of magnitude, the first two columns of Panel I suggest that increasing the deregulatory effort by 0.1 reduces input price inflation by an average of 2 percentage points. The magnitude of the effect appears to vary across observations of different firm sizes, with an average effect of 2.6 percentage

[21] Of the total 29,137 observations, 11,339 correspond to 1,752 exporters, out of which 647 are large firms, 848 are SMEs and 257 are size-switchers. Note that firms that change size category in the years in which they are present in the sample are not part of the subsamples used for estimation.

[22] Therefore, it excludes those firms that switch from non-exporting to exporting, and vice versa, over the sample period.

Table 2. Service regulations and intermediate input prices, 1991-2007

	Total sample		Large firms		SMEs	
	(1) *Fixed effects*	(2) *Random effects*	(3) *Fixed effects*	(4) *Random effects*	(5) *Fixed effects*	(6) *Random effects*
Panel I. *Dep. variable: Rate of variation in the price of intermediate consumption*						
ΔREG	0.184***	0.228***	0.258***	0.262***	0.181***	0.224***
	[0.040]	[0.036]	[0.073]	[0.062]	[0.053]	[0.045]
Variation in U.S. input prices	0.261***	0.312***	0.369***	0.405***	0.217***	0.278***
	[0.036]	[0.034]	[0.063]	[0.061]	[0.044]	[0.042]
Variation in world real exports	0.014***	0.018***	0.022**	0.022***	0.015**	0.017***
	[0.006]	[0.004]	[0.010]	[0.006]	[0.007]	[0.006]
Variation in import prices	0.001**	0.001**	0.002***	0.003***	0.000	0.000
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Recession	-0.003**	-0.002*	-0.002	-0.002	-0.003**	-0.002
	[0.001]	[0.001]	[0.002]	[0.002]	[0.001]	[0.001]
Panel II. *Dep. variable: Logarithm of the price of intermediate consumption*						
REG	0.489***	0.518***	0.664***	0.523***	0.213	0.489***
	[0.139]	[0.095]	[0.179]	[0.155]	[0.191]	[0.113]
U.S. input prices	0.672***	0.636***	0.889***	0.746***	0.296**	0.447***
	[0.109]	[0.092]	[0.161]	[0.147]	[0.135]	[0.110]
World real exports	0.020	0.033**	-0.041	0.017	0.121***	0.060***
	[0.029]	[0.016]	[0.042]	[0.027]	[0.036]	[0.020]
Import prices	0.000	-0.001	-0.001	-0.001	0.001	0.000
	[0.002]	[0.001]	[0.003]	[0.002]	[0.002]	[0.002]
Recession	-0.003	-0.003	-0.007	-0.007	-0.003	-0.002
	[0.003]	[0.003]	[0.005]	[0.005]	[0.003]	[0.003]

Notes: All specifications include a constant term, time and industry dummies; *** denotes statistical significance at 1%, ** at 5% and * at 10% level; robust standard errors figure in brackets. The REG indicator is based on the benchmark input-output table. See the text for detailed variable description.
Source: Authors' calculations based on ESEE, Fundación SEPI.

points in the case of large firms (columns 3 and 4) and of 2 percentage points in the case of SMEs (columns 5 and 6). Furthermore, as columns 3 to 6 of Panel II show, services reforms exercised a significantly greater downward pressure on the price level of intermediate consumption when downstream manufacturers were large. On the other hand, the rate of variation in the price of intermediate inputs of US manufacturing, in world real exports and in import prices are positively and significantly correlated with the inflation rate of intermediate consumption. These results indicate the presence of technology-, supply- and demand-side drivers of intermediate input prices, out of which, the price of intermediate inputs in US manufacturing had the largest influence, as confirmed in Panel II of Table 2. Finally, a firm that declares a recessionary main market exerts a downward pressure on the price variation of its intermediates. The results are generally robust to the measure of REG_{jt} that uses alternative weights, especially for the case of large firms, and to the inclusion of the price of imported raw materials.[23]

[23] Robustness checks are available from the authors upon request.

Overall, our results provide compelling evidence that service sector deregulation reduces the price of intermediate inputs paid by firms and that firm size is relevant for the link between services reforms and intermediate input prices. Since the pro-competitive cost effect of deregulation is stronger for large firms than for SMEs, we postulate that the impact of service regulations on firm's exports is more evident when firms are large.

4.2 Service regulations and large firms' exports

The first three columns of Table 3 present the baseline results obtained from the estimation of Eq. (4). Once endogeneity concerns are addressed, the baseline model shows a negative and significant effect of the price of intermediate consumption on the volume of exports of large manufacturers. Furthermore, the inclusion of the regulatory impact indicator as an external instrumental variable raises the coefficient estimate and its significance while the exogeneity tests indicate that the model is well-specified. A similar pattern is observed in the results of the full empirical model. Column 4 shows that, on this occasion, the fixed effects estimator captures a negative and significant relationship between the input price and the volume of exports. Likewise, the estimates that figure in columns 5 and 6 indicate that, once the *REG* instrument is included, the coefficient of interest increases while the significance level and the relevant exogeneity tests improve. According to the estimates in column 6, the long-run elasticity of exports to the price of intermediate consumption stands at 1.25 per cent. Thus, the evidence suggests that there is an input cost channel through which services reforms affect large firms' exports. With regard to other determinants, we find that size and, especially, TFP have a positive and significant effect on foreign sales. On the other hand, we find a negative association between the age of the firm and exports which might reflect an outward-looking expansion strategy among younger firms. The results also suggest that, once we control for all other firm attributes, capital intensity, multinational status, the market share in the firm's main market and its long-term leverage with financial institutions are not significantly associated with the volume of exports. Regarding the latter, it may be the case that long-term leverage with financial institutions is the channel through which firms finance the large fixed costs associated to long-term investment projects or entry into export markets, while it is unrelated to the variable costs of selling abroad.[24]

[24] These include shipping, duties and cross-border insurance, in addition, exporters have higher working capital needs due to longer time lags between production and payments. The results reported in Table 3 might be in line with the sunk costs hypothesis that ascribes a more relevant effect of firm's financial health on trade at the time of firm's entry into exporting, i.e., on the extensive margin of exports (Berman and Héricourt, 2010).

Table 3. Service regulation and large firms' foreign sales, 1992-2007

Dep. variable: Log exports						
	(1) OLS with *fixed effects*	(2) System *GMM*	(3) System *GMM*	(4) OLS with *fixed effects*	(5) System *GMM*	(6) System *GMM*
Regressors						
Log exports (t-1)	0.397***	0.434***	0.541***	0.330***	0.338***	0.340***
	[0.056]	[0.087]	[0.102]	[0.058]	[0.085]	[0.086]
Input price (in logs)	-0.119	-0.354**	-0.568**	-0.354**	-0.720***	-0.822***
	[0.145]	[0.181]	[0.238]	[0.165]	[0.243]	[0.265]
External IV:	NO	NO	YES	NO	NO	YES
Additional regressors:	NO	NO	NO	YES	YES	YES
TFP (in logs)				0.727***	1.273***	1.248***
				[0.117]	[0.410]	[0.380]
Size (in logs)				0.529***	0.633*	0.685*
				[0.074]	[0.365]	[0.360]
Capital intenstiy (in logs)				0.083	0.221	0.256
				[0.056]	[0.204]	[0.190]
Market share				-0.002**	0.000	0.000
				[0.001]	[0.003]	[0.003]
Leverage				0.001	-0.004	-0.004
				[0.001]	[0.012]	[0.014]
Age (in logs)				-0.008	-0.083**	-0.081**
				[0.022]	[0.039]	[0.038]
MNC				-0.053	0.063	0.049
				[0.086]	[0.062]	[0.060]
Number of:						
Observations	4498	4498	4498	3943	3943	3943
Groups	594	594	594	573	573	573
Instruments		30	34		44	46
Arellano-Bond AR(2) test		0.32 (0.752)	0.32 (0.752)		0.02 (0.983)	0.04 (0.970)
Hansen test of overid.		0.05 (0.975)	3.38 (0.760)		1.97 (0.992)	2.29 (0.997)
Difference-in-Hansen tests:						
GMM instruments for levels		0.05 (0.975)	2.03 (0.731)		1.24 (0.990)	1.57 (0.991)
Lagged exports		0.05 (0.975)	0.67 (0.716)		0.56 (0.754)	0.42 (0.810)
Input price		0.05 (0.975)	1.34 (0.512)		0.10 (0.953)	0.01 (0.994)
REG (level equation)			0.92 (0.630)			0.00 (0.983)
REG (difference equation)			0.23 (0.893)			0.31 (0.575)
TFP					0.09 (0.957)	0.08 (0.960)
Size					0.29 (0.863)	0.38 (0.827)
Capital intensity					0.40 (0.817)	0.44 (0.801)
Market share					0.17 (0.918)	0.12 (0.940)
Leverage					1.50 (0.827)	1.48 (0.831)

Notes: All specifications include a constant term, time and industry dummies; *** denotes statistical significance at 1%, ** at 5% and * at 10% level. Columns (1) & (4): OLS with fixed effects; robust standard errors (in brackets). Columns (2), (3), (5) & (6): Two-step efficient system GMM estimation; Windmeijer-corrected robust standard errors (in brackets); the test statistics are reported with p-values in parentheses. MNC refers to a multinational corporation dummy. The REG indicator is based on the benchmark input-output table.

Source: Authors' calculations based on ESEE, Fundación SEPI.

Table 4. Service regulation, input prices and large firms' foreign sales: Disaggregated regulation impact indicators

Dep. variable: Rate of variation in the price of intermediate consumption	*Fixed effects*	*Random effects*	*Fixed effects*	*Random effects*	*Fixed effects*	*Random effects*	*Fixed effects*	*Random effects*
ΔREG	0.641***	0.617***	0.185*	0.198**	2.434**	2.248**	0.273**	0.263***
	[0.209]	[0.198]	[0.096]	[0.081]	[0.973]	[0.946]	[0.127]	[0.085]
Regulation impact indicator in:	Energy	Energy	Transport	Transport	Communication	Communication	Prof. services	Prof. services
Additional regressors:	YES	YES	YES	YES	YES	YES	YES	YES
Dep. variable: Log exports								
	System *GMM*	System *GMM*	System *GMM*	System *GMM*	System *GMM*	System *GMM*	System *GMM*	System *GMM*
Log exports (t-1)	0.533***	0.343***	0.527***	0.359***	0.514***	0.349***	0.517***	0.349***
	[0.099]	[0.088]	[0.103]	[0.087]	[0.101]	[0.087]	[0.099]	[0.089]
Input price (in logs)	-0.631**	-0.783***	-0.589**	-0.857***	-0.669**	-0.816***	-0.647**	-0.797***
	[0.276]	[0.258]	[0.253]	[0.280]	[0.274]	[0.263]	[0.261]	[0.288]
External IV:	Energy	Energy	Transport	Transport	Communication	Communication	Prof. services	Prof. services
Additional regressors:	NO	YES	NO	YES	NO	YES	NO	YES
Arellano-Bond AR(2) test	0.29 (0.768)	0.06 (0.953)	0.29 (0.775)	0.10 (0.921)	0.27 (0.790)	0.06 (0.951)	0.27 (0.788)	0.06 (0.956)
Hansen test of overid.	2.62 (0.623)	2.59 (0.995)	2.85 (0.827)	2.86 (0.992)	2.43 (0.658)	2.27 (0.997)	2.15 (0.709)	2.93 (0.992)

Notes: See the notes to Tables 2 and 3.

Source: Authors' calculations based on ESEE, Fundación SEPI.

Our next set of results is presented in Table 4 where we separately consider the role of each regulated service. The estimates of Eq. (2) show that services reforms pertaining to all available categories reduced the inflation rate of intermediate consumption faced by large manufacturers, although with some heterogeneity. In our sample period, the waves of deregulation in the communication and energy sectors exerted the largest downward pressure on input prices. Likewise, the evidence suggests that the input cost channel of regulatory reforms is present across all service sectors, with a slightly larger impact of the regulatory environment in air, road and rail transportation on the volume of exports.[25]

4.3 Service regulations and SMEs' exports

In this section, we investigate whether there is an input cost channel through which services reforms affect SMEs' exports. Theory mechanisms suggest that, if present, this channel might be weaker than the one identified in the case of large firms. Columns 1 to 3 of Table 5 present the results of the baseline model. Once endogeneity issues are controlled for, the estimates capture a negative and significant effect of the price of intermediate consumption on the volume of exports of SMEs. The point estimate and its significance increase when the regulatory impact indicator is introduced as an external instrument.

25 Barone and Cingano (2011) found strong effects on value added growth of regulation in the provision of energy and professional services.

Table 5. Service regulation and SMEs' foreign sales, 1992-2007

Dep. variable: Log exports						
	(1) OLS with *fixed effects*	(2) System *GMM*	(3) System *GMM*	(4) OLS with *fixed effects*	(5) System *GMM*	(6) System *GMM*
Regressors						
Log exports (t-1)	0.482***	0.465***	0.480***	0.407***	0.352***	0.371***
	[0.027]	[0.047]	[0.047]	[0.028]	[0.064]	[0.062]
Input price (in logs)	-0.152	-0.410*	-0.578**	-0.712***	-0.863*	-0.859*
	[0.179]	[0.235]	[0.228]	[0.159]	[0.442]	[0.450]
External IV:	NO	NO	YES	NO	NO	YES
Additional regressors:	NO	NO	NO	YES	YES	YES
TFP (in logs)				0.811***	2.081***	2.380***
				[0.099]	[0.708]	[0.689]
Size (in logs)				0.667***	0.989***	0.892***
				[0.080]	[0.226]	[0.204]
Capital intenstiy (in logs)				0.106**	0.292	0.246
				[0.054]	[0.207]	[0.193]
Leverage				0.007	0.010	0.007
				[0.005]	[0.014]	[0.013]
Age (in logs)				-0.019	-0.120**	-0.114**
				[0.037]	[0.056]	[0.054]
MNC				-0.129	-0.197	-0.190
				[0.114]	[0.169]	[0.165]
Recession				-0.087***	0.784	1.076**
				[0.034]	[0.532]	[0.459]
Number of establishments				-0.173	-0.383***	-0.347***
				[0.106]	[0.109]	[0.101]
Number of:						
Observations	3877	3877	3877	3814	3629	3629
Groups	655	655	655	647	643	643
Instruments		30	32		51	53
Arellano-Bond AR(2) test		3.38 (0.001)	3.42 (0.001)		1.46 (0.145)	1.23 (0.218)
Hansen test of overid.		0.08 (0.959)	2.30 (0.680)		13.6 (0.402)	14.6 (0.480)
Difference-in-Hansen tests:						
GMM instruments for levels		0.08 (0.959)	1.96 (0.582)		5.44 (0.710)	7.05 (0.632)
Lagged exports		0.08 (0.959)	1.04 (0.595)		2.13 (0.345)	2.63 (0.269)
Input price		0.08 (0.959)	1.99 (0.369)		1.76 (0.415)	1.40 (0.496)
REG (level equation)			1.03 (0.311)			0.53 (0.465)
REG (difference equation)			0.77 (0.379)			0.37 (0.543)
TFP					2.42 (0.659)	2.24 (0.692)
Size					5.16 (0.523)	6.01 (0.422)
Capital intensity					4.00 (0.406)	2.80 (0.591)
Leverage					2.76 (0.599)	2.17 (0.705)

Notes: All specifications include a constant term, time and industry dummies; *** denotes statistical significance at 1%, ** at 5% and * at 10% level. Columns (2)-(3),(5)-(6): Two-step efficient system GMM estimation; Windmeijer-corrected robust standard errors (in brackets); the test statistics are reported with p-values in parentheses. Columns (1),(4): OLS with fixed effects; robust standard errors (in brackets). MNC refers to the multinational corporation dummy. The dummy recession is instrumented with its own lag. The REG indicator is based on the benchmark US input-output table.
Source: Authors' calculations based on ESEE, Fundación SEPI.

However, despite the fact that the *p*-values of the Hansen and the difference-in-Hansen tests for instrument validity exceed the 'common sense' threshold of 0.25 (Roodman, 2009), the Arellano-Bond test suggests that lagged instruments are being made invalid through autocorrelation.

The estimates of the full empirical model are presented in the last three columns of Table 5. In particular, columns 5 and 6 show that the inclusion of *REG* as an external instrument does not influence the coefficient on the input price. The regression in column

6 performs relatively well on the overidentification tests, albeit one p-value is just above the threshold of 0.25. Overall, we do not find robust evidence of an input cost channel through which service regulations influence the volume of exports of SMEs. Table 5 reveals the relevance of size and, especially, TFP for the export performance of SMEs, with point elasticities of 0.9 and 2.4 per cent, respectively. Likewise, the results show that the SMEs reporting a recessionary main market witnessed a significant rise of their sales abroad compared to those that did not report it. In addition, the estimates suggest that the age of the firm and the number of industrial establishments are negatively associated to the volume of exports. The latter result might capture, among other factors, the presence of an expansion strategy that favours reaching the domestic market over gaining scale or location for the foreign market. On the other hand, capital intensity, the level of long-term leverage with financial institutions and being owned by a foreign multinational corporation are not significantly associated to the export volume of SMEs.[26]

5. The estimated impact of service sector deregulation on firms' exports

This section presents a number of simulations that intend to illustrate the impact on firm-level manufacturing exports of adopting a more efficient regulatory framework in upstream services. Given the evidence gathered so far, the simulations are confined to the case of large firms. Using the estimated coefficients reported in column 3 of Table 2, the first exercise compares the rate of variation in the price of intermediate consumption from 1991 to 2007 fitted by the model with the corresponding counterpart once we assume that all components of REG_{jt} stayed constant over the sample period at their respective 1989 value. We then apply the long-run elasticity of exports (1.25 per cent) to the difference of the above inflation rates in order to gauge an orientative magnitude of the difference in export performance between the scenario in which Spain did not improve its regulatory framework at all and the scenario of observed service sector deregulation. Figure 3 presents the results of the first simulation.[27] The figure shows that the effects of lower service regulation on downstream manufacturing exports can be sizeable: from the smallest gains recorded in electrical and optical equipment (8.9 per cent) and transport equipment (14.3 per cent) to the largest gains recorded in chemicals (27 per cent), food products (27.7 per cent) and other non-metallic mineral products (36.6 per cent). From 1991 to 2007, the effect of services reforms channelled through the price of intermediate consumption increased exports by 22 per cent, on average. Consistent with Figure 2, the firms that benefited the most belonged to industries typically more dependent on service inputs.

[26] The specifications in Table 5 do not include the market share in the main market, as an overwhelming majority of SMEs declare it to be atomistic.

[27] In the figure, the numbering of manufacturing industries follows the order displayed in Table A.1.

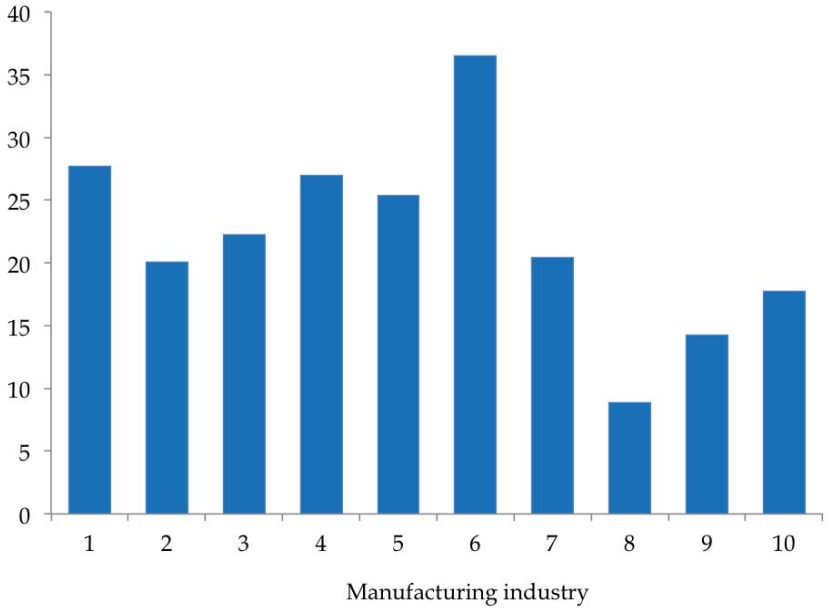

Figure 3: *Difference in total exports of large firms by sector of activity: Deregulation vs. no deregulation, 1991-2007 (%).*

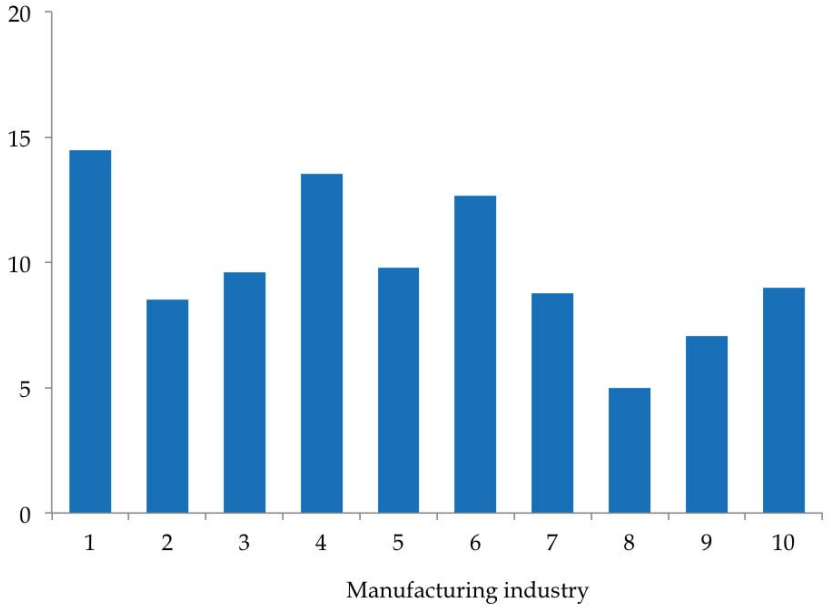

Figure 4: *Potential increase in total exports of large firms by sector of activity from convergence to the best-practice regulatory scenario, 1991-2007 (%).*

The second exercise calculates the potential firm-level export gains from Spain's adoption of the 'best practice' regulatory framework. Our counterfactual exercise assumes that REG_{jt} managed to converge to the 'best practice' value in 2007, the latter defined as the average regulation achieved in that year by the three countries with the best regulatory environment over the whole sample period. This 'best practice' regulation value is used to extract the simulated rate of variation in the price of intermediate consumption from 1991 to 2007, which is then compared with the fitted rate of variation of observed deregulation. Once again, we apply the long-run elasticity of exports to the difference in inflation rates. Figure 4 depicts the results of the exercise. Convergence to the 'best practice' regulatory framework would have increased exports by a further 9.8 per cent, with a range of variation that spans from 5 per cent (electrical and optical equipment) to 14.5 per cent (food products).

6. Robustness

Once our main findings are established, we carry out a number of robustness checks on the identification of the input cost channel. Columns 1 and 4 of Table 6 present the results of the full empirical model in Eq. (4) when the direct weights of Spain's input-output matrix for the year 2000 are used to compute the extent of service dependence in the measure of REG_{jt}. Once again, the evidence suggests that there is an input cost channel through which services reforms affect large firms' exports, while the evidence for SMEs is lacking.[28] Albeit the coefficient estimate on the price of intermediate consumption increases somewhat if compared to the baseline SMEs' specification, the exogeneity tests cast some doubt on instrument validity. Notice that the coefficient estimates of the other explanatory variables remain robust to the change of benchmark input-output matrix.

The results that figure in columns 2 and 5 of Table 6 account for the potential role of financial confounders identified in the literature. In particular, financial depth addresses the impact on firm exports of the scope and quality of Spain's financial system, while allowing for different levels of financial dependence by industry. Financial depth is thus defined as the product of financial development and external financial dependence, where the former is proxied by the ratio of private domestic credit to GDP and the latter is measured by an industry-level index of short-term liquidity needs (Raddatz, 2006, and Kroszner *et al.* 2007). Since Spain's private credit over GDP expanded substantially from the late 1990s till the eruption of the 2008 financial crisis, we try with alternative definitions

[28] This conclusion is robust to the use of the direct and indirect weights of the US input-output table for the year 2000 in the construction of *REG*. In an attempt to solve the measurement problem associated to service dependence, Barone and Cingano (2011) adopt the approach of Ciccone and Papaioannou (2006). The objective is to recover a measure of industry-level service dependence that is not specific to a benchmark country or to a level of regulation. Under this approach, a two-step estimation procedure produces an instrument for average service-dependence. Once the instrument is incorporated in the *REG* measure, Barone and Cingano (2011) confirm the robustness of their estimated baseline model.

Table 6. Service regulation and firms' foreign sales: Spain 2000 weights, financial depth and alternative TFP measure, 1992-2007

Dep. variable: Log exports	Large firms			SMEs		
	(1) Spain I/O	(2) Financial depth	(3) TFP based	(4) Spain I/O	(5) Financial depth	(6) TFP based
Regressors	2000 direct		Olley-Pakes	2000 direct		Olley-Pakes
Log exports (t-1)	0.340***	0.353***	0.318***	0.360***	0.364***	0.397***
	[0.085]	[0.082]	[0.077]	[0.065]	[0.064]	[0.061]
Input price (in logs)	-0.813***	-0.793***	-0.799***	-0.898*	-0.798*	-0.591
	[0.263]	[0.257]	[0.277]	[0.474]	[0.457]	[0.375]
External IV:	YES	YES	YES	YES	YES	YES
Additional regressors:	YES	YES	YES	YES	YES	YES
TFP (in logs)	1.221***	1.204***	1.293***	2.477***	2.310***	1.992***
	[0.396]	[0.381]	[0.346]	[0.739]	[0.698]	[0.536]
Size (in logs)	0.695**	0.679*	0.813**	0.914***	0.944***	0.934***
	[0.348]	[0.355]	[0.351]	[0.212]	[0.211]	[0.193]
Capital intenstiy (in logs)	0.248	0.225	0.256	0.307	0.274	0.192
	[0.190]	[0.182]	[0.185]	[0.206]	[0.195]	[0.198]
Market share	0.000	0.000	0.000			
	[0.003]	[0.003]	[0.003]			
Leverage	-0.003	-0.004	0.001	0.006	0.008	0.008
	[0.012]	[0.016]	[0.012]	[0.012]	[0.013]	[0.015]
Age (in logs)	-0.080**	-0.075*	-0.089**	-0.118**	-0.122**	-0.105*
	[0.038]	[0.039]	[0.037]	[0.055]	[0.055]	[0.054]
MNC	0.052	0.054	0.033	-0.220	-0.207	-0.080
	[0.061]	[0.060]	[0.058]	[0.167]	[0.165]	[0.160]
Recession				1.034**	1.093**	0.929*
				[0.475]	[0.466]	[0.528]
Number of establishments				-0.365***	-0.359***	-0.319***
				[0.108]	[0.103]	[0.096]
FINDEV x LiqNeeds		-0.010			0.043	
		[0.037]			[0.037]	
Number of:						
Observations	3943	3697	3943	3629	3629	3629
Groups	573	562	573	643	643	643
Instruments	46	46	47	53	54	52
Arellano-Bond AR(2) test	0.03 (0.975)	0.50 (0.614)	-0.07 (0.947)	1.24 (0.214)	1.19 (0.234)	1.53 (0.125)
Hansen test of overid.	2.56 (0.995)	2.78 (0.947)	3.28 (0.987)	15.1 (0.445)	14.4 (0.498)	15.1 (0.371)
Difference-in-Hansen tests:						
GMM instruments for levels	1.78 (0.987)	1.72 (0.988)	2.09 (0.978)	7.11 (0.626)	6.46 (0.693)	8.98 (0.439)
Lagged exports	0.59 (0.744)	0.83 (0.660)	0.21 (0.902)	2.88 (0.237)	2.69 (0.261)	2.61 (0.271)
Input price	0.00 (0.998)	0.15 (0.926)	0.11 (0.947)	2.32 (0.314)	1.46 (0.481)	1.20 (0.548)
REG (level equation)	0.06 (0.813)	0.01 (0.920)	0.28 (0.597)	0.20 (0.657)	0.05 (0.831)	1.55 (0.213)
REG (difference equation)	0.54 (0.462)	0.26 (0.608)	0.07 (0.788)	1.13 (0.288)	0.50 (0.479)	0.74 (0.388)
TFP	0.08 (0.959)	0.14 (0.933)	1.12 (0.572)	3.22 (0.522)	2.41 (0.660)	1.87 (0.393)
Size	0.35 (0.840)	0.29 (0.866)	0.61 (0.737)	5.47 (0.485)	5.85 (0.441)	7.08 (0.313)
Capital intensity	0.48 (0.787)	0.47 (0.791)	0.12 (0.944)	3.60 (0.462)	3.06 (0.547)	2.62 (0.623)
Market share	0.22 (0.897)	0.10 (0.949)	0.32 (0.852)			
Leverage	1.57 (0.814)	1.54 (0.820)	1.74 (0.784)	1.56 (0.817)	2.40 (0.663)	2.78 (0.595)

Notes: See the text and the notes to Tables 3 and 5. Financial depth is defined as the product of FINDEV (domestic credit to the private sector, excluding construction and real estate activities, over GDP) and LiqNeeds (an industry-level index of short-term liquidity needs). System GMM estimation method.
Source: Authors' calculations based on ESEE, Fundación SEPI.

of private credit that may or may not include credit to the construction and real estate sectors.[29] We use Raddatz (2006) and Kroszner *et al.* (2007) measure of liquidity needs by industry, which is defined as the ratio of total inventories over annual sales for US firms over the period 1980-1999.[30] Once again, adopting the US economy as a benchmark assumes that the financial structure displayed by US firms captures more closely the firm's choice of outside funds that only obeys to technological and economic reasons.[31] Notice that external dependence is beyond the control of individual firms and inherent to the nature of the industry, that is, firms operating in certain industries may face higher short-run working capital needs mostly related to the variable costs of their activity. The estimations reported in columns 2 and 5 of Table 6 do not find a significant relationship between financial depth and the volume of sales abroad, albeit the coefficient is correctly signed and the *p*-value is closer to significance in the SMEs subsample. Without precluding the possibility that its effect is partly picked up by the dummies, our results indicate that the economy's increased ability to support financial relationships did not necessarily raise the intensive margin of exports. In practice, the evidence may suggest that manufacturing firms rely on retained earnings, internal cash flows or some other form of trade credit to fund the variable costs of exporting. Finally, notice that, after controlling for financial depth, our main conclusions regarding the evidence of an input cost channel through which service regulation influences firms' exports still hold. The rest of the coefficient estimates are generally stable.

Columns 3 and 6 of Table 6 show that the results are robust to the use of an alternative estimate for firm-level TFP based on Olley and Pakes (1996). In the case of large firms, the coefficient of interest increases and the exogeneity tests tend to improve, while results again do not support an input cost channel of services reforms in the case of SMEs. The rest of the point estimates are stable. In two final robustness exercises, we first added the real volume of world exports by manufacturing industry to the baseline specifications in order to account for the upward world trade trend of the period. The world exports variable appears correctly signed but insignificant while the estimate on the price of intermediate consumption was robust to this change. And second, we included the regulatory impact indicator directly in the full empirical model of Eq. (4) to confirm that the results were not driven by the omission of the institutional variable in levels.[32]

[29] Kaminsky and Reinhart (1999) suggest that private credit over GDP may bias the financial depth proxy upwards during periods of rapid credit growth, which was the case of Spain in the 2000s.

[30] As noted in Manova *et al.* (2013), the ratio serves as a proxy for the duration of the production cycle and the liquidity needs to keep inventories stable and face demand.

[31] For example, US data is less likely to be distorted by factors such as industry subsidies. Kroszner *et al.* (2007) report the median level of various measures of external financing across US ISIC industries for the period 1980-1999. To match our industry classification, we compute the median of the relevant indicators of the ISIC classification.

[32] Estimates are available from the authors upon request.

7. Conclusions

Growing evidence suggests that regulatory barriers to competition in the markets for inputs matter for the performance of downstream industries. To date, the literature has shown that anti-competitive service sector regulation curbs productivity growth and determines the pattern of comparative advantage and trade. However, empirical evidence regarding the firm level mechanisms that drive these results was still lacking. In a panel study of firm-level data from Spanish manufacturers, we present evidence suggesting that service sector deregulation reduces the price of intermediate inputs paid by firms. Furthermore, the pro-competitive cost effect of better service regulation is bigger when downstream firms are large. Unlike SMEs, large firms may be able to negotiate better input prices in the face of a more competitive input market environment, raising their ability to compete internationally. Indeed, our estimates indicate that a better regulation is very beneficial for the export performance of large corporations, while the evidence for SMEs is weaker. Hence, firm characteristics matter for the impact of regulation on input prices and export volumes. Simulation exercises of our baseline specification suggest that large firms increased substantially their volume of exports as a result of services reforms, such that the firms that benefited the most belonged to industries typically more dependent on service inputs.

Appendix

A.1. Sample distribution by sector of activity.

Table A.1. Sample frequency by sector of activity, 1991-2010

INDUSTRY	Total sample	Large firms	SMEs
Food products, beverages and tobacco	4374	1367	3007
Textiles, textile products, leather and footwear	3406	650	2756
Pulp, paper, paper products, printing and publishing	3236	712	2524
Chemicals	2025	955	1070
Rubber and plastics products	1627	446	1181
Other non-metallic mineral products	2130	659	1471
Basic metals and fabricated metal products	5764	1629	4135
Electrical and optical equipment	2262	1039	1223
Transport equipment	2023	1200	823
Manufacturing nec	2290	323	1967
Number of observations (sum)	29137	8980	20157

Note: See the text for a description of each sample.
Source: Authors' calculations based on ESEE, Fundación SEPI.

A.2. Firm-level TFP estimation using Levisohn and Petrin's (2003) control function approach.

The point of departure to obtain firm-level TFP estimates is the log-linearized representation of a standard Hicks-neutral Cobb-Douglas production function where firm's gross output depends upon a number of observed determinants (namely capital stock, labor and intermediate inputs) and of unobserved determinants that are gathered in the productivity term, commonly referred to as TFP. In this context, we use the Levinsohn and Petrin (2003) estimation technique that adopts an explicit structural model of firm behavior to address the well-known 'transmission bias' problem and that accounts for serial correlation of productivity shocks. In order to derive their production function estimator, Levinsohn and Petrin (2003) rely on the firm's demand for intermediate inputs to back out a proxy for unobserved productivity. The identification of production function elasticities is done in a two-stage estimation procedure that critically hinges on a number of assumptions, e.g., a monotonically increasing relation between intermediate input use and productivity, the 'quasi-fixed' nature of capital stock whereby the level of capital stock is determined *prior to* firm's experience of the random productivity shock, or that the first lag of intermediate input use can serve as an instrument to identify the intermediate input elasticity in the second-stage of the estimation. Albeit the choice of this estimator is not absent of criticism, from Table A.1 we note that the magnitudes of the estimated input elasticities are consistent with the ones obtained in the literature using alternative techniques applied to the ESEE database (González and Miles-Touya, 2012).[33] The estimator was implemented on firm-level data from 10 manufacturing industries using the *levpet* command in Stata (Petrin *et al.*, 2004).

[33] A thorough and critical survey of the estimation techniques available for Cobb-Douglas production function estimation at the firm level can be found in Eberhardt and Helmers (2010).

Table A.2. Input elasticities estimated using Levinsohn and Petrin's (2003) control function approach, 1991-2010

INDUSTRY	Capital	Labor	Materials	Wald test: CRS	N
Food products, beverages and tobacco	0.09 ***	0.12 ***	0.77 ***	(0.902)	4374
Textiles, textile products, leather and footwear	0.08 *	0.25 ***	0.63 ***	(0.674)	3406
Pulp, paper, paper products, printing and publishing	0.07	0.28 ***	0.43 ***	(0.095)	3236
Chemicals	0.15 **	0.18 ***	0.48 **	(0.264)	2025
Rubber and plastics products	0.22 ***	0.31 ***	0.43 ***	(0.740)	1627
Other non-metallic mineral products	0.07 ***	0.16 ***	0.73 ***	(0.373)	2130
Basic metals and fabricated metal products	0.09 **	0.24 ***	0.68 ***	(0.844)	5764
Electrical and optical equipment	0.05	0.27 ***	0.54 ***	(0.170)	2262
Transport equipment	0.10 **	0.20 ***	0.68 ***	(0.777)	2023
Manufacturing nec	0.15 **	0.24 ***	0.52 ***	(0.345)	2290

Notes: Firm's output is the value of total sales plus the variation of inventories deflated by a firm-specific price index of output. Real capital stock is the firm's stock of capital evaluated at the current replacement value deflated by the price index of investment in equipment goods, where capital stock at the current replacement value is obtained using the perpetual inventory method that requires an initial-year estimate of capital stock and data on firm's investment in the previous period (for a detailed account on how to estimate capital stock from the ESEE, see Escribano and Stucchi (2008)). Labor input is defined as total effective hours worked. Materials is the value of intermediate consumption (raw materials, components, energy and services) deflated by a firm-specific price index of materials. Real capital stock is adjusted by firm-level data on capacity utilization. Variables are expressed in logs. *** denotes significance at 1%, ** at 5% and * at 10% levels. In parentheses, p-values of Wald tests on constant returns to scale (CRS). N refers to the number of observations.
Source: Authors' calculations based on ESEE, Fundación SEPI.

A.3. Time variation of the regulatory indexes in services.

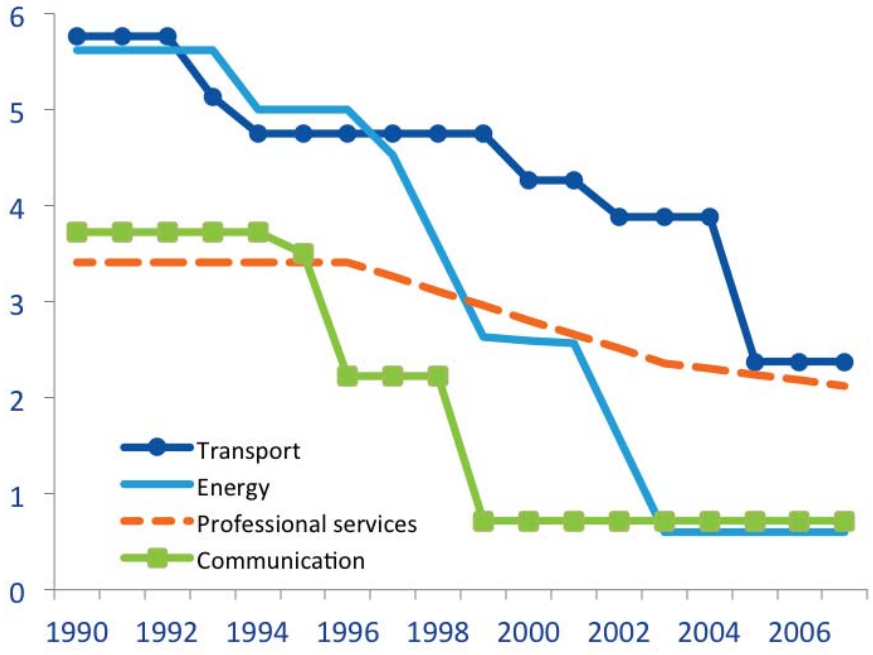

Figure A.3: *Spain: Regulatory indexes of four upstream service activities.*

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