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Competition in Services and Efficiency of Manufacturing Firms: Does "Liberalization" Matter?

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Competition in services and efficiency of manufacturing firms: does "liberalization" matter?*

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Abstract

In developed economies, services form an increasing proportion of inputs employed by manufacturing firms. While downstream firms act in a very competitive environment, services often operate in protected or highly regulated markets. In this paper, I empirically investigate whether the degree of competition in services affects the efficiency of manufacturing firms through services production inputs. By using both firm and sector level data for France, through input-output analysis I show that variations in the upstream competition, especially in network industries, affect the average productivity level in manufacturing industry: an increase in average markups is associated with a reduction in manufacturing productivity. The findings differ according to firms size and initial efficiency level: in the short run less efficient and small firms are relatively mostly harmed by an uncompetitive service sector.

Keywords: Service sector, competition, productivity, I-O tables.

JEL Classification: D24, L11, L51, L80

*First Version: September 2007. Some sections of this paper incorporate methods and procedures contained in a CESifo working paper n.2942 "Competition in the service sector and the performances of manufacturing firms: does liberalization matter?" and chapter 2 of my Ph.D. thesis. All estimations are, however, updated and new. I thank Hylke Vandenbussche, Gianmarco Ottaviano, Horst Raff, Giordano Mion, Jozef Konings and Davide Castellani for useful comments. I gratefully acknowledge fundings from EARIE and Center for Operation Research and Econometrics (CORE)

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1 Introduction

In recent years, the provision and consumption of services have been crucial to developed economies. This so-called tertiary sector accounts for large fractions of GDPs, and it employs a large portion of the labour force¹. Changes in consumers' preferences for services (mobile calls, internet, bank accounts, and distribution chains) are not the only factor contributing to this growth. Manufacturing firms have been increasing their use of services in the production process. Traditional industrial sectors purchase services to implement production, sell output, to manage their financial activities. Services such as transport, retail, and telecommunications (TLC) are inputs fundamental to a firm's existence. By considering input-output (I-O) tables, it is possible to observe the increasing role of services as input providers for manufacturers. In the UK, the burden of services on total input rose from 25% in 1984 to 44% in 1995 (Barba-Navaretti et al., 2006). In France, the share of services in manufacturing increased by 17% between 1995 and 2000 (Eurostat: I-O Tables 2000), peaking at 28% among manufacturing inputs.

Despite these facts, little of the economic literature explicitly addresses services as inputs for the production process. In such a framework, it is important to consider the services' market structure. Within the traditional models of an industrial organisation, a concern arises when upstream and downstream sectors are characterised by different market powers (Gabszewicz and Zanaj, 2007): the downstream profitability is harmed whether the competition in the upstream market is weak. Services and manufacturers are empirically observed to operate in two different competitive environments (Barba-Navaretti et al., 2006). Manufactured goods are usually involved in strongly competitive markets, while many service providers operate in monopolistic (energy) or protected (financial- or business-related activities) sectors². While manufacturers are increasingly exposed to fierce competition (trade liberalisation), services are relatively more protected. Given that manufacturing firms employ services as inputs in the production process, the combination of both anti-competitive domestic regulation and protection against foreign competitors potentially weakens the competitive position of those domestic firms that rely on

¹The share of European GDP comprising services rose from 52.2% in 1970 to 70% in 2000. Source: OECD (2005).

²In the next section, I consider the differences among services types. Unlike manufacturers, services do not extensively compete in international markets, so competitive pressure in the tertiary sector is potentially lower. Recently, Ariu and Mion (2010) showed that services trade has increased because of technical innovation.

services as inputs. In the present paper, I analyse whether variations in the average degree of service competition affect the efficiency of downstream (manufacturing) firms through the provided inputs³.

Recently, Arnold et al. (2011) showed that services competition affects manufacturing firms' productivity in the Czech Republic. When service liberalisation occurred, foreign entry contributed to the improved performance of manufacturing sectors. The authors provide evidence that the liberalisation process had a relevant and positive impact for all manufacturers. Such an empirical relationship can be explained by several mechanisms. For example, tougher competition may stimulate firms to invest in R&D or to upgrade the quality of services provided (Aghion et al., 2006). Similarly, high-performance inputs increase the efficiency of the production process (Amiti Konings, 2007): these improvements will facilitate production and reduce operating costs in downstream manufacturing firms. Moreover, through competition, liberalisation stimulates an increase in the number of provided varieties; the expansion of the number of varieties used in production is a source of productivity growth in the case of imperfect substitution among inputs (Ethier, 1982).

Compared with previous literature, the present paper provides two novel considerations. First, a developed economy as France is the subject of the analysis while the other studies focus on developing countries or transition economies (e.g. Arnold et al. (2011) for Czech Republic; Fernandes and Paunov (2008) for Chile). In a developing country (or in a transition economy), a liberalization process usually impacts all economic sectors. In such a case, the economy is likely to observe service liberalisation and growth in manufacturer productivity, both due to the modernisation process. Such simultaneity can bias an analysis that relies on I-O matrices (as do the present and previous studies), making it difficult to disentangle the contribution of services competition from the pure productivity growth due to reallocation. The French data minimise such concerns because France has not recently experienced a wide and deep transformation of the economic system.

In addition, France is an interesting case study because of the relatively low level of services

³The WTO argues that *it is impossible for any country to prosper today under the burden of an inefficient and expensive services infrastructure. Producers and exporters of textiles, tomatoes or any other product will not be competitive without access to efficient banking, insurance, accountancy, telecoms and transport systems [...]. The benefits of services liberalisation extend far beyond the service industries themselves; they are felt through their effects on all other economic activities[...]* WTO-GATS FactBook (2005).

competition. The OECD has estimated that services deregulation in France may generate gains in terms of economic efficiency: if France was to align its norms on regulation (specifically in the service sectors) to that of the least restrictive OECD countries⁴, over the subsequent ten years it would stand to gain an estimated net maximum annual extra growth of 1.41% (in terms of multi-factor productivity, i.e. MFP). Table 1.1 shows the potential benefits due to an economic deregulation for the whole French economy. In particular, liberalisations in network services should increase benefits; therefore, the impact of competition in network industries (e.g. electricity, TLC, and transport) is carefully considered.

Table 1.1: Effect of easing regulation on MFP*.

	MFP growth over ten years % increase in the annual rate	Inward FDI % increase in level
Economy wide regulation	0.19	0.57
Industry specific regulation	0.43	-
State ownership	0.79	-
FDI restrictions	-	0.10

‡ Source: OECD France Survey 2001

The second novel aspect of this work is the methodology applied to measure the degree of services competition. Unlike the work of Arnold et al. (2011) and Bourlés et al. (2011) which rely on indicators reported by international institutions (as OECD or the European Bank of Reconstruction and Development), in the present paper service-sector competition is measured by market-based indicators. Using firm-level (Amadeus, Bureau Van Dijk), and sector-level (OECD Stan) data, I represent services competition with theory-based indices such as price-cost margin, concentration index, or markup. The favorite indicator for competition is a firm's markup, which is obtained by estimating a structural model (De Loecker Warnzinsky, 2012) of imperfect competition with firm-level data. I show that the computed proxies (markups and others) are consistent with the underlying theoretical models; therefore, these indicators can be considered reliable approximations of both market structure and the strength of the services competition. After aggregating markups, I-O matrices⁵ (at NACE 2 digit) are used to link services with

⁴The OECD claims that the liberalisation of network industries in France lagged behind that of other large continental countries. However, the first wave of French deregulation reforms have begun to produce positive externalities in terms of lower prices, more diversified supply, and improved quality, and it has had an impact on economic activity. Source: OECD (2001).

⁵Even if efficiency is measured at a firm level, it is important to observe that I-O coefficients (at NACE 2 digit) provide a macroeconomic interpretation of the results: the empirical results show how variation in the average degree of competition affects the average productivity of manufacturers.

manufacturing sectors. Then I define the firm-level productivity of manufacturers as residual of a production function, and I perform a short-run analysis in which a firm's productivity depends on the services competition level: in particular, the empirical analysis exploits the role of network services as input providers.

This paper contributes to the recent literature on services' liberalisation process in terms of both methodology and policy conclusions. First, I provide evidence that a reduction in the average services' markup has a positive impact on manufacturing productivity. In the preferred econometric result, it is shown that a reduction of one standard deviation⁶ of the average markup increases the average manufacturer efficiency by 1.5%. Second, I identify heterogeneous responses of firms from variations in services competition. The magnitude of the effect depends on the relative size and initial efficiency of a firm; in the short-run, smaller and less efficient firms are harmed by a reduction of services competition. Finally, I show that the empirical relationship is determined by a specific sub-sample of services, network industries (energy, telecommunication, transport, etc.). The same qualitative conclusion may be drawn if competition indicators from the OECD are used (entry barrier index in network industries). According to OECD (2001), an increase in competitive pressure can potentially produce benefits in terms of efficiency growth for the whole economy (Table 1.1). This paper concludes that a negative correlation exists between manufacturers efficiency and the competition in services; thus, policies in favour of services competition (and in particular network industries) have effects far beyond the service sectors themselves.

The paper is organised as follows. Section 2 discusses the related literature. In Section 3, I describe the data, competition indicators, and efficiency measures for both services and manufacturers. Section 4 illustrates the empirical strategy and discusses issues with the estimations. In Section 5, I report the estimation results, and in Section 6 I perform robustness checks. Finally, Section 7 concludes.

⁶One standard deviation unit over the mean for network services.

2 Literature

The role of inputs as factors influencing a firm's efficiency has been widely analysed. Amiti and Konings (2007) provide evidence that the productivity of Indonesian manufacturing firms increased when taxes on imports were reduced. Given that imported goods are used as inputs, a 10 percentage point decrease of the import tariff increases firms' productivity by 12%; a variety of expansion and substitution effects are identified as the main mechanism of transmission. Moreover, an import tariff reduction has a larger impact on productivity than does an output tariff reduction. Similarly, Forlani (2009) finds, for a sample of Irish firms, that imports' intensity is a source of productivity growth, and in particular, that the effect is more significant for the less efficient firms.

The theoretical modelling of I-O linkages (and productivity growth) is more challenging. Bourlés et al. (2011) develop an endogenous growth model in which they show how competition affects innovation in the input market (raising competition stimulates incentives to innovate) and consequently productivity growth in downstream sectors. In a similar framework, Grossman and Helpman (1991) show that a monopolistic competitive sector that produces horizontally differentiated intermediate inputs can affect the productivity of a final good producer; an expansion of upstream variety increases the downstream efficiency via imperfect substitution among intermediate inputs.

Similar to the present work are Arnold et al. (2011) and Fernandes and Paunov (2008), which emphasise the role of services in the production processes of manufacturing firms. Arnold et al. (2011) show that service liberalisation has had a positive impact on the average productivity of manufacturing firms in the Czech Republic. The authors employ institutional indicators⁷ that capture different aspects of service liberalisation (in particular foreign entry); they link services with manufacturing by employing I-O matrices. Finally, they evaluate the impact of liberalisation on productivity growth with matching techniques. The authors explain that service liberalisation improves input quality (lower cost for a given characteristic) and expands the available variety: better quality and a large variety of inputs explain manufacturing productivity growth. Therefore, the main findings are twofold. First, policies in favour of services liberalisation

⁷The indicators are provided by the European Bank of Reconstruction and Development.

are important to manufacturing firms' efficiency, as long as firms rely on services as inputs. Second, Arnold et al. (2011) show that foreign services competition is a key channel to improve the performances of downstream manufacturing sectors.

In a similar framework, Fernandes and Paunov (2008) show, by employing Chilean firm-level data, that inward FDI in service sectors have a positive effect on manufacturing productivity. Part of this productivity growth is explained as an effect of backward spillovers from services. Bourlés et al. (2010) provide an empirical analysis similar to that presented here. Based on an endogenous growth model, their analysis examines the impact of service-sector regulation on productivity growth; by estimating a panel of 15 OECD countries and 20 sectors (both services and manufacturers) for the period from 1984 to 2007, they conclude that anti-competitive regulation (approximated by OECD indicators) shrinks productivity growth, in particular for sectors close to the productivity frontier in the long-run. While they conclude that pro-competitive policies have a positive impact on productivity growth, the present paper claims that a negative correlation exists between services competition and manufacturing efficiency. Similarly, Daveri et al. (2011) find that firm-level productivity is negatively correlated with a sector's entry barriers: the effect is determined by a firm's markup.

Unlike the previous literature, the present paper is focused on firm-level manufacturing productivity. The empirical strategy is partially similar to other applied research on cross-market linkages; however, there are differences in terms of the analysed sector (manufacturing) and aggregation level (Bourlés et al., (2011)), as well as in terms of competition indicators and targeted country (Arnold et al., (2011)). In particular, market-based indicators provide an additional source of information for single-country analysis because they are derived from theoretical models: given that a uniform measure of competition across countries is not required, market-based indicators may convey additional information. Finally, France provides an interesting case that offers benchmark results (OECD, 2001). A developed economy allows us to minimise the problems of reallocation and technology change. In the case of a developing country (or transition economy), the main risk is measuring a spurious relationship between services liberalisation and productivity growth, thus allowing for the possible overestimation of the impact of services because of the simultaneous growths of manufacturing productivity and of services competition.

3 Data Analysis

To estimate the empirical relationship between manufacturing efficiency and services competition, both firm and sector-level data are employed (sources in Tab. A.1). I separate service-sector data from manufacturing data because each group involves different issues related to estimation. First, I describe the service-sector data with relative competition proxies; then I describe the data for manufacturing sectors and the corresponding productivity measures.

3.1 Service data

Service-sector data are collected at both the firm level and the sector level (NACE 2). The Amadeus (Bureau Van Dijk) database is the main source for firm-level data, containing the annual balance sheet data for a large number of French firms. Here, I consider firms with one million Euros of operating revenues in 2004. The dataset includes 7596 service firms operating in France from 1996 to 2004. Services are divided in four macro groups: network, retail, financial services, and other business activities (Appendix A). I recover information on operating revenues, fixed assets, material costs, labour force, wage bill (total expenditure for labour force), and value added, among others. Nominal values are expressed in thousands of Euros, and the variables are deflated with sector-specific deflators (Source: EU-Klems).

Sector-level data are collected from three different sources. The OECD Stan database provides data for market size (revenues), labour market size, and an indicator for the level of entry barriers in services (Conway and Nicoletti, 2006); the EU-Klems database is the source for price deflators, while Eurostat reports input-output coefficients (purchase value). Given that I-O coefficients are defined at a NACE 2 digit level, sector-level data are collected (or calculated) at the same level of aggregation (Table A.2 reports the descriptive statistics). Finally, the number of firms with more than 10 employees (in NACE 2) is collected from Insee-Alisse⁸.

With the mentioned data, I calculate competition indicators that vary over time and across sectors. A large variety of approaches has been used to approximate competitive pressure and to assess the impact of competition. In the present paper, market-based indicators are preferred to increase the precision via theory-based indicators (compared to institutional index) and to iden-

⁸Institut National de la Statistique et des Études Économiques, and Accès en Ligne aux Statistiques Structurelles d'Entreprises. French national office of statistics.

tify correlations between manufacturing efficiency and services competition, rather than evaluate the effect of policy intervention. Given that liberalisation and deregulation policies⁹ are implemented to raise the competition level, I am confident that the degree of services competition can be captured by market-based indicators. Even if institutional measures are more useful in a cross-country analysis because they are harmonised (Bourlés et al., 2011), market-based indicators are more suitable in the case of a single-country analysis because of the market structure approximation and firms' heterogeneity.

3.1.1 Market power measures

The main indicator for services competition is given by firm-level markup, estimated according to the procedure¹⁰ of De Loecker Warzynski (2012, DLW onward). Markup measures a firm's market power, that is, the firm's capacity to charge higher prices for a given demand. In an imperfect-competition framework, a firm sets a price above its marginal cost¹¹. The DLW methodology is based on a cost minimisation problem for variable inputs without adjustment costs (materials), and markup is defined as the ratio of price to marginal cost (p/c). The output elasticity to input is related to the share of input's expenditure in total sales and a firm's markup as follows:

$$\beta_{it}^X = \mu_{it} \frac{P_{it}^X X_{it}}{PQ_{it}} \quad (3.1)$$

where β_{it}^X is the output elasticity to input X (i.e. materials). To estimate markup, it is necessary to recover output elasticity from the estimation of a production function and to calculate (from micro-level data) the share of input X in total sales (PQ_{it}). Such methodology is based on the control function approach developed by Olley Pakes (1996) and Levinsohn Petrin (2003) to control for unobserved productivity shocks which are correlated with input demand. The procedure consists of two steps and follows Akerberg et al. (2006) (ACF) closely. We assume a value added Cobb-Douglas production function in three inputs¹²: labour (l), material (m), and

⁹In the present paper, I interchangeably use liberalisation and deregulation to describe policies designed to change market structure, i.e. to raise the competition level.

¹⁰A similar approach has been developed by Martin (2010).

¹¹Under the assumption of a downward sloping demand curve.

¹²Implicitly, it is assumed that deflated sales are considered a measure of physical quantity. In the context of markup estimation, the omitted price variable bias is not a concern, given that we are not interested in a reliable

capital (k). The Cobb-Douglas production function in three inputs is preferred for two reasons. First, it allows for the use of material as a free adjustable input in the estimation of markups (our measure of interest): labour seems a priori less flexible as an input for a rigorous estimation of μ . Second, a translog function in three inputs, albeit flexible, requires the estimation of too many parameters (10). A material demand function is used to proxy the unobserved productivity shocks (ω_{it}); the markets share for the principal NACE 4 market is included as an additional control for the input demand function¹³. The first stage of DLW is similar to ACF, and it requires the estimation of following equation in logs:

$$y_{it} = \phi_{it}(l_{it}, k_{it}, m_{it}, share_{it}) + \epsilon_{it}, \quad (3.2)$$

where ϕ is a complex (polynomial) function of inputs and market share. In the first stage it is not possible to identify either the coefficients of labour and capital (state variables) or the coefficient of material (proxy function), whereas the expected output ($\widehat{\phi}_{it}$) and residuals ($\widehat{\epsilon}_{it}$) are recovered. Production function coefficients are estimated in the second stage by assuming that unobserved productivity follows an autoregressive law of motion ($\omega_{it} = g(\omega_{it-1}) + \xi_{it}$). Using $\omega_{it}(\boldsymbol{\beta}) = \widehat{\phi}_{it} - \beta_l l_{it} - \beta_m m_{it} - \beta_k k_{it}$, ω is regressed non-parametrically on its lags, and the estimates of coefficients are obtained through unexpected productivity shocks $\xi(\boldsymbol{\beta}_{it})$ with the following moment condition:

$$E \left(\xi(\boldsymbol{\beta}_{it}) \begin{pmatrix} l_{it} \\ k_{it} \\ m_{it-1} \end{pmatrix} \right) = 0. \quad (3.3)$$

In Eq. 3.3, it is assumed that the amounts of capital and labour are decided one period ahead

measure of productivity. However, the omitted price bias will underestimate the markups (De Loecker Warzynski, 2012), but it will not impact the relationship between the average markup in services and manufacturing productivity.

¹³In DeLoecker Warzynski (2012), export status is used as control variable. The control function approach requires that demand function of input (material) be monotonic in productivity, i.e. an invertible function. According to the author, the monotonicity of intermediate inputs in productivity holds under a large class of models of imperfect competition.

(state variables), implying that l_{it} and k_{it} are not correlated with contemporaneous productivity shocks ξ_{it} . Given that material is the free adjustable input (the current material level reacts to shocks in productivity), the m_{it} coefficient is identified through its lagged value¹⁴. A standard GMM technique is used to retrieve the production function's coefficients for each NACE 2 market (with bootstrapped standard errors). Finally, it is possible to calculate markups from the material coefficient (β_m , i.e. elasticity of output to material), and the cost share of material (corrected by the residual of first stage, ϵ_{it}). More precisely, the estimated markup $\hat{\mu}$ of service provider i in sector j at time t is

$$\hat{\mu}_{ijt} = \hat{\beta}_m \left(\frac{P_{it}^X X_{it}}{P_{it} \frac{Q_{it}}{\exp(\hat{\epsilon}_{it})}} \right)^{-1}, \quad (3.4)$$

where $\exp(\hat{\epsilon}_{it})$ is used to control for variations in a firm's output due to variations in the input demand generated by input prices, productivity, technology parameters, and market characteristics such as the elasticity of demand and income levels (i.e. terms uncorrelated with $\phi_{it}(\cdot)$). It is important to emphasise that DLW's method is flexible and consistent with various assumptions regarding the nature of competition; in addition, the estimated markup can be considered an average markup across products in the case of a multiproduct firm (De Loecker Warzynski, 2012).

From a different perspective, market power can be approximated using alternative methodologies. For example, Aghion et al. (2006) suggest to measure market power with the Lerner index, defined as the ratio between operating profits minus financial costs and sales' value; similarly, Daveri et al. (2011) define a firm's markup (μ) as the ratio between value added to the sum of labour cost and capital cost. Alternatively, Tybout (2003) proposes to use price cost margin (PCM), which is defined as the difference between the production value and the total variable costs divided by the total production value (i.e. $\frac{pq-cq}{pq} = 1 - \frac{1}{\mu}$). In the present paper, the Lerner index (Aghion et al., 2006) is preferred to control the robustness of the results¹⁵ obtained from

¹⁴It is necessary that material price be correlated over time.

¹⁵In a previous version of the paper (Forlani, 2011b), PCM proxied the firm's markup. However, Tybout's definition does not consider the cost of capital, which is an important component of the definition of market structure in some service industries. In addition, PCM assumes that labour and material costs are good proxies for the short-term marginal costs. For these reasons, in Forlani (2011b) an alternative indicator (at the sector

the structural markup (Eq. 3.4). The Lerner index of firm i in sector j at time t is defined as

$$l_{ijt} = \frac{\text{operating profits}_{ijt} - \text{financial cost}_{ijt}}{\text{sales}_{ijt}}. \quad (3.5)$$

where the financial cost is capital depreciation with a rate of 8% (Aghion et al., 2006). For the empirical analysis, it is necessary to calculate the average markup for the NACE 2 digit market; thus firm-level observations (Eq. 3.4 or Eq. 3.5) have to be aggregated. Next, consider markup μ : I define the average market power in sector j as follows:

$$MP(\mu)_{jt} = \frac{1}{N(j)} \sum_{n(j)=1}^{N(j)} \sum_{i=1}^n mkup_{ijt} * w_{ijt}(n4), \quad (3.6)$$

where w_{ijt} is firm's weight, defined as market share¹⁶ in the first NACE 4 market for firm i . Then, the average markup for a NACE 2 market j ($MP(\mu)_{jt}$) is calculated as the mean of average markups across the $N(j)$ NACE 4 markets. As long as $MP(\mu)_{jt}$ increases, the average market power increases (by construction), and the average competition level decreases: in section 3.1.3, I show that $MP(\mu)_{jt}$ is a reliable indicator for the degree of competition (and similarly the average of the Lerner index, $MP(l)_{jt}$).

3.1.2 Additional competition indicators

Additional types of indicators are used in the empirical analysis to test the robustness of the results. First, I calculate the index for the market concentration level and an indicator for heterogeneity in firms' size. The concentration level in a two-digit market is defined by the C5 index¹⁷, namely the sum of the first five market shares for a given pair sector-year. Differently

level) is calculated for the markup μ , which is obtained from a parametric estimation (Roeger, 1995) that controls for time variations and economies of scale (Dobrinisky et al., 2006). These two indicators provide the same qualitative results of the present version.

¹⁶Given that input output matrices are defined at a 2 digit level, it is necessary to calculate proxies at the same level of aggregation. However, I define the weighted average at NACE 4 to take into account markup heterogeneity across markets. I calculate market share as the ratio of firm revenues to market revenues in a 4 digit market; market size is defined as the sum of firms' revenues (from Amadeus). Different aggregation systems or a different market size definition (market size from OECD Stan) does not change the results.

¹⁷A similar concentration index is the Herfindahl index, i.e. the sum of the squared value of market shares for all firms in a market. However, in the present case the Herfindahl index gives rise to doubt concerning its validity

from Eq. 3.6, market size in terms of revenues (deflated) is calculated at a 2 digit level by using the OECD Stan dataset, so that market shares are the ratio of domestic revenues (from Amadeus) to the corresponding market size. The C5 for sector j at time t is

$$C5_{jt} = \sum_{r=1}^5 \left(\frac{Rev_{ijt}^r}{MktSize_{jt}} \right). \quad (3.7)$$

Competition is expected to decrease whether concentration increases. However, it is not obvious that high concentration provides evidence of low competition, given that a market can simultaneously be highly concentrated and highly competitive. In a simple duopoly (*a lá* Bertrand), strong competition may exist even if the concentration level is high; alternatively, the existence of sunk costs requires a minimum concentration for which it is convenient to remain in the market.

Given the importance of sunk costs, I introduce an additional indicator of competition that takes into account the existence of entry barriers and economies of scale. The minimum efficient scale (MES) at NACE 2 is defined at industry level j as follows:

$$MES_{jt} = \frac{\widehat{AV}_{jt}}{\overline{AV}_{jt}}. \quad (3.8)$$

The parameter MES_{jt} is the ratio of the average value added for the larger firms (those accounting for top 50% of the industry value added, \widehat{AV}_{jt}), to the average value added for the smaller firms¹⁸ (\overline{AV}_{jt}). MES approximates the dimensional heterogeneity of an industry (NACE 2): the higher the index is, the greater are the differences in size between large and small firms. In addition, MES is a proxy for the optimal firm's dimension: a large MES value indicates that a new firm has to be large to be successful in the market. In other words, the higher the value of MES is, the higher are the sunk costs associated with entry into the market (Maioli et al., 2006). However, MES can be plagued by regulation (in the sense that regulation prevents firms from entering in the market) and generates higher value added. Thus, MES may result large while in fact MES is much lower because of entry restriction.

due to the absence of entire firms' populations; small firms are not included in the Amadeus sample, so all market shares are not available.

¹⁸I rank firms according to value added (by year and sector), and then I calculate the total value added by industry. Next, I define the marginal firm that contributes 50% of the industry's value added, and I use it as threshold. Finally, I calculate the averages for firms ranked above \widehat{AV} , and below \overline{AV} of the marginal firm. The averages are weighted with market shares similarly to Eq. 3.7.

To test the robustness of C5 and MES, I introduce into the empirical specification an indicator that measures the degree of entry barriers for network industries (i.e. energy, TLC, and transport services). Such an index (with others) is reported¹⁹ by the OECD (Conway and Nicoletti, 2006), and it has been used to assesses the impact of services competition on efficiency in a cross-country analysis (Bourlés et al., 2011). A decrease in the index implies that entry barriers in network industries have been reduced because of deregulation (Tab B.5).

Finally, I take into account additional controls, which are indirectly related to services competition. First, I define the average efficiency to control for spillover effects (backward) in the I-O analysis (Javorcik, 2004). As mentioned before, the production function for services is suitable to obtain a good estimate of μ , but it does not allow us to recover a reliable measure of productivity because of an unobserved price bias (De Loecker Warnzinsky, 2012). Thus, productivity is calculated by using a numerical index: the numerical indices (such as the Tornqvist index) are commonly employed to assess firm's efficiency in service sectors, and in particular in network industries (Coelli et al., 2003). Consider $\ln Y_{it}$, S_{ift} , and $\ln X_{ift}$ to be, respectively, the log of the output for firm i , the input type- f as a share of total revenues, and the inputs' consumption; the overbarred terms are the weighted means (at NACE 4 j) for the corresponding firm-level variables. Then, the efficiency index (Aw et al., 2001) for firm i at time t in sector j is defined as

$$\begin{aligned} Index_{it}^j &= (\ln Y_{it} - \ln \bar{Y}_t) + \sum_{s=2}^t (\ln \bar{Y}_s - \ln \bar{Y}_{s-1}) \\ &\quad - \sum_{f=1}^F \frac{1}{2} (S_{ift} + \bar{S}_{ft}) (\ln X_{ift} - \ln \bar{X}_{ft}) \\ &\quad - \sum_{s=2}^t \sum_{f=1}^F \frac{1}{2} (\bar{S}_{fs} + \bar{S}_{fs-1}) (\ln \bar{X}_{fs} - \ln \bar{X}_{fs-1}). \end{aligned} \tag{3.9}$$

The efficiency index derives from a translog production function, and the considered inputs are tangible fixed assets, labour (labour force), and materials; then, the variable *Index* is aggregated as weighted mean for each service sector j (as Eq. 3.6 to consider heterogeneity across sectors).

¹⁹The OECD provides several indicators to measure competition in non-manufacturing sectors. They are based on detailed information on laws, rules, and market settings. Entry barrier has been chosen from among other indicators because it is defined for a large number of network industries. For more details, see Conway and Nicoletti (2006).

Efficiency from Eq. 3.9 has two appealing characteristics: (i) it does not imply any assumptions concerning market structure and (ii) it implies a functional form (compared to a Cobb-Douglas in three inputs), which is preferable when dealing with heterogeneous firms²⁰.

As a final control, I include a standardised measure of foreign direct investment (FDI) as flow values (Source: Bank of France). Using information on total industry labour employment (OECD-Stan), I construct a standardised index of FDI intensity as the ratio of FDI flows to the total amount of labour force in each two-digit market; such an indicator allows us to obtain a homogeneous measure of FDI across heterogeneous industries. The FDI indicator is added to control for not only (backward) spillover but also for potential effects that FDI may have on the competition level²¹ (Arnold et al., 2011).

3.1.3 Indicators' reliability

In the previous sections, I described different indicators for services competition. It is crucial for the empirical analysis to show that the provided indicators are related to the services market structure. Next, I provide evidence that elucidates the relationship between indicators, services competition, and market structure.

Two mechanisms characterise with a certain regularity the observed market structure (Sutton (1991)). First, price competition is linked to the degree of market concentration for a given market. Second, firms tend to differentiate products to increase consumers' willingness to pay through R&D activity. Depending on the assumptions concerning the products' characteristics (homogeneous vs. differentiated) and competition type (e.g., Bertrand, Cournot, or monopoly), it is possible to observe different interactions between the degree of concentration, price competition, and market size²².

Because the empirical strategy is based on I-O coefficients, I provide descriptive statistics

²⁰Other measures such as labour productivity (value added per worker) are misleading. Any improvement may be generated by an increase in the value added due to an abuse of a dominant position, rather than to improvement in the efficiency.

²¹Nonetheless, it is not possible to know *a priori* whether more FDIs raise or shrink the degree of competition in a given industry. FDI may encourage services competition through the presence of new firms; otherwise, foreign competitors may enter directly like an oligopolist, replacing local firms or creating a cartel with the national incumbent (Vandenbussche and Veurglers 1999). In this case, liberalisation policies to encourage FDI in services have not a positive effect on the competition level because a dominant position can be created by new incumbents who prioritize profits over social welfare.

²²It is important to remember that the estimated μ is robust to different types of market conduct (Bertrand, Cournot, monopoly).

for a two-digit market; in particular, I show how firms' mass (Source: Alisse) and market size (OECD Stan) are correlated with indicators of competition and the average capital intensity for intangible assets (IK is intangible capital to labour force and is a proxy of R&D expenditure). Tables 3.1 and 3.2 report OLS estimations, where different indicators are regressed on the logs of firms' mass and market size, respectively. The negative signs for $MP(\mu)_{jt}$ and $MP(l)_{jt}$ in both tables suggest that market power is negatively correlated with market size and number of firms; the differences between the $MP(\mu)_{jt}$ and $MP(l)_{jt}$ coefficients may be explained by the fact that $MP(l)_{jt}$ overestimates market power because the Lerner index does not allow us to control for output price or demand shocks²³. Moreover, an increase in the firms' mass ($Log(Firms)$) or in market size ($Log(Size)$) is statistically associated with a lower concentration level (Col. 3) and a reduction in MES indicator²⁴ (Col. 5). In addition, large or crowded markets are more R&D intensive (Tab. 3.2), so a firm finds it convenient to be capital intensive, regardless of whether the market is large enough to recover its innovation cost. As also observed in Aghion et al. (2006), R&D activity and competition exhibit a negative correlation (Tab. B.4). Finally, average productivity decreases when the market expands, or alternatively in large markets, when the presence of less efficient firms is consistent with the short-run perspective (Col. 8). Therefore, I expect a negative effect from the indicators of competition: as long as an indicator increases, the average level of competition decreases, with an expected negative effect on manufacturing productivity.

Given that a large part of empirical analysis is focused on network industries, it is important to devote attention to them (Section C), in particular to market power, making a comparison with indicators of regulation from the OECD. During the period of analysis (1996 to 2004), regulation has decreased in France, in particular in the electricity, gas, post, and telecommunications sectors; Table B.5 shows that entry barriers, public ownership, and vertical integration has been reduced over time. The deregulation process is the result of the implementations of EU directives on competition. In line with OECD analysis, the average market power decreases over time across all service sectors (Tab.B.2). However, the market power index (Col. 1, $MP(\mu)$) shows a bell-shaped

²³If I substitute $MP(\mu)_{jt}$ at NACE 2 digit with the corresponding value at firm-level (μ), I obtain the same qualitative results.

²⁴The entry barrier index from the OECD is calculated only for five networks industries. However, the index is positively correlated with $MP(\mu)_{jt}$ for 35 observations: average market power shrinks when the market entry barriers are reduced.

Table 3.1: Market Structure: Firms*.

	(1)	(2)	(3)	(4)	(5)	(6)
	MP(μ) _{jt}	MP(l) _{jt}	C5 _{jt}	MES _{jt}	IK _{jt}	Index _{jt}
Log(Firms) _{jt}	-0.045*** (0.007)	-0.852*** (0.197)	-0.083*** (0.006)	-0.014 (0.075)	0.080 (0.127)	0.034 (0.033)
Constant	0.758*** (0.083)	10.746*** (3.241)	1.399*** (0.054)	9.791*** (1.230)	5.842*** (1.329)	-0.249 (0.247)
Obs	108	96	108	108	108	108
R ²	0.277	0.150	0.605	0.105	0.052	0.069

[‡] OLS estimation from 1997 to 2004. Robust standard errors are in squared brackets. Firms: log of firms' mass at NACE 2. MP(μ) is market power from markup estimation. MP(l) is market power from Lerner index. IK: average intangible fixed assets per firm at NACE 2 (source: Amadeus). Time dummies included. Significance level: * is the p-value>0.1, ** is the p-value>0.05, and *** is the p-value>0.01.

Table 3.2: Market Structure: Size*.

	(1)	(2)	(3)	(4)	(5)	(6)
	MP(μ) _{jt}	MP(l) _{jt}	C5 _{jt}	MES _{jt}	IK _{jt}	Index _{jt}
Log(Size) _{jt}	-0.113*** (0.008)	-1.160*** (0.224)	-0.113*** (0.009)	0.156 (0.096)	0.722*** (0.182)	-0.196** (0.078)
Constant	2.455*** (0.145)	23.122*** (4.074)	2.688*** (0.175)	8.706*** (1.746)	-4.300 (3.312)	3.486** (1.386)
Obs	117	117	117	117	117	117
R ²	0.456	0.090	0.355	0.103	0.141	0.106

[‡] OLS estimation from 1997 to 2004. Robust standard errors are in squared brackets. Size: log of total revenues for a two-digit market. MP(μ) is market power from markup estimation. MP(l) is market power from Lerner index. IK: average intangible fixed assets per firm at NACE 2 (source: Amadeus). Time dummies included. Significance level: * is the p-value>0.1, ** is the p-value>0.05, and *** is the p-value>0.01.

pattern for network industries: the index increases until 1999 (the year before liberalisation in electricity and TLC), and then it decreases to a level above 1996 level. This effect is determined by the evolution of markups in TLC (Tab.B.1). Such results, with statistics in Table B.3, do not contradict the OECD indicators that suggest a generalised improvement in liberalisation policies; it is just observed (in the short run) that liberalisation allows firms to set on average higher markups and then to return to lower values. Because private firms are profit maximisers compared to public ones, private firms try to extract higher rents once they enter network industries²⁵.

²⁵Barba-Navaretti et al. (2006) maintain that liberalisation without deregulation may be ineffective to raise the degree of services competition: the new entrants may replace the public incumbents and maintain a low competitive pressure. Additional descriptive statistics for service sectors are in Section B.

3.2 Manufacturing data

Firm-level data for manufacturing firms are collected from the Amadeus dataset (Bureau van Dijk); I consider firms with one million Euros of operating revenues in 2004 for a total of 7211 individuals. Nominal values of tangible fixed assets, material costs, and value added are expressed in thousands of Euros, and variables are deflated with sector-specific deflators (Source: EU-Klems). Productivity is calculated at the firm level with a residual of a production function (Olley and Pakes, 1996) as an indicator of technical efficiency²⁶. Before productivity can be estimated, it is crucial to consider three important concerns that could invalidate the subsequent econometric analysis; in other words, TFP could be biased by three unobserved factors, which must be controlled for. First, I need a measure of productivity which is purged by the firm's markup. Second, productivity should not be biased by an unobserved output price. The third source of bias is due to the lack of information about services' consumption at firm-level²⁷. Given that TFP is calculated as a residual, it is important to have an unbiased indicator of technical efficiency; unobserved factors may enter the TFP and consequently invalidate the interpretation of the estimated results. A simplified version of the empirical model is

$$tfp_{imt} = \beta_1 MP_{mt} + controls + \epsilon_{it}, \quad (3.10)$$

where MP_{mt} measures the effect of average market power in services on manufacturing industry m . The empirical model aims to estimate the effect of variations in the degree of services competition on manufacturing firms' productivity. The marginal effect of interest is given by β_1 , that is, the estimated impact of a variation in competition (MP) on productivity (TFP). If a productivity indicator is not free of unobserved factors, the β_1 coefficient captures not only the effect of competition on TFP but also the effect of competition on the unobserved factors. Assume that it is not possible to disentangle productivity from a firm's markup; in this case, the β_1 coefficient is given by

$$\beta_1 = \frac{\partial tfp_{it}}{\partial MP} = \frac{\partial \omega_{it}}{\partial MP} + \frac{\partial \mu_{it}}{\partial MP}, \quad (3.11)$$

²⁶In this work, productivity and efficiency are synonymous with total factor productivity (TFP).

²⁷Arnold et al. (2011) are able to retrieve information about services consumption at firm level with the Amadeus dataset for Czech Republic.

for a generic measure of competition (MP). In this case, it is not possible to identify the effect of competition on technical efficiency (ω) from the effect on a firm's markup (μ); there is the risk of overestimating the effect of services' market power because MP also affects the markups of manufacturing firms. The same argument can be used for other unobserved factors such as output price or input (services) consumption; in the former case, β_1 is biased by the effect of services competition on output price, while in the latter case, the bias depends on variations in the use of services due to upstream competition variation. In conclusion, the second term of Eq. 3.11 does not allow us to recover reliable estimates.

To solve these problems, the production function is estimated by again following the DLW (2012) methodology to disentangle efficiency from markups. In contrast to the methods applied in Section 3.1.1, here I consider a Cobb-Douglas production function in two inputs (labour and capital), while material still defines the proxy function²⁸; obviously, the coefficient for material is not estimated, and labour is considered the free adjustable input (as in Olley and Pakes, 1996) so that it is instrumented with its lag in the second stage. In addition, the chosen functional form allows us to address concerns regarding an unobserved output price and services consumption²⁹, because they do not enter into the residuals calculation. By following the estimation procedure illustrated in section 3.1.1, I recover TFP and markup for a firm-year pair. The TFP is the measure of a firm's technical efficiency, and it is the dependent variable for the main estimated equation (4.2); markup μ is used as an additional control.

²⁸The implicit assumption of Cobb-Douglas is that factor elasticities remain constant over time, as do input-output coefficients. A translog production function forces us to assume variable elasticities. The production function is estimated at NACE 2, for which value added is the dependent variable. The ratio of export value to total revenues is used as an additional control in the proxy function (as in De Loecker and Warzynski (2012)).

²⁹In addition, material is deflated using a price index which is calculated as a weighted average of manufacturing output deflators. Material deflator for a firm in sector m is defined as

$$ID_{mt} = \sum_n^N \bar{a}_{mn} * defl_{nt} \quad (3.12)$$

where $(defl_{nt})$ is the output deflator of (manufacturing) sector n at time t . As weights, I consider a transformation of input-output coefficients. The coefficient \bar{a}_{mn} is "rescaled" between two manufacturing sectors m and n , i.e. \bar{a}_{mn} is the ratio of inputs' purchase of sector m in manufacturing sector n to the total amount of inputs' purchase of sector m .

4 Empirical Strategy

To link competition measures (described in section 3) to downstream manufacturing productivity, I construct a measure of intersectoral linkages by using I-O coefficients (Bourlés et al., 2011; Arnold et al., 2011). The idea is to capture a transmission mechanism through service inputs; a variation in services competition affects inputs' quality and consequently downstream productivity, in particular for firms in sectors that use services more intensively. The coefficient α_{mj} is the I-O coefficient, and it is defined as the ratio of input consumption of sector m for intermediate input j (from services) to the total amount of input consumption from sector m . Then, a generic competition index is aggregated across service industries by using I-O coefficients as weights. Finally, I calculate the average indicator of competition (CI) at time t for a manufacturing sector m as

$$CI(X)_{mt} = \sum_j^J \alpha_{mj} * X_{jt}, \quad (4.1)$$

where X_{jt} is a generic competition proxy (Section 3) for service industry j at time t . The index $CI(X)$ can be interpreted as a weighted average of a competition index across different service sectors; weights change across industries such that $CI(X)$ ideally captures the effect of the average competition level in services for each manufacturing sector m .

A crucial point is that I-O coefficients are assumed to be constant over time to minimise endogeneity concerns, namely reverse causality. I employ an I-O table for 2000 (Eurostat) because coefficients are temporally located in the middle of the observational period (from 1996 to 2004). It is assumed that a firm's average input mix does not change within the period, so that α_{mj} is considered a reliable mean. If time variant coefficients were used in Eq. 4.1, it would have not been possible to disentangle the effects of competition on productivity from changes in the inputs' mix (changes in the α 's), given that services' consumption is not observed at a firm level. Moreover, the assumption of constant I-O coefficients is consistent with the production function from a short-run perspective: Cobb-Douglas in two inputs implicitly considers a fixed technology of production.

4.1 Productivity Equation

To determine the effect of a variation in the average degree of services competition on manufacturing efficiency, I estimate the following empirical model:

$$TFP_{imt} = \beta_0 TFP_{imt-1} + \beta_1 CI(X)_{mt-1} + FC_{imt-1} + SC_{mt-1} + D_t + \varepsilon_{it}, \quad (4.2)$$

where TFP_{imt} is firm's efficiency and $CI(X)_{mt}$ (Eq. 4.1) is the link variable. The testable hypothesis is that positive variations in the degree of service competition (i.e. a reduction in $CI(X)$) is associated with the higher efficiency of manufacturing firms: given that quality and the variety of services may increase with the degree of competition, manufacturing productivity benefits from such competition through improved inputs from the upstream market. The β_1 coefficient is expected to be negative, given that an increase in an indicator is associated with a reduction in competition³⁰ (Tab 3.1 and 3.2).

In equation 4.2, FC_{imt-1} indicates firm-level control variables, while SC_{mt-1} indicates sector-level control variables. In the former group are included sales growth to control for firm-level demand shifters and log of capital intensity. Sector-level controls are FDI per worker (FDI_{pw}), price index for services ($Price_{mt-1}$), and the average market power in manufacturing industries ($\bar{\mu}(M)$): all the tree controls are defined at a two-digit market and are calculated as described in Eq. 4.1. The role of FDI per worker has been already discussed in previous sections. The price index for services is used as an additional control for unobserved services consumption: The parameter $Price$ is the weighted average of services output deflators, and it is used to capture variations in TFP due to variations in service price.

Instead, $\bar{\mu}(M)$ measures the average markups in manufacturing industries; given that the majority of inputs are still purchased from other manufacturing sectors³¹, it is necessary to control for the average market power in the other input markets, and a control for manufacturing markup is defined similarly to that for services³² (Eq. 3.6). All the regressors are taken with one

³⁰Given the lack of information about services' consumption at firm-level jointly with the use of an I-O matrix at NACE 2, β_1 has to be interpreted as the effect of a variation in the average degree of services competition on the average manufacturing productivity.

³¹On average, 75% of inputs in manufacturers are manufactured.

³²In some sense I control for general equilibrium effects. Given that the market power of services potentially affects manufacturing market power, and that a firm's markup is statistically correlated with productivity (Daveri et al., 2010), with $\bar{\mu}$ I allow for spillovers across manufacturers due to variation in the market power of services.

lag period; it is assumed that adjustments in the degree of services competition affect manufacturing productivity with a one-period lag. Finally, the estimated model includes time dummies D_t , sector dummies, and an *i.i.d.* error term ϵ_{it} .

The next step is to exploit the rich set of information which is available as panel data. An advantage of employing firm-level data in panel form is that it is possible to control for cross-sectional differences in productivity using firms' fixed effects and to capture unobserved individual heterogeneity that could arise from firms' location, internal characteristics, or service use. In particular, fixed effects with time dummies are used to control for business cycles and changes in the economic policy (regional and national). I assume the existence of unobserved heterogeneity among the firms, and I redefine the error term as the sum of two components, one for a firm's time invariant characteristics h_i , and one for the *i.i.d.* term η_{it} ($\epsilon_{it} = h_i + \eta_{it}$). In this framework, both firm-level control variables and the lagged dependent variable are potentially endogenous, that is, correlated with the composite error term. To address these problems, it seems appropriate to consider equation 4.2 as a dynamic panel with fixed effects. The estimation techniques developed by Arellano and Bond (1991) and Blundell and Bond (1998) are suitable tools in this context. More precisely, the baseline model is estimated with a system-GMM estimator³³ because of the high persistency in the autoregressive term of TFP. Due to this high persistence, I have to introduce a second lag for the dependent variable, TFP_{imt-2} to eliminate the serial correlations.

In the system-GMM estimator, I consider as endogenous variables³⁴ the lagged dependent and firm-level controls (output growth and capital intensity). Competition proxies and the sector-level control are considered exogenous; I assume that a single manufacturing firm cannot affect the average market structure in either services or in manufacturing (by definition the error term

³³Briefly, the system GMM is composed by a system of two equations, one in first-difference as in the standard GMM (Arellano and Bond, 1991), and a second set of additional moment conditions in levels. In the difference equation, variables in first difference are instrumented with lagged values in levels, while for the equation in levels, the variables are instrumented with lagged values in first difference. In other words, the moments in the difference GMM approach are augmented by another set of moment conditions (assuming that the stationarity assumption for the initial condition holds). The system GMM by Blundell Bond (1998) provides a more efficient estimator if the autoregressive term of the dependent variable (β_0) is close to one, but the time series of TFP is not stationary ($E(TFP_{i0}|c_i = 0)$). If a simple OLS is estimated for the current level of TFP on its past value, I find a β_0 close to 0.95.

³⁴An unbalanced panel is considered with Roodman routine (2006). The balanced panel is used in the robustness checks section. Endogenous variables are instrumented from the third lag: lags used as instruments do not change across different specifications. Earlier lags are correlated with the error term, according to Hansen-Sargan test for over-identification. Table B.6 provides the list of variables and instruments.

is at firm-level). In addition, the definition of sector variables as weighted averages (Eq. 4.1) attenuates the endogeneity concerns: the validity of the assumption is confirmed by statistical tests (Hansen-Sargan).

Finally, two specification tests are used to check the validity of the GMM estimator. First, the error term (excluding the fixed-effect component) must be serially uncorrelated. Arellano Bond test statistics (1991) checks the validity of this hypothesis: under the null hypothesis of no serial correlation, the first differences of the error term must be serially uncorrelated with errors of order two. Second, the Hansen-Saragn test of over-identifying restrictions analyses the joint validity of instruments in the case that number of instruments is larger than number of endogenous variables.

5 Empirical Results

Table 5.1 reports the first results: each column represents a regression, and the dependent variable is the TFP or the residual from the production function estimation (De Loecker Warzynski, 2012). In the baseline model, I define the competitions' indicators (Eq. 4.1) by aggregating all service sectors, where service-sector variables are reported with an S as superscript³⁵. As shown in Tables 3.1 and 3.2, an increase in the indicators signals a reduction in the competitive level, and thus I expect a negative coefficient for β_1 .

Columns one and two report the results for OLS and the fixed effect estimator, respectively. As expected, the sign of $MP(\mu^S)$ is negative: an increase in the average markup of services is associated with a lower manufacturing productivity in both the OLS and FE models. In the other columns, the system GMM estimator is implemented. Even if I control for unobserved heterogeneity at firm level, a negative and statistically significant correlation between services market power and manufacturing efficiency still exists, and thus an increase in the markups (not significant), concentration ($C5_{mt-1}^S$), or minimum efficiency scale (MES_{mt-1}^S) negatively affects manufacturing productivity³⁶. The results suggest that a reduction in services competition is associated with low manufacturing productivity. Besides productivity ($Index^S$), improvements

³⁵Table B.6 reports the list of variables employed in the estimations

³⁶I use one indicator for each regression with the FDI and price deflator as controls to avoid the problems of multicollinearity caused by the extensive use of I-O matrices.

in services have a positive spillover effect on the manufacturing efficiency (Col.6); similarly, FDI intensity ($FDIpw^S$) always shows a positive effect. Such effects can be explained by a backward spillover effect (Smarzynska Javorcik B., 2004) or can be the results of competitive pressure due to the presence of multinationals. By enhancing competition, FDI stimulates improvement in the quality of services provided (FDI intensity and average markups are negatively correlated in service sectors, Tab. B.4): however it remains difficult to identify the transmission mechanism. The price deflator has positive sign, as does the manufacturing average markup. While $Price^S$ is not significant in the GMM model, the average markup ($\bar{\mu}(M)$) for providers of manufactured inputs is statistically relevant³⁷. The positive impact on productivity suggests a type of positive effect in terms of efficiency due to raising markups (Konings Vandenbussche, 2008). Finally, a Hansen test and an AR2 test confirm the validity of the GMM estimator assumptions.

By construction of explanatory variables, competition affects manufacturing efficiency through service inputs. A potential explanation relies on the fact that higher competition levels are associated with higher quality and technology standards (Arnold et al., 2011) or a larger variety; in addition, competition may incentivise firms to invest in R&D and innovation³⁸. In conclusion, the reported results seem to support the initial hypothesis: variations in the competition level of services reflect on the average manufacturing productivity. Nonetheless, it is important to avoid easy conclusions. The competition indicators as reported in Table 5.1 include by construction the characteristics of a variety of heterogeneous service industries. For example, regulation of the telecommunication sector (which is characterised by natural entry barriers) differs from that of the retail sector (Conway Nicoletti, 2006). The number of competitors in telecommunications is much smaller compared to the number of firms in the business services; however, such evidence does not imply *a priori* a lower level of competition (Sutton, 1991): for example, a 10% variation in the average markup in TLC sector has a different meaning in terms of competition compared to a corresponding variation in other business activities. Within this framework, the results reported in Table 5.1 cannot be reliable, given that they aggregate highly different industries.

Therefore in the next step, I focus the analysis on a particular group of services: networks. The network industries are characterised by huge fixed costs and are highly regulated compared

³⁷Variable $\bar{\mu}(M)$ is considered exogenous; if $\bar{\mu}(M)$ is defined endogenously, the results do not change.

³⁸Aghion et al. (2006) show that the relationship between product market competition and innovation is u-shaped. The R&D proxy is negatively correlated with the competition proxy as is PCM, Tab. B.4.

Table 5.1: Baseline Estimation[‡].

	(OLS)	(FE)	(3)	(4)	(5)	(6)
	TFP_{imt}	TFP_{imt}	TFP_{imt}	TFP_{imt}	TFP_{imt}	TFP_{imt}
TFP_{imt-1}	0.937*** (0.003)	0.896*** (0.005)	0.670*** (0.123)	0.719*** (0.127)	0.713*** (0.128)	0.777*** (0.117)
TFP_{imt-2}			0.212** (0.089)	0.180* (0.092)	0.185** (0.093)	0.132 (0.086)
$MP(\mu^S)_{mt-1}$	-0.067** (0.032)	-0.086*** (0.032)	-0.081 (0.140)			
$C5_{mt-1}^S$				-6.402** (3.065)		
MES_{mt-1}^S					-0.449** (0.180)	
$Index_{mt-1}^S$						4.267*** (1.153)
$Price_{mt-1}^S$	0.277*** (0.092)	0.221** (0.091)	0.026 (0.029)	0.022 (0.033)	0.030 (0.036)	0.021 (0.025)
$FDI_{pw}_{mt-1}^S$	0.124** (0.054)	0.122** (0.054)	0.526*** (0.196)	1.380*** (0.528)	1.712*** (0.594)	0.579*** (0.149)
$\bar{\mu}(M)_{mt-1}$	0.424 (0.260)	0.408 (0.254)	1.029** (0.495)	1.570*** (0.546)	1.773*** (0.591)	0.918*** (0.279)
Cons.	-0.881*** (0.443)	-0.416 (0.453)	0.156 (0.221)	-0.153 (0.204)	-0.248 (0.206)	0.110 (0.147)
Obs	30,581	30,581	30,309	30,309	30,309	30,309
Firms	.	7,250	7,213	7,213	7,213	7,213
R ²	0.946	0.178				
AR2 Test	.	.	0.245	0.436	0.431	0.797
Hansen Test	.	.	0.398	0.528	0.554	0.411
# Instr.	.	.	85	85	85	85

[‡] System GMM estimator: one step estimator is used. TFP is the dependent variable: it is the residual calculated from the estimation of production function in 2 inputs (De Loecker Warzynski, 2012). Each column represents a different regression. Firm level control are not reported. Year dummies included. Robust standard errors are clustered at NACE 4 and are reported in brackets. Significance level: * is the p-value>0.1, ** is the p-value>0.05, and *** is the p-value>0.01. Instr.: total number of instruments. For the Hansen test (over-identification test) and AR2 test are reported the p-values.

to other sectors. Moreover, network industries offer an interesting case study given that several EU directives were focused on market competition in network industries. In particular, France has been characterised by a strong level of regulation, and low degree of competition in these industries (OECD, 2001), even if regulation in electricity and TLC has been reduced (Tab. B.5) in compliance with EU directives. Additionally, firm-level data for network industries are more representative of the entire population, in comparison with data from other services composed of many small firms³⁹. For these reasons, network industries seem an interesting case to analyse (a more accurate discussion about network industries in France is in Section C).

Table 5.2 reports the estimations' results for competition proxies considering only with net-

³⁹It is important to emphasise that if I perform the same analysis by considering other service industries (business, retail, or financial services), I do not obtain any significant results (available upon request).

work industries in Eq. 4.1 (Energy Services (40), Land Transport (60), Water Transport (61), Air Transport (62), Auxiliary transport services (63), and Post and Telecommunication (64)). The N superscript indicates that the indicators are constructed by aggregating only network industries.

Table 5.2: Network industries[†].

	(1)	(2)	(3)	(4)	(5)	(6)
	TFP_{imt}	TFP_{imt}	TFP_{imt}	TFP_{imt}	TFP_{imt}	TFP_{imt}
TFP_{imt-1}	0.937*** (0.148)	0.920*** (0.151)	0.941*** (0.148)	0.930*** (0.148)	0.994*** (0.130)	0.923*** (0.154)
TFP_{imt-2}	0.034 (0.111)	0.047 (0.113)	0.030 (0.111)	0.038 (0.111)	-0.009 (0.100)	0.045 (0.115)
$MP(\mu^N)_{mt-1}$	-0.885*** (0.298)					
$MP(l^N)_{mt-1}$		-4.274*** (1.567)				
$C5_{mt-1}^N$			-4.502*** (1.459)			
MES_{mt-1}^N				-0.226*** (0.077)		
$Index_{mt-1}^N$					2.541** (1.047)	
$EntryB_{mt-1}^N$						-0.521** (0.236)
$Price_{mt-1}^N$	0.013 (0.029)	0.020 (0.030)	0.014 (0.028)	0.020 (0.030)	-0.003 (0.022)	0.019 (0.032)
$FDI_{pw}_{mt-1}^N$	1.718** (0.720)	1.469** (0.671)	1.414** (0.635)	1.295** (0.606)	1.671** (0.649)	1.944*** (0.739)
$\bar{\mu}(M)_{mt-1}$	0.183 (0.149)	0.275* (0.165)	0.235 (0.159)	0.281* (0.169)	0.263* (0.159)	0.375* (0.206)
Cons.	0.220 (0.193)	0.196 (0.191)	0.216 (0.191)	0.194 (0.187)	0.095 (0.148)	0.104 (0.177)
Obs.	30,350	30,350	30,350	30,350	30,350	30,350
Firms	7,213	7,213	7,213	7,213	7,213	7,213
AR2 Test	0.239	0.276	0.206	0.2323	0.059	0.281
Hansen Test	0.628	0.584	0.606	0.595	0.686	0.597
# Instr.	58	58	58	58	58	58

[†] System GMM estimator: one step estimator is used. TFP is the dependent variable: it is the residual calculated from the estimation of production function in 2 inputs (De Loecker Warzynski, 2012). Each column represents a different regression. Firm level control are not reported. Year dummies included. Robust standard errors are clustered at NACE 4 and are reported in brackets. Significance level: * is the p-value>0.1, ** is the p-value>0.05, and *** is the p-value>0.01. Instr.: total number of instruments. For the Hansen test (over-identification test) and AR2 test are reported the p-values.

The results are in line with the previous findings, even if the aggregation has changed; the average market power measured by Lerner index($MP(l^N)_{mt-1}$), and the level of entry barriers in network industries ($EntryB_{mt-1}^N$) are introduced to make the results more robust. The coefficients remain negative and significant for all indicators: an increase in the average competition level for networks has a positive effect on the average manufacturing productivity. Column 1

provides the preferred specification: it shows that an increase in the average markups of services has a negative impact on manufacturing productivity. Similarly, a higher Lerner index in services is associated with lower manufacturing productivity (Col. 2); concentration index ($C5$) and MES provide the same results.

Finally, column 6 shows that a reduction in the entry barriers has a positive effect on downstream productivity, as predicted by Bourlés et al. (2011). Moreover FDI and average efficiency in services are positively correlated with manufacturing efficiency. The results suggest that services competition and manufacturing efficiency are correlated: average manufacturing productivity benefits in term of growth from positive variations in the services competition. The results as reported in Table 5.1 and Table 5.2 are not easy to interpret. In such a form, coefficients are not comparable given the different definitions; therefore, coefficients are not meaningful to a policy evaluation. Thus, correspondent marginal effects are calculated by employing standardised variables; the marginal effect is defined as a one standard deviation increment over the mean⁴⁰ (coefficient of variation), and results are reported in Table 5.3. For each estimation, the first columns report the marginal effect from the competition indicator, while the second column reports the marginal effects of FDI.

Table 5.3: Marginal Effects[‡].

	Table 5.1		Table 5.2		Table D.1	
	M.Eff.	M.Eff.(FDI)	M.Eff.	M.Eff.(FDI)	M.Eff.	M.Eff.(FDI)
$MP(l)$.	.	-2.036***	0.997**	-3.314***	1.034***
$MP(\mu)$	-0.047	0.197***	-0.416***	0.852**	-0.584***	1.173***
$C5$	-1.338**	0.590***	-1.866***	0.820**	-3.486***	1.026***
MES	-0.090**	0.666***	-0.104***	0.751**	-0.210***	0.930***
Index	2.368**	0.345***	3.343**	0.969**	6.097***	1.276***
EntryB	.	.	-0.245**	1.127***	-0.629***	1.277***

[‡] Significance level: * is the p-value>0.1, ** is the p-value>0.05, and *** is the p-value>0.01

With this transformation it is possible to compare the magnitude of coefficients, and is thus possible to observe that a one standard deviation increase in $MP(\mu)$ has a larger impact on manufacturing productivity compared to the same variation in MES (from Table 5.2): for a one standard deviation increase of $MP(\mu)$, the average manufacturing productivity shrinks 0.41%, while a similar variation in MES generates a reduction of 0.10%. Variations in the average

⁴⁰The marginal effect is calculated as coefficient multiplied by the correspondent coefficient of variation, which is the ratio between the standard deviation and the mean of the variable in the sample of estimation. Such a ratio defines a uniform measure across different variables, given that the ratio is a dimensionless and scale invariant.

market power have a larger effect on manufacturing efficiency compared to MES (across networks). The average Lerner index ($MP(l)$) provides an even stronger marginal effect. However, the Lerner index does not allow us to control for input prices, productivity, and technology parameters as in the case of the estimated μ . It seems plausible that marginal effect of $MP(l)$ overestimates the impact of a market power reduction, given that the other factors may enter in the Lerner index. The marginal effect reported for $C5$ in networks is close to -2 : however, as I mentioned before, concentration is an imperfect measure of competition, and it may explain the magnitude of the coefficient. It is worthwhile to observe that the marginal effect of entry barriers is less than half of $MP(\mu)$ (-0.245) but larger than MES ; this result suggests that market-based indicators provide the same intuition as obtained from institutional variables, and it reinforces the idea that a reduction in market power (as well as in other indicators) corresponds to an increased level of services competition.

Finally, FDI intensity always has a positive effect on manufacturing efficiency, indeed larger than a comparable reduction in the competition indicators: however FDI includes several effects due to services as backward spillovers or competitive pressure from foreign investors, which are not possible to disentangle. Besides, efficiency growth in services has always a positive spillover effect on the average manufacturing productivity. By comparing the marginal effects of Table 5.1 (reporting only system GMM results) and Table 5.2, it is observed that the magnitude of the effect has increased. These results strongly suggest that the average downstream efficiency is mainly affected by network industries. In the last part of Table D.1, I show the results of estimating Eq. 4.2, using Olley and Pakes productivity (1996) as a dependent variable, and average indicators from network industries. As mentioned in section 3.2, in this case it is not possible to disentangle a firm's productivity from markups. It is possible to observe that marginal effects from Table D.1 are higher than those in Table 5.2, confirming the effectiveness of the DLW approach in the present framework. If efficiency and markups (at firm-level) are not separately identified, the estimated coefficients can be biased. Given that it is not possible to separate the effect of competition on productivity from the effect on firm's markup, the estimated coefficient captures both phenomena and marginal effects result larger⁴¹ in Table D.1.

⁴¹It is plausible that an increase in the competition level of services has a positive effect on markups of manufacturing firms. This increase explains the difference in marginal effects. The positive and significant coefficient of $\bar{\mu}(M)_{mt-1}$ in Table D.1 supports this idea.

In conclusion, the results are consistent with the expectations of the OECD, according to which France benefits in terms of aggregate TFP from deregulation and liberalisation policies in favour of competition, in particular in network industries (Appendix C). Indeed, the positive effect from a reduction in entry barriers reinforces the findings. However, with the present analysis it is not possible to define an optimal level for indicators (i.e. competition level), given that the variables of interest are defined as weighted means across different service sectors; it is unknown whether the observed value of competition indicators are above or below an optimal value. Moreover, it is difficult to define widely acceptable criteria according to which the competition level is optimal (maximise manufacturing firms' efficiency or consumer welfare). Thus, it is hard to say how much the markup or the minimum efficiency scale must be reduced in each sector to maximise growth; what is inferred is that services competition and manufacturing efficiency are negatively correlated, indicating that liberalisation and deregulation policies that encourage services competition have a positive effect far beyond services themselves.

6 Robustness check analysis

To test the robustness of previous findings, I estimate whether the characteristics of manufacturing firms determine the size and significance of previous findings. With robustness tests I determine whether downstream firms respond differently to variations in the competition of the upstream market. In the first test, I determine whether the estimated effect changes in function of firm's relative efficiency (distance from efficient frontier); in the second test I determine whether firm's average size is relevant.

The robustness analysis considers only network industries, while services competition is measured by the average markup $MP(\mu^N)$ indicator (preferred indicator). The first exercise is similar to Bourlés et al. (2011), but it is performed with a different approach (and different data). To test whether the empirical relationship depends on firm's relative efficiency (initial level of efficiency), I split the sample according to a notion of distance from the efficient frontier. I construct a firm-level measure of distance-to-the-frontier in which distance is a notion of how productive each firm is relative to the most productive firm in the sector (NACE 2). Following the approach of Konings and Vandenbussche (2008), the distance of each firm i is constructed as the ratio

of firms' efficiency (TFP) to the productivity frontier, by using as reference period year 1997; the distance variable is therefore time invariant. The frontier for the NACE 2 digit sector m is defined by the firm with the highest productivity level in 1997; the distance indicator is

$$Dist_{im1997} = \left(\frac{(TFP)_{im1997}}{\max(TFP)_{m1997}} \right). \quad (6.1)$$

where TFP is the De Loecker Warzinsky (2012) residual and $\max(TFP)_{m1997}$ is the maximum level of efficiency observed in sector m (the frontier does not change in the sample period). The variable $Dist$ is defined between 0 and 1; a value of one indicates the most efficient firm, while values close to zero refer to laggard firms compared to the frontier firm. According to Eq. 6.1 firms are divided in four groups (25th, 50th, 75th percentile). In the first group (*Ist*) there are the less efficient firms (average efficiency= 5.60), that is, farther from the frontier, while the last group (*IVth*) includes the most efficient ones (average efficiency= 8.34) The results in table 6.1 show that less efficient firms are on average more affected by variations in the average market markup of services (network), while firms above the median distance (*IIIrd* and *IVth*) are not hurt by an anti-competitive upstream market (the effect is still negative but not significant). These results suggest that less efficient firms suffer more from an anti-competitive service sector, and the marginal effects in table 6.2 confirm the results. It interesting to note that the positive effect from FDI increases with the relative efficiency of a firm: the more efficient the firm is the larger are the benefits from FDI in services (still, it is difficult to say whether this effect is a pro-competitive effect or a type of backward spillover).

Finally, in the last two columns of Table 6.1, I consider a balanced panel: equation 4.2 is estimated by considering firms that are observed in each year of the estimation's sample. In in column B1, competition is measured as usual by average markup, while in column B2 the entry barrier indicator (from the OECD) is employed. In both cases, a statistically significant and negative coefficient is reported (as expected). Increases of one standard deviation in average markup and entry barriers are associated with a reduction in average productivity of 0.64% and 0.46%, respectively (Table 6.2). Finally, marginal effects are larger than in the case of full sample (Tab. D.1), possibly suggesting that previous results were driven by the presence of laggard firms.

These results seem in contrast with those of Bourlés et al. (2011), who detect negative effects

Table 6.1: Network industries - Robustness check - Distance[‡].

	(Ist)	(IInd)	(IIIRD)	(IVth)	(B1)	(B2)
	TFP_{imt}	TFP_{imt}	TFP_{imt}	TFP_{imt}	TFP_{imt}	TFP_{imt}
TFP_{imt-1}	0.679*** (0.126)	0.955*** (0.243)	0.698*** (0.112)	0.544*** (0.173)	0.740*** (0.127)	0.747*** (0.128)
TFP_{imt-2}	0.208* (0.113)	-0.021 (0.218)	0.157 (0.096)	0.342** (0.137)	0.173 (0.108)	0.172 (0.108)
$MP(\mu^N)_{mt-1}$	-1.351** (0.572)	-0.815* (0.424)	-0.350 (0.591)	-0.688 (0.612)	-1.382*** (0.442)	
$EntryB_{mt-1}^N$						-0.543* (0.310)
$Price_{mt-1}^N$	0.091** (0.041)	0.011 (0.022)	0.017 (0.032)	0.057 (0.039)	0.022 (0.028)	0.028 (0.032)
$FDI_{pw}_{mt-1}^N$	-0.179 (0.794)	1.936* (1.014)	2.585* (1.561)	3.535*** (0.798)	1.912** (0.795)	1.700** (0.704)
$\bar{\mu}(M)_{mt-1}$	0.682 (0.492)	0.285* (0.172)	0.208 (0.240)	0.411 (0.335)	0.066 (0.171)	0.341 (0.236)
Cons.	0.388** (0.152)	0.425** (0.211)	0.992*** (0.267)	0.676** (0.323)	0.684** (0.280)	0.442 (0.289)
Obs.	5,470	5,685	5,951	5,766	12,858	12,858
Firms	1,151	1,179	1,169	1,157	1,893	1,893
Av.TFP	5.601	6.677	7.244	8.346	.	.
AR2 Test	0.196	0.903	0.169	0.586	0.377	0.440
Hansen Test	0.281	0.669	0.244	0.424	0.195	0.1975
# Instr.	58	58	58	58	58	58

[‡] System GMM estimator: one step estimator is used. TFP is the dependent variable: it is the residual calculated from the estimation of production function in 2 inputs (De Loecker Warzynski, 2012). Each column represents a different regression. Firm level control are not reported. Year dummies included. Robust standard errors are clustered at NACE 4 and are reported in brackets. Av.TFP is the average efficiency by percentile. Significance level: * is the p-value>0.1, ** is the p-value>0.05, and *** is the p-value>0.01. Instr.: total number of instruments. For the Hansen test (over-identification test) and AR2 test are reported the p-values.

for sectors close to the frontier; however, it is necessary to emphasise that the present approach differs from theirs in four aspects: i) this work considers a short-run perspective, while Broulès et al. (2011) consider a long-run horizon (from 1984 to 2007) with an error correction model; ii) the second difference the assumption of fixed technology (Cobb-Douglas) compared to a multi-factor productivity approach; iii) I analyse the impact of services competition on manufacturing efficiency, while Broulès et al. (2011) considers all sectors; iv) the present paper considers firm-level data for a single country rather than a cross-country analysis by sectors⁴² (manufacturing and others). Therefore, the present results are complementary rather than contrary in that they provide a short-term perspective (the anti-competitive service sector harms less efficient manufacturing firms).

The second exercise determines whether marginal effects from $MP(\mu^N)$ vary in function of

⁴²It is not possible to infer how the average efficiency of a sector behaves relative to the efficient frontier because there are no comparison terms to identify the frontier by sector.

Table 6.2: Marginal Effects - Robustness Analysis[‡].

	Table 6.1			Table 6.3	
	MP(μ^N)	FDI ρ^N		MP(μ^N)	FDI ρ^N
Ist(Distance)	-0.663**	-0.842	Large	-0.484**	1.369**
IInd(Distance)	-0.372*	0.735*	Small	-0.540***	0.994**
IIIRD(Distance)	-0.157	0.962*	Ist(Size)	-0.700**	1.041
IVth(Distance)	-0.309	1.479***	IInd(Size)	-0.409	0.250
Bal(MP(μ^N))	-0.646***	0.736**	IIIRD(Size)	-0.646**	0.736***
Bal(EntryB ^N)	-0.463*	0.654**	IVth(Size)	-0.550 **	1.483***

[‡] Significance level: * is the p-value>0.1, ** is the p-value>0.05, and *** is the p-value>0.01

firm's size. I again split the estimation's sample into two groups, one formed by large firms (*Large*) and the other with medium-sized and small firms (*MedSm*). More precisely, large firms are defined as firms that employ on average more than 200 workers (across all years), while medium and small firms have less than 200 employees (firms do not vary in this regard during the period of analysis). The idea is to understand to what extent service inputs are crucial for large or small firms. The results are reported in Table 6.3. The MP(μ^N) coefficient suggests that medium- and small-sized firms suffer from a decrease of services competition; the marginal effects in Table 6.2 confirm this intuition. In the subsequent four columns, I divide the estimation sample into four groups according to the quartiles of average firm employment. In the first group, there are firms with less than 37 workers on average, in second group between 38 and 64, in the third between 64 and 146, and in the last there are firms with more than 146 employees on average. The median value is 64, so groups *Ird*, *IInd*, and *IIIRD* include almost all firms in column *MedSm*. Very small firms (*Ist*) and medium-sized ones (*IIIRD*) seem to be more harmed by an increase in services markup⁴³. However, according to Table 6.2, it is difficult to say that there exists a linear relationship between firm's size and the marginal effect of average markup, as in the case of distance to the frontier: regardless, small firms suffer a larger reduction in efficiency after an increase in the average services markup (compared to the last quartile). Finally, large firms seem to benefit from an increasing level of FDI intensity in services (Tab.6.2) compared to small ones.

The results reinforce the main hypothesis that variations in services competition have a relevant impact on manufacturing productivity: high levels of market power in network industries are associated with lower efficiency for manufacturing firms. In particular, small and less-efficient

⁴³When I perform the same exercise using the median value of average employees (i.e. 64) as a threshold, I obtain the same qualitative results: firms below the median suffer more from the anti-competitive service sectors.

firms are more hurt by a reduction in services competition, and thus the competitiveness of weak firms depends also on the conduct in other markets (services). In conclusion, more competition in service sectors can foster productivity growth in other industries and improve the competitiveness of the whole economy.

Table 6.3: Network industries - Robustness check - Size[‡].

	(Large) TFP_{imt}	(MedSm) TFP_{imt}	(Ist) TFP_{imt}	(IInd) TFP_{imt}	(IIIrd) TFP_{imt}	(IVth) TFP_{imt}
TFP_{imt-1}	0.480** (0.230)	0.839*** (0.133)	0.791*** (0.167)	0.638*** (0.143)	0.615*** (0.138)	0.466*** (0.172)
TFP_{imt-2}	0.436** (0.178)	0.086 (0.100)	0.160 (0.146)	0.255** (0.126)	0.204** (0.102)	0.380*** (0.117)
$MP(\mu^N)_{mt-1}$	-1.021** (0.503)	-1.153*** (0.355)	-1.068** (0.469)	-0.873 (0.569)	-1.512** (0.646)	-1.173** (0.478)
$Price_{mt-1}^N$	0.058 (0.058)	0.033 (0.028)	0.032 (0.029)	0.046 (0.032)	0.051 (0.042)	0.084 (0.058)
$FDI_{pw}_{mt-1}^N$	2.244** (1.121)	1.734** (0.691)	1.426 (0.873)	-0.041 (0.803)	1.955*** (0.739)	2.583*** (0.843)
$\bar{\mu}(M)_{mt-1}$	0.036 (0.251)	0.255 (0.187)	0.499** (0.218)	0.259 (0.260)	0.101 (0.341)	0.092 (0.296)
Cons.	0.611 (0.444)	0.449** (0.211)	0.263 (0.172)	0.583*** (0.179)	1.217*** (0.376)	1.042** (0.512)
Obs	4,944	25,406	5,985	7,675	8,159	8,531
Firms	1,103	6,110	1,565	1,865	1,867	1,916
AR2 Test	0.233	0.743	0.529	0.244	0.203	0.0744
Hansen Test	0.400	0.307	0.689	0.808	0.296	0.449
# Instr	58	58	58	58	58	58

[‡] System GMM estimator: one step estimator is used. TFP is the dependent variable: it is the residual calculated from the estimation of production function in 2 inputs (De Loecker Warzynski, 2012). Each column represents a different regression. Firm level control are not reported. Year dummies included. Robust standard errors are clustered at NACE 4 and are reported in brackets. Significance level: * is the p-value>0.1, ** is the p-value>0.05, and *** is the p-value>0.01. Instr.: total number of instruments. For the Hansen test (over-identification test) and AR2 test are reported the p-values.

7 Conclusions

Despite the increasing role of services as inputs for manufacturing process, little attention has been devoted to understanding whether the services market structure (competition) affects the efficiency of manufacturing firms. On the one hand, services account for an increasing proportion of inputs used by manufacturing firms. On the other hand, the degree of competition in large part of the services sector differs from the competitive pressure in the manufacturing sector. While services operate in highly regulated and protected markets (in particular network industries), manufacturers are often exposed to global competition due to trade liberalisation; even if

the recent statistics on trade in services show an increase in the volumes (Ariu and Mion, 2011), trade in manufactured goods is still more relevant to determining the market structure and firms' behaviour. Therefore, such asymmetry may harm manufacturing firms' performances, especially for those that rely more intensively on service inputs. This paper answers some of these questions by providing evidence on how variations in services competition affect manufacturing efficiency. In particular, the analysis focuses on the most crucial service sectors (network industries) and illustrates how estimated effects change in function of firms' characteristic. Following the literature on input-output analysis for service liberalisation (Arnold et al., 2011; Bourlés et al., 2011), I show that the average degree of services competition is positively correlated with manufacturing productivity: results are in line with the expectations of the OECD for France (Table 1.1). A reduction of one standard deviation in the average markup level raises the aggregate productivity of manufacturing firms between 0.4% and 0.7%. The paper finds that network industries are crucial for downstream efficiency; moreover, competition in other service sectors has no impact on productivity. In addition, firms' responses to variations in services competition are heterogeneous; medium- and small-sized firms, as well as firms far from frontier (relatively less efficient), are more harmed by services' market power. However, unlike the previous literature, in this work services competition is measured by using market-based indicators; in particular average services competition is described by firm-level markups. Compared to an institutional indicator, market-based indicators have a more reliable theoretical background so that markup is able to capture the competitive pressure in a given market. A second novel aspect of this work is the targeted economy. I focus the analysis on a developed economy, France: such focus allows us to mitigate the problem of *cointegration* between services' liberalisation process and productivity growth. Additionally, France is an interesting case study that offers a benchmark for the analysis (OECD, 2001). The empirical results suggest several conclusions. The inefficiencies in service sectors may be reduced by encouraging competition, which has a positive effect on manufacturing productivity: pro-competitive policies in the tertiary sector may determine better services for manufacturing firms and consequently increase competitiveness. A reduction in the average markup has a positive effect far beyond the services themselves, especially for weaker manufacturing firms. However, services are highly heterogeneous among such firms; therefore, interventions must consider the different characteristics of each sector (like the economies of scale in network

industries). What remains partially unclear is the mechanism of transmission. Increased competition has two positive effects on the production inputs (i.e. services). First, more competition implies a larger variety of inputs provided, and consequently a positive effect from imperfect substitution (Eicher, 1982). Secondly, more competition may force firms to differentiate products and to provide higher input quality (Aghion et al., 2006); this second explanation seems more reliable, and it is supported both by theory and empirical evidence (Tab. 3.1). Future research should focus on the analysis of the transmission mechanism by considering different types of services used by a firm. A detailed data-set containing information about services' consumption at firm-level can produce fruitful insights.

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A Data Description

Sector list, in parenthesis NACE 2 digit code.

Manufacturing. Food (15), Textile (17), Wearing and Apparel (18), Leather (19) Pulp Paper and Publishing (22), Chemicals and Chemicals products (24), Rubber and plastic product (25), Other non-metallic mineral products (26), Basic metals(27), Fabricated metal product (28), Machinery and equipment (29), Office machinery and computers (30), Electrical machinery (31), Radio television communication equipment (32), Medical, precision and optical instrument (33), Motor vehicles (34), Other Transport equipment (35), Manufactures n.e.c. (36).

Services. *Networks:* Energy & Network Services (40), Land Transport (60), Water Transport (61), Air Transport (62), Auxiliary transport services (63), Post and Telecommunication (64). *Retail:* Wholesale and Retail (50). *Financial services:* Financial Intermediation (65). *Other Business Activities:* Real estate activities (70), Renting of machinery and equipment (71), Computer and Related activities (72), R&D (73), Other Business activities (74).

Table A.1: Sector Level Data Source.

Data	Source	Aggregation Level	Time	Definition
Firm data	Amadeus	Firm Lev.	Variante	Firms with more 1 Mill. Eur. of rev. in 2004
Input output coefficients	Eurostat	NACE 2	Invariant	Purchase coefficient year 2000
Deflators	Eu-Klems	NACE 2	Variante	Price index (ref. year 1996)
Number of firms	Alissee	NACE 2	Variante	Firms with more than 10 employees
FDI	Bank of France	NACE 2	Variante	FDI Stock in mil. of Euros
Market Size	OECD Stan	NACE 2	Variante	Total revenues in mil. of Euros
Industry Employment	OECD Stan	NACE 2	Variante	Number of workers
Entry Barrier Index	OECD Stan	NACE 2	Variante	Conway Nicoletti (2006)

Table A.2: Descriptive Statistics[‡].

Sector	Revenues	Fix. Cap.	Wage	Empl.	Export	Firms
15	44876.01	9759.41	4821.49	159.51	0.54	1746
17	23361.94	4952.48	4104.71	154.46	0.83	383
18	18810.3	4611.32	2924.66	98.76	0.84	305
19	22998.21	2508.33	5109.45	187.49	0.71	98
22	22988.49	9438.65	5672.28	120.47	0.46	804
24	110991.8	50688.74	16547.71	383.60	0.73	911
25	33994.1	8589.10	7027.91	208.42	0.69	840
26	34496.71	16940.84	7273.19	206.50	0.35	506
27	76910.4	21234.58	12089.69	338.03	0.75	280
28	15627.58	3210.03	3820.51	122.38	0.62	1494
29	33643.95	5544.46	6886.40	190.83	0.73	1114
30	412424	63577.06	31240.11	909.49	0.69	34
31	54778.08	20830.02	12212.28	327.66	0.73	391
32	90577.76	20686.50	16544.11	380.75	0.62	280
33	58796.34	20780.74	8813.38	397.40	0.75	395
34	494157.5	103330.10	26725.98	1222.01	0.67	347
35	128785.1	29907.24	28448.61	609.68	0.61	180
36	12624.02	2769.05	2510.76	99.88	0.59	1079
40	386033.1	469490.3	54599.24	676.06	0.09	75
50	97547.08	13076.24	7833.54	265.54	0.40	3600
60	128970.2	146839	50262.36	1296.25	0.52	248
61	224624.2	58403.53	27582.31	396.13	0.46	27
62	778186.6	159341.2	243101.40	933.49	0.41	21
63	86196.23	164942.6	14387.79	412.18	0.57	331
64	1736172	2247657	290428.70	7297.49	0.40	54
65	268101	141044.6	45406.13	1182.14	0.28	343
70	75984.78	187273.8	9724.64	274.04	0.05	518
71	86015.5	77795.43	8792.46	259.88	0.19	140
72	70366.01	14961.55	26365.91	481.59	0.49	260
73	71696.09	77260.48	19538.97	351.46	0.55	44
74	563938.5	364350.8	80646.36	3561.35	0.40	1995

[‡] In cells are reported sector's averages. Revenues: deflated value of operating revenues in Th. of Euros. Fix. Cap.: fixed assets deflated in Th. of Euros. Wage: total wage bill in Th. of Euros. Empl: numbers of employees. Export: percentage of exporters. Firms: number of firms in dataset. Source: Amadeus

Table A.3: Production Function Estimation in Manufacturing Industry[‡].

Sector	K	Std.Err(k)	L	Std.Err(l)	μ	TFP	Obs
15	0.219	0.011	0.209	0.013	1.13	9.70	4989
17	0.139	0.014	0.127	0.015	0.62	8.75	1470
18	0.431	0.021	0.466	0.035	3.11	7.77	1071
19	0.706	0.083	0.797	0.184	1.65	7.27	318
22	0.354	0.033	0.355	0.035	1.02	8.73	2382
24	0.391	0.035	0.399	0.033	1.49	10.49	3407
25	0.523	0.025	0.555	0.037	1.35	8.80	3661
26	0.650	0.029	0.947	2.122	1.63	5.44	2192
27	0.849	0.020	0.569	0.062	2.02	10.91	1180
28	0.507	0.015	0.522	0.021	1.24	7.64	6063
29	0.578	0.035	0.619	0.054	1.52	8.31	4707
30	0.507	0.067	0.538	0.078	1.38	11.82	94
31	0.794	0.127	0.968	0.571	1.57	6.36	1697
32	0.520	0.039	0.547	0.049	1.53	10.45	984
33	0.454	0.026	0.449	0.028	1.05	8.74	1513
34	0.531	0.025	0.571	0.048	1.64	9.17	1326
35	0.553	0.025	0.631	0.053	1.22	8.91	607
36	0.576	0.020	0.883	0.117	1.17	4.47	2706

[‡] Bootstrapped robust standard error reported. Time dummies included.

B Competition Measures in Services

Table B.1: Competition indicators: averages[‡].

NACE 2	MP(<i>l</i>)	MP(μ)	C5	MES	Index	Revenues	Employment	Firms	FDI Flows
40	0.371	2.306	0.787	11.264	-1.554	46421.14	137579	313	-70.5331
50	0.157	1.344	0.465	9.903	0.179	252039.1	3193701	85443	-85.3485
60	0.584	1.418	0.256	9.273	0.370	53003.46	617831	12344	32.58503
61	0.702	4.216	0.906	10.945	0.146	5303.488	17361	195	72.5871
62	0.531	12.114	1.000	11.139	0.075	12806.36	64017	147	54.8252
63	0.500	18.650	0.598	10.337	-0.376	41508.02	341067	245	371.0284
64	0.530	2.293	0.962	9.810	0.125	48281	449814	526	910.2213
65	0.249	22.260	0.817	12.278	-0.068	123962.1	743117	.	5439.322
70	0.404	1.388	0.500	10.768	-2.357	199262.8	250012	4841	1851.399
71	0.591	2.859	0.810	10.848	-0.308	19572.78	68040	1541	247.9849
72	0.383	2.541	0.733	10.715	0.479	46617.81	407044	5248	813.9713
73	0.412	6.283	0.718	10.366	-0.024	29684.44	221642	349	196.185
74	0.253	1.390	0.562	12.766	-0.078	215783.3	2437508	36876	13588.82
Total	0.436	6.082	0.701	10.801	-0.261	84172.76	688364	12523	1801.773

[‡] Revenues: total sector revenues in millions of Euros. Empl: number of employees. Firms,; number of firms in a market with moire than 5 employees. FDI Flows in millions of Euros. Source: Amadeus Dataset and OECD Stan data-set

Table B.2: Average market power by Area-Year[‡].

year	MP(μ)					year	MP(<i>l</i>)				
	1	2	3	4	Total		1	2	3	4	Total
1996	2.567	1.106	0.004	7.307	4.081	1996	0.445	0.138	0.192	0.448	0.403
1997	2.767	1.105	0.005	6.012	3.675	1997	0.428	0.146	0.223	0.389	0.376
1998	3.281	1.128	0.010	5.154	3.584	1998	0.454	0.155	0.276	0.407	0.399
1999	4.964	1.112	0.010	5.766	4.595	1999	0.583	0.153	0.216	0.452	0.471
2000	3.211	1.084	0.008	5.817	3.803	2000	0.559	0.146	0.268	0.414	0.449
2001	3.423	1.143	0.012	4.631	3.450	2001	0.590	0.158	0.324	0.418	0.470
2002	3.142	1.212	0.011	4.812	3.395	2002	0.558	0.171	0.297	0.393	0.444
2003	3.285	1.183	0.008	2.849	2.704	2003	0.621	0.173	0.249	0.403	0.474
2004	3.039	1.188	0.005	2.174	2.331	2004	0.591	0.177	0.195	0.353	0.437

[‡] Source: Amadeus data-set. 1: Network; 2: Retail. 3: Financial Services. 4: Other business actives.

Table B.3: Average market power by Network industries[‡].

Sector	1996	1997	1998	1999	2000	2001	2002	2003	2004
40	2.434	2.558	2.788	2.909	1.922	1.796	1.481	1.413	1.043
60	1.657	1.967	1.943	1.831	1.921	1.947	2.267	2.566	1.821
61	4.770	3.673	3.973	3.999	4.134	4.589	3.866	3.448	2.818
62	1.859	2.878	3.719	4.869	3.108	4.344	2.674	3.847	3.873
63	3.948	4.835	6.444	6.205	5.685	5.482	5.071	5.108	5.236
64	0.733	0.688	0.818	9.973	2.496	2.380	3.490	3.329	3.445

[‡] Average market power. *Networks*: Energy & Network Services (40), Land Transport (60), Water Transport (61), Air Transport (62), Auxiliary transport services (63), Post and Telecommunication (64).

Table B.4: Correlation Matrix[‡].

Corr	Firm	Size	MP(<i>l</i>)	MP(μ)	C5	MES	IK	Index
Firm	1							
Size	0.816*	1						
MP(<i>l</i>)	-0.483*	-0.628*	1					
MP(μ)	-0.364*	-0.083	0.005	1				
C5	-0.764*	-0.579*	0.193*	0.236*	1			
MES	-0.001	0.162	-0.070	0.149	0.442*	1		
IK	0.069	0.322*	-0.279*	-0.012	0.271*	0.790*	1	
Index	0.110	-0.053	0.133	0.039	-0.025	-0.157	-0.178	1

[‡] Size: log of total revenues for a two-digit market. Firms: log of firms' mass at NACE 2. MP(μ) is market power from markup estimation. MP(*l*) is market power from Lerner index. IK: average intangible fixed assets per firm at NACE 2 (source: Amadeus)

Table B.5: OECD Regulation index for network industries[†].

	Airlines		Telecom		Electricity		Gas		Post		Rail		Road	
	Entry Barriers	Public Ownership	Entry	Public Ownership	Market Structure	Entry	Public Ownership	Market Structure	Entry	Public Ownership	Market Structure	Entry	Public Ownership	Market Structure
1996	2.5	6.0	4.7	6.0	5.4	6.0	6.0	6.0	6.0	3.9	5.0	6.0	6.0	6.0
1997	2.5	6.0	4.4	3.7	5.2	6.0	6.0	6.0	6.0	3.9	5.0	6.0	6.0	6.0
1998	2.5	6.0	0.0	3.7	4.7	6.0	6.0	6.0	6.0	3.9	5.0	6.0	6.0	6.0
1999	2.5	3.3	0.0	3.7	3.7	4.3	6.0	6.0	6.0	3.9	5.0	6.0	6.0	6.0
2000	2.5	3.3	0.0	3.7	3.9	2.3	6.0	4.5	6.0	3.9	5.0	6.0	6.0	6.0
2001	2.5	3.3	0.0	3.5	2.7	2.3	6.0	4.5	6.0	3.9	5.0	6.0	6.0	6.0
2002	0.0	3.3	0.0	3.4	2.8	0.3	6.0	4.5	6.0	1.4	5.0	6.0	6.0	6.0
2003	0.0	3.3	0.0	3.5	2.7	0.3	6.0	4.5	6.0	1.4	5.0	6.0	6.0	6.0
2004	0.0	2.6	0.0	3.5	2.6	0.3	6.0	1.5	0.5	1.4	5.0	6.0	6.0	6.0

[†] Source: Conway Nicoletti (2006) et OECD, Entry

Table B.6: System-GMM variables[‡].

Variable	Obs.	Mean	S.D.	Min	Max	Type	Instrument	Description	Status
TFP	30350	6.95	1.56	-0.64	16.73	Endogenous	3rd and 4th lag	Olley and Pakes (1996) TFP	Firm level
TFP(op)	30349	3.57	0.67	-1.54	7.85	Endogenous	3rd and 4th lag	Ordinary Least Square TFP	Firm level
Log(KL)	30350	2.62	0.92	0	6.54	Endogenous	3rd and 4th lag	Capital intensity	Firm level
ΔY	30350	.066	0.19	-1.91	5.72	Endogenous	3rd and 4th lag	Output growth	Sector level
$\bar{\mu}(M)$	30350	0.22	0.09	0.09	0.51	Exogenous	no	Average markup of manufacturing input market	Sector level
MP(μ^S)	30350	0.53	0.32	0.14	1.81	Exogenous	no	Average markup in services	Sector level
MP(μ^N)	30350	0.09	0.05	0.03	0.29	Exogenous	no	Average markup in network	Sector level
MP(t^S)	30350	0.05	0.01	0.03	0.09	Exogenous	no	Average Lerner in services	Sector level
MP(t^N)	30350	0.01	0.01	0.005	0.04	Exogenous	no	Average Lerner in network	Sector level
C5 ^S	30350	0.10	0.02	0.06	0.17	Exogenous	no	Concentration index in services	Sector level
C5 ^N	30350	0.02	0.01	0.01	0.05	Exogenous	no	Concentration index in Networks	Sector level
MES ^S	30350	1.82	0.34	1.30	2.73	Exogenous	no	Minimum efficiency scale in services	Sector level
MES ^N	30350	0.31	0.15	0.11	0.73	Exogenous	no	Minimum efficiency scale in Networks	Sector level
Price ^S	30350	3.558	0.78	1.60	4.99	Exogenous	no	Service price	Sector level
Price ^N	30350	0.07	0.04	0.03	0.19	Exogenous	no	Network price	Sector level
FDI _{pw} ^S	30350	0.0006	0.003	-0.000	0.0013	Exogenous	no	FDI intensity in services	Sector level
FDI _{pw} ^N	30350	0.017	0.084	-0.44	0.234	Exogenous	no	FDI intensity in networks	Sector level
Index ^S	30350	-0.043	0.03	-0.16	0	Exogenous	no	Average efficiency in services	Sector level
Index ^N	30350	-0.017	0.023	-0.14	0.014	Exogenous	no	Average efficiency in networks	Sector level
EntryB ^N	30350	0.067	0.057	0.008	0.28	Exogenous	no	Entry barriers in networks	Sector level

[‡] Variables used for the estimation of Eq. 4.2. All sector level variables are constructed as described in Eq. 4.1. Source: Amadeus, OECD Stan, EU-Klems, Eurostat, Alisee.

C Networks in France: an example of service sector

In this section, I briefly describe service sectors' characteristics for European Union (EU) and France, with a particular attention to networks industries. The EU is characterized by free trade in commodities but not free trade in services. The low competitive pressure in services depends on many factors, of which four are the most important. At first, some services, such as transport or telecommunications (networks) are natural monopolies because of high entry costs, due to network construction or network accessibility. Second, services particularly in Europe have traditionally been largely state owned or highly regulated in order to maintain low prices, and to overcome market failures such as asymmetric information. Third, services such as transport or telecommunication have been state owned for reasons of national strategic interest. Fourth, service providers must be located close to service users (firms or consumers), because services cannot be easily imported nor traded like manufactured goods⁴⁴. The EU attempts to deal with the competition in the service sector with the so-called "Bolkenstein reform" (Bolkestein Directive, 2006), especially in the field of services to person. The reform was introduced in an effort to encourage competition between European service providers, to foster efficiency and quality in services; the main declared objective was to incentive free trade in services across European countries, such that the benefits split between consumers and firms. The relevance of services for manufacturing firms is discussed also by Gordon (2004), who claims that differentials in productivity growth between Europe and the USA (in the mid of nineties) depend on different regulation of the services market. He sustains that the poor European performances are due to inefficiencies in service; while in Europe services are protected and the EU market is fragmented, in the USA services are completely free to move from one state to another and to compete in a larger market. In 2000, services accounted for 70% of the France's GDP and 71% of its labour force (OECD Survey 2001). On average, services accounted for 28% of the total inputs to manufacturing sectors; this is relatively low compared to the UK or Germany, where services accounted for 44% and 39% respectively (Barba-Navaretti et al., 2006). However the French figure increased by 17% in the five years from 1995 to 2000 (according to Eurostat I-O tables). Traditionally, a large proportion of service firms in France were state-owned or under public control, in some specific sectors as network industries. Public utilities were vertical integrated, but after liberalization whether the network's owner is competing in the market itself (e.g., Electricite de France, EDF), it is obliged to provide network access to all potential competitors for a reasonable price. The role of the state is strong, and it often influences the investment decisions of foreign firms like in the case of Enel-Suez merger. In 2006 the

⁴⁴Sector as retails is not so highly regulated, compared to the other services. It is important to notice that the characteristics across services are highly heterogeneous

French government blocked the hostile bid of an Italian group (Enel) for the privately owned firm, Suez (a vertically integrated energy firm). Instead France government encouraged the merger of Suez with the state-owned Gas de France, addressing national interests as motivations⁴⁵. However a process of service sector deregulation began in 1998, and this has already produced some results. For example, following EU directives France implemented reforms in the energy market with two new laws, one in 2000 opening 30% of the market to competition and another in 2003 with 35% of the market. It was created RTE, a network management company independent from EDF; RTE is required to provide producers with free and equal access to its transmission network. Since 2000 business customers have had a free choice of suppliers, and it has been true also for private customers: by April 2000, some 52 business customers (9%) had cancelled their contract with EDF⁴⁶. This situation put pressure on prices, resulting in substantial price cuts for business customers. However public ownership in electricity and gas sectors is still strong (Table B.5) as well as in transports. National ownership and state presence remains in some network industries given that networks remains of strategic interest for a national economy; other limitations to full liberalization are natural entry barriers associated to networks (i.e., it is too costly to duplicate a network). Similarly, also TLC market has been opened to private competitors both national and foreign.

⁴⁵The Economist, August 26th 2006

⁴⁶OECD France Survey 2001

D Additional Tables

Table D.1: Network industries: Olley Pakes TFP in two inputs[‡].

	(1)	(2)	(3)	(4)	(5)	(6)
	$TFP(op)_{imt}$	$TFP(op)_{imt}$	$TFP(op)_{imt}$	$TFP(op)_{imt}$	$TFP(op)_{imt}$	$TFP(op)_{imt}$
$TFP(op)_{imt-1}$	0.781*** (0.157)	0.839*** (0.152)	0.764*** (0.149)	0.718*** (0.153)	0.936*** (0.099)	0.955*** (0.141)
$TFP(op)_{imt-2}$	0.042 (0.077)	0.017 (0.075)	0.046 (0.074)	0.066 (0.076)	-0.036 (0.056)	-0.032 (0.073)
$MP(t^N)_{mt-1}$	-6.956*** (2.316)					
$MP(\mu^N)_{mt-1}$		-1.242*** (0.366)				
$C5_{mt-1}^N$			-8.411*** (2.391)			
MES_{mt-1}^N				-0.457*** (0.135)		
$Index_{mt-1}^N$					4.634*** (1.780)	
$EntryB_{mt-1}^N$						-0.699** (0.351)
$Price_{mt-1}^N$	-0.046* (0.025)	-0.046* (0.024)	-0.054** (0.024)	-0.051** (0.024)	-0.045*** (0.017)	-0.021 (0.015)
$FDI_{pw}_{mt-1}^N$	1.782*** (0.541)	2.023*** (0.517)	1.769*** (0.523)	1.603*** (0.526)	2.200*** (0.604)	2.202*** (0.570)
$\bar{\mu}(M)_{mt-1}$	0.726** (0.351)	0.515* (0.308)	0.727** (0.345)	0.875** (0.379)	0.602*** (0.232)	0.577* (0.329)
Cons.	0.800** (0.374)	0.727** (0.371)	0.930** (0.384)	0.971** (0.379)	0.441** (0.220)	0.274 (0.264)
Obs	30,350	30,350	30,350	30,350	30,350	30,350
Firms	7213	7213	7213	7213	7213	7213
AR2 Test	0.230	0.138	0.233	0.355	0.001	0.021
Hansen Test	0.561	0.572	0.554	0.563	0.811	0.598
# Inst.	58	58	58	58	58	58

[‡] System GMM estimator: one step estimator is used. TFP is the dependent variable: it is the residual calculated from the estimation of production function in 2 inputs (Olley Pakes, 1996). Each column represents a different regression. Firm level control are not reported. Year dummies included. Robust standard errors are clustered at NACE 4 and are reported in brackets. Significance level: * is the p-value>0.1, ** is the p-value>0.05, and *** is the p-value>0.01. Instr.: total number of instruments. For the Hansen test (over-identification test) and AR2 test are reported the p-values.