Markup responses to international outsourcing: an empirical analysis

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1. INTRODUCTION

International outsourcing, namely the contracting out of activities previously performed within a firm to foreign subcontractors outside the firm (Fritsch and Görg, 2015), has become a key trend since the past half-century. Although not always, it often takes the form of vertical production outsourcing and thus concerns the acquisition of inputs of production that are then used at a different level of the supply chain. As economic integration and global production shifting have increased, policymakers and scholars have recognized possible links (and conflicts) between the effects respectively predicted by International Trade and Industrial Organization. Indeed, while entailing most of the advantages derived from globalization, outsourcing agreements might result in higher firms' market power whenever efficiency gains are not entirely passed on consumers and might eventually trigger competition. Therefore, assessing whether international outsourcing has an effect on outsourcing firms' markup could be a relevant question both from the point of view of International Trade and Industrial Organization.

In the light of that, I empirically investigate whether the gains predicted by International Trade theory translate into an increase in intrabrand competition (pushing down prices) in the outsourcing firms' country or if, instead, they mainly increase firms' market power, as proxied by markup. On the understanding that an increase in margin does not automatically imply illicit conduct according to competition policy and does not necessarily reduce consumer welfare in the end[1], the purpose of this study is to analyze whether and how international outsourcing affects firms' markup. Furthermore, the research allows understanding to what extent consumers benefit from international outsourcing gains, in terms of changes in the pricing strategy.

Investigating whether and how international outsourcing might affect market power could be interesting for different reasons. As long as internationalized firms tend to be larger, more capital-intensive and characterized by higher sales, it could be the case that they also have

[1] One should recall that increases in markups do not make outsourcing agreements anticompetitive per se from the point of view of competition law. Indeed, there could be many reasons for which firms' market power increases (e.g. product differentiation, competitive advantage, etc.), which do not necessarily imply an illicit conduct. More precisely, whether a vertical outsourcing agreement is considered potentially restrictive or anticompetitive only depends on whether there are specific anticompetitive clauses or conditions in the contract at issue. For this reason, the practical competition evaluation falls outside the scope of this study, since it would require a case-by-case analysis.

high market power. In this regard, Altomonte (2012) claims that firms' turnover increases with the degree of complexity of international activities and that this trend could lead to an internationalization activities' ranking from low selective (exporting) to highly selective and more complex practices (foreign direct investments and active outsourcing). Moreover, besides being a current topic of debate, international outsourcing is also structurally different from other internationalization practices for various reasons. On one hand, differently from mergers, firms involved in outsourcing's alliances remain two separate firms pricing independently, even though international outsourcing agreements are often conducted on a long-lasting basis. Consequently, since there is not a direct drop in the number of firms that softens competition, as in FDI, potential change in firms' market power is more relevant. Furthermore, as long as outsourcing does not imply integration, procompetitive effects in outsourcing arising from the implementation of a unique pricing strategy are not present (e.g. avoidance of double marginalization). On the other hand, outsourcing should be kept distinct from importing, since outsourcing firms completely hive off an entire service, saving on the fixed costs of building up the outsourced service.

Specific features of outsourcing agreements, as well as gains and challenges arising from this particular internationalization practice, are described in Section 2, where I make a brief review of the literature on the predicted effects of outsourcing, including theoretical and empirical studies.

In light of the existing literature, in this study, I investigate of the effect of international outsourcing on markup, and on the possible channels through which it eventually operates. In particular, assuming a monopolistic competition set up, where firms' pricing strategy consists of charging a markup over the marginal cost[2], I identify two main mechanisms.

First, international outsourcing can affect markups through the reduction in marginal costs and productivity gains. Indeed, the contracting out of activities to foreign firms that are more productive allows reducing marginal costs due to the availability of cheaper inputs in the outsourced country and the higher efficiency of specialized providers in the provision of intermediate goods and services. Moreover, outsourced inputs could eventually better match in-sourced inputs and lead to a more efficient production process. Finally, variable

[2] In this study, I treat variable costs as a proxy for marginal costs, as the latter are not observed in the data.

costs savings could enable firms to innovate and further reduce their internal costs, leading to indirect efficiency gains. While savings on the fixed costs of building up the outsourced service are, by definition, not directly passed on consumers and do not influence prices directly, the pass-through rate of variable costs gains could affect the evolution of markup and price. By focusing on the effect of outsourcing on markups, I can infer whether the hypothesized cost efficiencies are passed through or not. In particular, in the case of complete pass-through, markups should remain stable after a change in marginal costs and price should eventually decrease. By contrast, a variation in marginal costs that corresponds in absolute value to a variation in markups provides evidence for zero pass-through of efficiency gains. In this case, one would expect to find a positive and significant relationship between outsourcing and markups.

The second mechanism concerns possible effects of outsourcing that are aside from the drop in variable costs and that, instead, operate through the demand. In particular, by outsourcing non-core activities and saving on the fixed cost of their development, firms can specialize in core competencies. Moreover, by outsourcing the production to more specialized suppliers, firms can gain access to higher quality inputs. The former two effects, which are specific for outsourcing, could eventually lead to the relocation of the production function towards differentiated and higher quality goods. This would ultimately allow firms to gain a competitive advantage on the market and targeting consumers with higher willingness to pay, thus influencing the pricing behavior.

I present the model and theoretical framework in detail in Section 3.1.

Given the former distinction, in the empirical analysis I try to disentangle the two channels through which outsourcing could affect markups (namely, through variable cost efficiencies and through product differentiation). First, I investigate the effect of outsourcing on markup controlling for some relevant firms' characteristics (namely, revenues, age, competition, size, country and sector of belonging) but without controlling for total factor productivity (TFP).[3] According to this specification, the effect (if any) of international outsourcing embraces both the channels. Then, I control for TFP in order to investigate whether there is

[3] Total Factor Productivity is a measure of economic efficiency and is measured as the ratio of aggregate output to aggregate inputs. In this study, I use an estimation of TFP that is derived from the Solow residual from a Cobb-Douglas production function, estimated following Levinsohn and Petrin (2003).

evidence for an effect of outsourcing on markups that does not operate through the reduction in marginal costs, but rather through the demand. I employ a reduced form econometric model and I use firm-level data about 14.169 firms from seven European countries in 2008 from the combined EFIGE-AMADEUS dataset (Section 3.2). Finally, since self-selection is an important matter in internationalization practices when these activities involve an initial fixed cost (Helpman, 2006), I construct a counterfactual model and use matching procedures to look for a causal effect of international outsourcing on firms' markup.

Results are summarized in Section 4. Correlations highlight that the positive relationship between outsourcing and markup loses significance as soon as relevant controls about firms' characteristics are included. However, when controlling for TFP in order to isolate the competitive channel, TFP is found to be strongly negatively related to markup. Finally, when looking for the causal effect and addressing self-selection in internationalization, findings suggest that size-driven self-selection can be an issue. Results confirm the positive relationship between outsourcing and markup, even though the significance of the effect considerably depends on the statistical command used for performing matching. Indeed, when using the standard user-written command for propensity score matching in Stata, the average treatment effect on the treated is not significant at the usual confidence levels. However, when switching to a more precise recently developed command, there is significant evidence for a positive direct effect of outsourcing on markup, which goes beyond TFP gains and is not biased by self-selection.

2. LITERATURE REVIEW

Both the literature in International Trade and Industrial Organization have modeled the welfare effects of various internationalization practices (namely export, import, foreign direct investments, and international outsourcing).

In particular, models of firms' heterogeneity, selection, and trade in International Economics rationalize the idea that factors are reallocated towards more productive firms within an industry in response to trade liberalization. This increases average sectoral productivity and which is a source of welfare gains due to trade (Melitz, 2003). Melitz and Ottaviano (2008) incorporate variable demand elasticity into a selection model with firms' heterogeneity to study the pro-competitive effects of International Trade. The mentioned models of firms' heterogeneity also provide evidence for self-selection in internationalization (Helpman, 2006). Indeed, more productive firms may self-select into internationalization practices that involve a fixed cost, as in Melitz (2003). Under a linear demand model as Melitz and Ottaviano (2008), for instance, demonstrated that more productive firms charge higher markups, hence self-selection predicts a positive relationship between the two variables. Antràs and Helpman (2004) model the internationalization choice in the specific case of outsourcing. In particular, they develop a North-South model in which final-good producers in the North differ in productivity levels and decide whether to integrate vertically or to outsource inputs of production based on productivity and sectoral characteristics. At the equilibrium, firms with different productivity levels choose different ownership structures and supplier locations.

These and other predictions have been widely tested empirically both in the context of International Trade and Industrial Organization. While the former primarily deals with gains from trade, studies in Industrial Organization often analyze competition effects and changes in market power too.

Finally, within the context of the impact of outsourcing on aggregate economic welfare, the conventional analysis of trade policy also highlights the effects on the level of employment and income distribution. Despite being a hot topic of discussion, I do not discuss the latter here.

Some relevant studies respectively within the International Trade and the Industrial Organization theory are discussed in detail below.

2.1. **Gains from international outsourcing agreements**

Different studies in International Trade empirically looked for evidence of gains from international outsourcing.

The major gains derive from the achievement of efficiency gains after the outsourcing of a part of the production process to a more efficient specialized provider occurs.

Indeed, outsourcing agreements have been discovered to foster productivity and economic growth (Mann and Kirkegaard, 2003) in the outsourcing country, after achieving efficiency gains in terms of lower variable costs through the relocation of the production chain. In this regard, Criscuolo and Leaver (2005) find that a 10% increase in outsourcing intensity is associated with a 0.37% increase in TFP in the manufacturing and services sectors in the United Kingdom in the early 2000s. Similarly, Görg and Hanley (2003) perform an analysis on data for plants in the Irish electronics sector and find that by outsourcing services abroad firms achieve productivity gains downstream, for those activities that are closer to consumers. They claim that outsourcing low-skill intensive activities allow firms to reallocate their production towards more high-skill intensive and productive activities, having thus a positive impact on productivity at the firm level.

However, cost saving from international outsourcing could also generate indirect efficiency gains for outsourcing firms. Indeed, lower variable costs not only imply higher profits for outsourcing firms but they have also been proved to incentivize firms to increasingly innovate (Glass and Saggi, 2001; Fritsch and Görg, 2015). Moreover, outsourcing might also generate gains from trade in other goods with the outsourced country. Specifically, the primary benefits of outsourcing and the consequent expansion of skills abroad might give rise to a positive secondary effect consisting in the reduction of other imported goods' price, due to efficiency gains (Bhagwati, 2004).

In addition to the mentioned evidence for efficiency gains, the literature also highlights other gains that do not necessarily result from a reduction of variable costs.

For example, it has been discovered that the substitution for higher quality inputs could eventually lead to higher quality outputs and higher markups. In this regard, Atkin et al. (2015) analyze the manufacturing market of a standardized ball and find that higher quality inputs are associated with higher quality outputs, and that firms providing higher quality

products charge larger markups. Kugler and Verhoogen (2012) model the former idea in the case of importing, but the theoretical mechanism could apply also to the case of outsourcing. Similarly, Goldberg et al. (2010) investigate the relationship between declines in import costs in India and domestic firm product's price. They find that lower input tariffs account for 31 % of the new products introduced by domestic firms. The gain is mainly driven by access to new and higher quality inputs' varieties and not simply by cheaper existing imported ones. Similarly, firms could benefit from higher market power in the market if, after input substitution and the reallocation of activities, they focus on the production of differentiated products. In this regard, in the context of foreign direct investments (i.e. cross-border mergers and joint ventures), Neary (2015) analyzes cross-border mergers as driven by comparative advantage, and highlights possible efficiencies derived from the resulting specialization.

2.2. Competition effects of international outsourcing

Other scholars from Industrial Organization highlight different mechanisms through which (vertical) international outsourcing can affect firms' markup and competition "at home" (i.e. in the downstream market).

One mechanism is based on imperfect competition in the input markets. Arya et al. (2008) show that, by outsourcing orders to a supplier to which its rival has already transferred part of its activities, a firm prevents the rival from extracting monopolistic benefits from the supplier. The increase in competition in the upstream market lowers the price in the downstream market.

Another mechanism, based on collusion, highlights that the subcontracting of intermediate goods may increase rivals' propensity to collude because firms have the opportunity to exchange information about cost, commercial strategies and pricing information during the course of the transaction (Chen et al., 2011). The latter could be relevant for explaining higher markups when more firms outsource from the same provider.

Finally, Békés et al. (2016) study the relationship between various globalization practices, namely exporting, importing, outsourcing and foreign direct investments, and firm-level markups finding positive correlations.

2.3. Outsourcing, markup, and pass-through

The study conducted by Békés et al. (2016) distinguishes between three channels through which internationalization practices might affect markups, namely self-selection, indirect effects through gains in TFP and direct effects that are specific for the internationalization mode at issue. Even though their study does not investigate causal relationships and does not specifically focus on outsourcing itself, it provides useful insights for the mechanisms through which outsourcing might affect markups. Some other studies in the literature directly address the mentioned channels in similar or different contexts.

For example, a related question that has been explored in the literature concerns the pass-through of the achieved TFP gains. For instance, Hellersteir and Villas-Boas (2010) investigate the relationship between firms' degree of vertical integration and its pass-through of foreign cost shocks. However, they deal with exchange rate shocks rather than with direct gains from outsourcing, which represent benefits derived from the change in the relative value of currencies. Interestingly, they recall three reasons for incomplete pass-through of exchange rate shocks, namely the importance of local non-traded costs in the total costs of imported goods, markup adjustment and the costs of nominal price adjustment. More extensively, the literature on markups and pass-through in the context of International Trade rather focuses on the effect of lower import and export tariffs on market power. For example, De Loecker et al. (2016) exploit India's trade liberalization episode to show that firms' internationalization lowered final prices, even though the decline in prices was smaller than the relative decline in marginal costs, providing evidence that firms raised markups. Furthermore, Brandt et al. (2017) examine the effects of China's WTO accession on the evolution of markups and productivity of manufacturing firms highlighting the role of procompetitive effects of trade liberalization.

In the light of the existing literature and building on Békés et al. (2016)'s characterization, the aim of this study is to extend previous analyses on internationalization practices to the particular case of international outsourcing agreements. In particular, while attempting to address the self-selection threat, I focus on the effect on markup through the two possible channels that have been suggested, namely the variable cost reduction and the competitive effect.

3. THE MODEL

In this section, I present a model for rationalizing the channels through which international outsourcing might affect markups, and which will be later used to investigate whether there is evidence for such an effect. First, I formalize the research question in the theoretical framework and identify the two main mechanisms (Section 3.2). Second, I explain the model to be tested empirically and the related econometric techniques. Finally, Section 3.3 describes the data. I use firm-level data about 14.169 European firms from the combined EFIGE-AMADEUS dataset.

3.1. Theoretical Framework

The literature review provides evidence for marginal costs saving and other gains from the contracting out of internal activities to foreign suppliers. In order to estimate whether these gains result in a price reduction, I focus on the effect of international outsourcing on firms' markups, as data on prices and marginal costs are not available.

In particular, assuming a monopolistic competition set up, firms' pricing strategy consists of charging a price $p(c)$ that is made of a markup $\mu(c)$ over the marginal cost c. This reads as:

(1)

$$p(c) = \frac{\varepsilon(c)}{\varepsilon(c) - 1} * c = \mu(c) * c$$

The marginal cost c is computed as a weighted average of local inputs' cost, c^h, and the lower foreign inputs' cost, c^f, faced by firms with contract-length agreements abroad. Markup is allowed to vary along the demand curve, so that it changes with the demand elasticity $\varepsilon(c)$. I assume for convenience a linear demand function.

From Equation (1), it follows that:

(2)

$$\mu(c) = \frac{\varepsilon(c)}{\varepsilon(c) - 1} = \frac{p(c)}{c}$$

Therefore, the effect of outsourcing on markup involves two main effects. The first one is an efficiency gains' effect that mainly operates through the availability of cheaper inputs and reduces (directly or indirectly) marginal costs. The second effect operates through the

demand. In particular, thanks to the relocation of the production and the provision of differentiated and higher quality products, firms could gain a competitive advantage and address lower demand elasticity consumers. The distinction becomes clear when totally differentiating markup:

(3)

$$d\mu(c) = \frac{d\mu(c)}{dc} * dc + \frac{d\mu(c)}{dp} * dp$$

For what concerns the former effect, the analysis of the effect of international outsourcing can be modeled with the introduction of a lower foreign variable cost. Efficiencies gains, indeed, are an important driver explaining the effect of outsourcing on markups. In this regard, Altomonte et al. (2012) find a significant positive correlation between outsourcing and TFP when analyzing a restricted sample of the combined EFIGE-AMADEUS dataset[4] (providing evidence for efficiency gains from outsourcing in terms of lower variable costs). It is worthy to notice that the extent to which outsourcing affects markups through cost efficiencies is intrinsically linked to the pass-through rate of cost efficiencies. Therefore, from the total effect of outsourcing on markup - which entails both channels-, one could also infer the rate of pass-through of cost efficiencies and their effect on the final price. More formally, when taking the first partial derivative by c^f from Equation (1), it is clear how the effect outsourcing (i.e. the introduction in the cost function of foreign lower variable costs) on the final price crucially depends on the markup change. In other words, the effect of outsourcing on markups provides indirect evidence for whether the variable cost reduction translates into a decline in prices, or it only increases markups.

(4)

$$\frac{dp(c)}{dc^f} = \frac{d\mu(c)}{dc} * \frac{dc}{dc^f} * c + \frac{dc}{dc^f} * \mu(c)$$

Therefore, one could infer the change in price, $\frac{dp(c)}{dc^f}$, implied by the efficiency gains, respectively from the change in markup and the change in marginal costs. Looking at the second term of the total derivative in (4), the partial derivative of variable costs by foreign variable costs is positive and at least equal to the reduction in costs due to cheaper foreign

[4] They restricted the original full sample to the one containing those firms whose productivity was computable due to missing balance-sheet data.

inputs (and larger if foreign inputs have spillover effects allow achieving efficiencies through insourced inputs' substitution). Depending on the sign of the partial derivative of markup by costs, the first term of the right-hand side can either be negative or null (as firms are maximizing profits).

In particular, one would observe:

- $\frac{d\mu(c)}{dc} * \frac{dc}{dc^f} = 0$, i.e. no effect on the markup of lowering variable costs after outsourcing, meaning that firms completely pass-through their cost efficiencies. In other words, outsourcing does not affect markups through the cost channel. In the absence of a direct effect of outsourcing on markups, markups remain stable after outsourcing.
- $\frac{d\mu(c)}{dc} * \frac{dc}{dc^f} \leq 0$, i.e. pass-through of efficiencies. In the extreme case, $\frac{d\mu(c)}{dc} * \frac{dc}{dc^f} * c = \frac{dc}{dc^f} * \mu(c)$ and there is no pass-through at all. The effect on markups due to cost efficiencies after outsourcing is negative and changes in price do not reflect efficiency gains.

Since data on local and foreign variable costs are not separately available, I cannot precisely isolate and test the cost efficiency effect. Therefore, in the empirical analysis, I rather investigate the total effect of outsourcing on markup, being aware that, in addition to the effect of outsourcing's efficiency gains on markups, the coefficient would embrace the effect operating through the second channel too (captured by the derivative of markup by price in Equation 3).

The second channel through which international outsourcing can affect markups goes beyond the reduction of variable costs and operates through the demand. In particular, it has been argued that by outsourcing non-core activities to a specialist provider and saving on the fixed cost of their development, outsourcing firms can specialize in core competencies (Glass and Saggi, 2001; Görg and Hanley, 2003). Highly specialized inputs that better match the production function could then favor the production of higher quality and differentiated products (Kugler and Verhoogen, 2012). In this regard, for example, Navaretti and Falzoni (2004) note that after offshoring (either in the form of FDI of outsourcing) the internal division of labor may increase and a demand for high skilled workers arise, leading to the relocation of the production towards diversified goods (they find

that the latter effect is more pronounced when outsourcing towards low-income countries). Differentiated and higher quality products provide firms with a competitive advantage and allow them to target consumers with a lower elasticity of demand, charging higher markups.

This latter mechanism through which outsourcing may affect markup and which derives from the relocation of the production, product differentiation, and quality improvements, it's not an immediate effect of the marginal costs reduction, but it is rather captured by the price component of the markup's derivative. In the empirical part of this study, after investigating the total effect of outsourcing on markups, which includes the effect of efficiency gains, I try to isolate this "competitive" effect of outsourcing. With this aim, I control for TFP in the reduced form model and I include it among the weights for propensity scores when building later the matching model.

Clearly, input substitution, product differentiation, and quality improvements are only some of the possible mechanisms that can explain the effect of outsourcing entailed in the derivative of markup by price. Other mechanisms at play could be, for instance, the level of competition in the market, conduct or cartel behavior and other effects for which, nonetheless, it would be difficult to empirically control in this analysis. Therefore, I will be careful in the interpretation of the effect of outsourcing that does not operate through marginal costs' reduction.

3.2. Description of the model

In order to empirically analyze whether and how international outsourcing affects firms' markup, I first employ a reduced form model for markup and test the hypothesis with Ordinary Least Squares, respectively with and without sector and country fixed effects, in order to control for variability across sectors and countries.

(5)

$$Markup = \beta_1\, Active\ outsourcer \quad + \beta_2\, Revenues + \beta_3\ Size + \beta_4\, Competitorsinhomecountry + \ \beta_5\, Age \ + \ \beta_6\, Country + \ \beta_7\, Sector + \epsilon$$

In particular, firms' markup is regressed on the outsourcing dummy adding some relevant controls, namely revenues, firms' size, a dummy for competition in the home country, age and country and sector fixed effects.

In Equation (5), I do not control for TFP, in order to keep the effect of international outsourcing on markup that operates through cost reduction. In other words, the $\beta_1$coefficient of the outsourcing variable captures the total effect (correlation) of outsourcing on markups, thus including both the price and cost component, for some given characteristics.

In a second stage, I control for TFP in order to isolate the effect of outsourcing on the markup that does not operate through efficiency gains. In this way, the correlation between the outsourcing variable and the dependent variable (i.e. markup), should be cleared out of the effect that operates only through the marginal cost reduction.

(6)

$$Markup = \beta_1\, Active\ outsourcer \quad + \beta_2 \log(TFP) + \beta_3\ Revenues + \beta_4\ Size + \beta_5\ Competitorsinhomecountry + \beta_6\, Age + \beta_7\, Country + \beta_8\, Sector + \epsilon$$

Building on the latter specification, I also test the model after adding an interaction term between competition (which is a dummy variable for whether there is competition in the domestic market or not) and TFP, in order investigate channel effects. The interaction term allows isolating the drive of TFP to markup, conditional to the fact that the firm operates in a competitive sector (i.e. the competition dummy equals one). One would expect the rise in markup following a productivity gain to be less likely in a competitive market scenario and, therefore, a negative coefficient for the interaction term. However, as the competition is a dummy, this specification allows controlling only for the presence and not for the level of competition in the market. Moreover, I add the interactions respectively between competition and outsourcing and between TFP and outsourcing. In particular, the latter interaction term would capture how outsourcing would influence the effect on markup for a given level TFP (or, conversely, how being in the outsourcing group influences the effect of TFP on the markup).

Finally, I employ a counterfactual model and matching procedures in order to identify the direct causal effect of international outsourcing on markup and address the self-selection threat. Indeed, as long as firms require higher productivity to internationalize in order to cope with initial internationalization fixed costs, OLS correlations could be biased due to self-selection. In support of the self-selection hypothesis, Altomonte et al. (2012), for example,

highlights that, among 14,759 sampled European firms, internationally active firms tend to be larger, have higher sales and are more capital intensive. Moreover, they find that firms' turnover increases with the degree of complexity of international activities, from exporter to importer of material, active outsourcing, and FDI. Given self-selection in internationalization, matching could, therefore, be convenient in order to identify the causal effect. Indeed, matching allows controlling for selection on observables and, to some extent, on observably heterogeneous impacts, without requiring a particular specification of the Equation or decision process. However, it requires identifying an appropriate counterfactual group with common support to the treated group (outsourcing firms) and conditional independence assumption holding. In this regard, I identify some characteristics for the selection on observables, namely firm's size, revenues, and TFP, which are the explanatory variables according to which the mean conditional on outsourcing varies the most. In particular, size is included in order to address the self-selection problem, as larger firms are more likely to internationalize. The use of the variable size, which is a categorical variable based on four classes of employees, instead of the number of employees, gives more importance to the advantages of having a large dimension rather than to the cost of employees. Revenues and TFP are other relevant factors for explaining the probability of a firm to successfully outsource.

Before entering into the details of matching, I should discuss the reasonability of the common support (CS) and conditional independence assumption (CIA) in the specific case.

On one hand, the CS assumption ensures that there is sufficient overlap in the characteristics of the treated and untreated group and that, therefore, matching is possible. One possible threat to the validity of this assumption could be the self-selection in internationalization (Helpman, 2006). Indeed, if outsourcing firms are intrinsically different in terms of controls from non-outsourcing firms, it would be difficult to find a common support for matching. However, by looking at the data, it is possible to notice that in practice it is not verified that all and only the largest and most efficient firms internationalize (and vice-versa), suggesting that there could be other drivers for outsourcing. Therefore, it is possible to find some common characteristics between the outsourcer and non-outsourcer group for performing matching. In any case, I check the validity of the common support assumption empirically when conducting matching.

On the other hand, the CIA assures that all the criteria for the assignment of the treatment are well represented in the Xs (i.e. unobservable characteristics do not influence the outcome). While remaining a strong assumption, the validity of the CIA can be improved including all the relevant characteristics available for the decision to outsource in the controls (namely, revenues, TFP, size). Matching on these observable characteristics allows addressing also another potential threat, namely firms' mortality. Indeed, it is reasonable to believe that several firms have exited the market after the internationalization of the outsourcing firms and after the increase of efficiency in the market occurred. However, if the firms that exited the market are the least efficient ones, as long as there are no other relevant unobservable characteristics that determine the survival of firms (i.e. CIA holds), the interpretation of matching is still causal. Indeed, matching occurs between firms with similar characteristics regardless of firms' mortality. However, if firms' mortality after outsourcing was determined by other reasons than productivity (e.g. chance), the control group would not be a good counterfactual. Therefore, while assuming the CIA, I should keep in mind that there could be unobservable mechanisms threatening the assumption.

In order to perform matching, I first estimated propensity scores through a reduced form probit model, regressing the probability to outsource on firms' size, TFP and revenues turnover in 2008. As already mentioned, relying upon the economic intuition, I build propensity scores on these variables because, when analyzing the conditional distribution on outsourcing, their means are significantly different between the treated and control group. In particular, the inclusion of size, which is the main driver for internationalization, allows addressing the self-selection threat. In a later stage, I also perform matching using different propensity scores built on different explanatory variables (further details are reported in Appendix C).

(7)

$$Prob\ Outsourcing = \beta_1\, Revenues + \beta_2\, TFP + \beta_3\, Size + \epsilon$$

After testing myself the significance of the mentioned explanatory variable on the probability to outsource, I build the control group accordingly.[5] Based on the estimated propensity

[5] The marginal effects from the probit regression and the coefficients found when building propensity scores are slightly different due to the common support and balance option that have been added when computing propensity scores. However, in both the cases I conduct a probit regression.

scores, each outsourcing firm is associated with some comparable non-outsourcing firms for all the treated subjects. The averages in outcomes for treated firms are then compared with weighted averages in outcomes for the matched artificial control groups. This should give a consistent estimation of the Average Treatment effect on the Treated (ATT), which is, given by the average difference in outcomes in the two groups.

The generalized formula for the ATT is:

(8)

$$ATT = \sum_{i \in T} \left[y_i - \left(\sum_{j \in C} w(i,j) y_j \right) \right]$$

The estimated effect identifies the causal relation of outsourcing on markups, everything else being equal. This allows addressing the self-selection problem and isolating the direct effect of outsourcing on markups, which does not operate through the reduction in variable costs. Indeed, propensity scores are computed in order to make firm-level observations comparable, so that matching compares likes with likes. Therefore, any variation in markup between the matched firms can be reasonably traced back to international outsourcing.

3.3. Data

The statistical analysis uses firm-level data from the combined dataset between EU-EFIGE/Bruegel-Unicredit and AMADEUS/Bureau van Dijk database[6]. In particular, cross-section data have been used sampling 14.169 firms from seven European countries from 2008, as the relevant variable "outsourcing" refers to that year.

On one hand, EFIGE is a dataset about 150 firm-level variables, including measures of firms' international activities (e.g. outsourcing, exports, FDI, import) as well as other quantitative and qualitative statistics covering the structure of the firms, level of competition, investment, R&D, innovation and market structure. Data are collected from a sample of 14,759 surveyed firms (all with more than 10 employees) in 7 European economies (namely, Austria, Germany, France, Hungary, Italy, Spain, and the United Kingdom) and coming from 11

[6] I have been granted the access to the full-set integrated dataset between EFIGE and AMADEUS by Bruegel after signing a confidential agreement.

manufacturing industries (according to the NACE Clio classification[7]). Information are mostly collected as a cross-section for the last available budget (year 2008). On the other hand, AMADEUS database contains information about 21 million companies across Europe. I used balance-sheets data from AMADEUS both as independent variables and to construct the dependent variable (markup). The combined dataset also contains firm-level measures of TFP, as estimated by Altomonte et al. (2013).

The following variables are included in the study.

Table 1. – Variables

Variable name	Type	Indicator	Source
Markup	Numerical	Markup 2008	Author's computation
Active outsourcer	Dummy	Firm with production activity contracts or agreements abroad (1=Yes; 0=No)	EFIGE
TFP	Numerical	Log total factor productivity in 2008	EFIGE (Computed from AMADEUS data)
Revenues	Categorical	Operating revenue turnover (annual, 2008)	AMADEUS
Size class	Categorical	1: 10-19 employees 2: 20-49 employees 3: 50-249 employees 4: >= 250 employees	EFIGE
Competition Home	Dummy	Firm has competitors in its own country (1=Yes; 0=No)	EFIGE
Age	Dummy	1=Young (< 6 years) 0=Old	EFIGE
Country	Categorical	1: Austria 2: Germany 3: France 4: Hungary 5: Italy 6: Spain 7: UK	EFIGE
Sector	Categorical	Industries 1 to 11 (aggregates from NACE Clio)	EFIGE

Source: EFIGE, AMADEUS Dataset

Note: Variables all refer to 2008

[7] "NACE Clio was the branch of NACE 1970 used for the compilation of input-output tables. It was designed as a nomenclature of branches, made up of "homogeneous production units" (OECD Glossary)

For what concerns the dependent variable, I construct markup according to the Levenson and Petrin method (Appendix A), using sector-specific output elasticities of labor from heterogeneous, industry-specific Cobb Douglas production functions and the revenue share of labor, computed using AMADEUS data.

The explanatory variable, namely international outsourcing, is a dummy variable taking value 1 if the firm has production activity agreements abroad and 0 otherwise.

TFP (in log) is the Solow residual from a Cobb-Douglas production function estimated following the semi-parametric algorithm proposed by Levinsohn and Petrin (2003) and readily available in the combined EFIGE-AMADEUS dataset. TFP is included in the regression as soon as I control for the cost channel.

One potential issue with the TFP measure that I employ is that it is a revenue-based measure since it is a residual from a Cobb-Douglas production function where the output is proxied by value added (net revenues). In particular, the latter implies that a change in markup through the price channel does affect revenues. Consequentially, it could potentially affect TFP, thus leading to a mechanical reverse causality problem. Indeed, even though TFP depends on revenues while markup (in the way it is constructed) depends on sales, they are likely to be highly correlated. Optimally, one would like to have a proxy for output in the production function that is not correlated with sales. I recognize that this is a weak point of the empirical strategy, which in turn could be of inspiration for future works.

Finally, for what concerns sector fixed effects, to preserve anonymity, information about industrial sectors are only made available in the EU-EFIGE/Bruegel dataset in the form of dummies identifying sectors. Therefore, it is not possible to know what 'industry i' corresponds to. However, it still makes sense to incorporate industrial sectors among the controls in order to account for sector heterogeneity and to investigate whether the sector of belonging is significant for the probability to outsource, regardless the specific meaning of industry i. [8]

[8] A minimum identification of firms' sectors of activity in EFIGE is based on the Pavitt Technological class. The dataset reports firms' Pavitt technological class, distinguishing between traditional, scale intensive, specialized and science-based suppliers. Nevertheless, Altomonte and Aquilante (2012) point out that since the original 11 NACE Clio codes might map into different Pavitt classes, the two taxonomies should be used independently. Therefore, in this study, I prefer focusing only on NACE Clio sectors as they show greater variability than sectors from the Pavitt classification.

Tables 2 and 3 provide an organized view of firms' frequency distribution by country, sector of belonging, age, size and firms' distribution conditional on outsourcing activities.

It is interesting to notice that firms are approximately equally distributed across countries (with the exception of Austria and Hungary that have fewer observations), but not across sectors. In any case, except for sector 5, each of the sector and country clusters has at least 400 observations. Moreover, the majority of firms belongs to the second size class (between 20 and 49 employees), while only 7% of firms have more than 250 employees.

When turning to outsourcing, the 590 active outsourcers are mostly based in France, Germany, Italy and the UK (Table 3). While recognizing that the distribution of outsourcing firms is not equal, I do not consider the relatively low number of outsourcing firms to be a threat to the statistical validity of the model, since the absolute number of treated firms is still high. Similarly, the outsourcing distribution by sector is far from being homogenous. In particular, outsourcing firms are concentrated in sectors 1, 2, 3, 8 and 9 (sectors are aggregated according to NACE Clio classification). Nevertheless, one should consider that these sectors display major observations. Indeed, when looking at the share of outsourcing firms within each sector, the conditional distribution exhibits less variance. However, I recognize that the fact that some sectors might be for some reasons more apt for internationalization might cause multicollinearity issues if the sector of belonging significantly determines the internationalization status and the markup. A similar reasoning applies to outsourcing distribution by size. However, as expected from the theory, Graph 2 shows that the share of outsourcing firms is increasing in the size classes (larger firms are more likely to outsource internationally).

Table 4 shows the descriptive statistics of markup in the outsourcing and not-outsourcing group. One might notice that the mean of markup in the group of outsourcing firms is higher than that of not outsourcing firms. Moreover, from Graphs 3 and 4, average markup is almost equally distributed across sectors (except for sector 5 which displays a significantly higher average markup) and across countries.

Table 2: Frequency Distributions

Country	Freq	Percent (%)	Cum.
AUT	443	3	3
FRA	2,973	20.14	23.15
GER	2,935	19.89	43.03
HUN	488	3.31	46.34
ITA	3,021	20.47	66.81
SPA	2,832	19.19	85.99
UK	2,067	14.01	100
Total	14,759	100	

Sector	Freq	Percent (%)	Cum.
1	1,520	10.3	10.3
2	1,966	13.32	23.62
3	2,353	15.94	39.56
4	705	4.78	44.34
5	21	0.14	44.48
6	563	3.81	48.3
7	937	6.35	54.64
8	3,430	23.24	77.88
9	1,802	12.21	90.09
10	424	2.87	92.97
11	1,038	7.03	100
Total	14,759	100	

Firm size	Freq	Percent (%)	Cum.
1	4,694	31.8	31.8
2	6,085	41.23	73.03
3	2,970	20.12	93.16
4	1,010	6.84	100
Tot	14,759	100	

Age	Freq	Percent (%)	Cum.
Young	9,518	64.49	64.49
Old	5,241	35.51	100
Total	14,759	100	

Table 3: Frequency distributions conditional on outsourcing

Active Outsourcer	Freq	Percent (%)	Cum.
0	14,169	96	96
1	590	4	100
Total	14,759	100	

Firm's size	0	1	Total
1	4,564	130	4,694
2	5,868	217	6,085
3	2,809	161	2,970
4	928	82	1,010
Total	14,169	590	14,759

Country	0	1	Total
AUT	421	22	443
FRA	2,795	178	2,973
GER	2,828	107	2,935
HUN	477	11	488
ITA	2,890	131	3,021
SPA	2,790	42	2,832
UK	1,968	99	2,067
Total	14,169	590	14,759

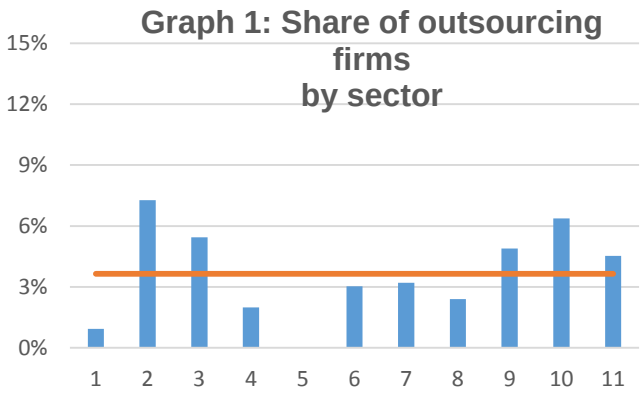
Sector	0	1	Total
1	1,506	14	1,520
2	1,823	143	1,966
3	2,225	128	2,353
4	691	14	705
5	21	0	21
6	546	17	563
7	907	30	937
8	3,348	82	3,430
9	1,714	88	1,802
10	397	27	424
11	991	47	1,038
Total	14,169	590	14,759

Data source: Combined EFIGE-AMADEUS dataset

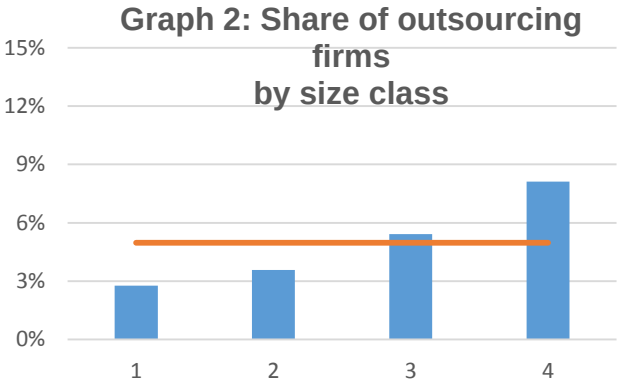
Table 4: Descriptive statistics – Markup in 2008

Active Outsourcing	Obs	Mean	Std. Dev.	Min	Max
0	8,552	2.228191	12.45834	0.009003	1128.593
1	360	2.400717	1.691157	0.413476	14.12176

Data source: Combined EFIGE-AMADEUS dataset

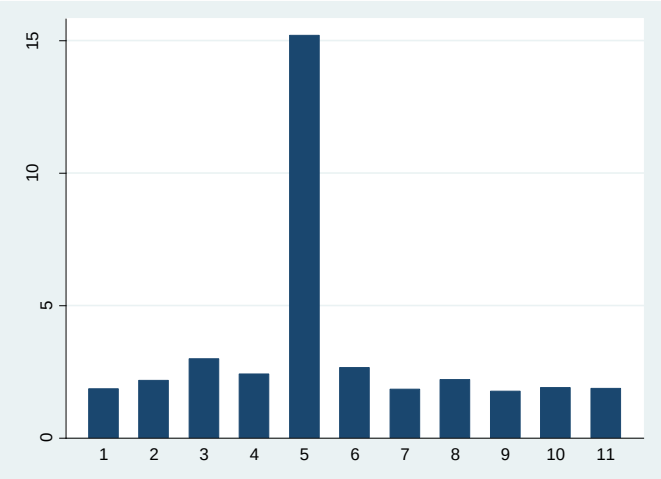


Data source: Combined EFIGE-AMADEUS dataset



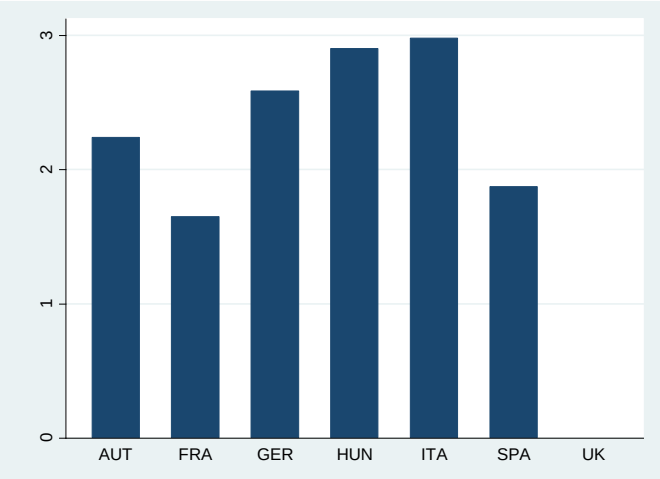
Data source: Combined EFIGE-AMADEUS dataset

Graph 3: average markup across sectors



Data source: Combined EFIGE-AMADEUS dataset

Graph 4: average markup across countries



Data source: Combined EFIGE-AMADEUS dataset

Note: Average markup in the UK is null since there are no values for markup for UK (missing values)

3.3.1. Missing values

Balance sheet data from AMADEUS have been used to compute the production function and markups following De Loecker estimation procedure. As far as AMADEUS dataset suffers from missing data, this results in 5847 (out of 14759 observation) missing values for markup, mainly for firms located in Austria, Germany, Hungary, UK (Table 5). The reason for missing values can be mainly traced to missing data in the cost of employees and sales in these countries. However, as far as data are randomly missing and there is no firms' selection in missing data, this should not be a serious threat for the estimation (i.e. missing markup's values seem equally distributed). Nevertheless, in Appendix B I repeat the analysis using a sample restricted to France, Italy and Spain (for which fewer values are missing). Results do not significantly differ.

Table 5: Missing markup values per country

Country	Total	Markup missing values
AUT	443	25
FRA	2973	2730
GER	2935	554
HUN	488	295
ITA	3021	2828
SPA	2832	2480
UK	2067	0

Data source: Author's computation from "The EU-EFIGE/Bruegel-Unicredit dataset"

Table 6: Missing markup values per variable, share

Variable	Missing data	Missing data (%)
Outsourcing	230	38.98%
Non-outsourcing	5617	39.64%
Revenues larger than the average	3944	67.45%
Revenues smaller than the average	1903	32.55%
Size 1	1736	36.98%
Size 2	2376	39.05%
Size 3	1367	46.03%
Size 4	368	36.44%
Age=0 (Old)	3585	68.40%
Age=1 (Young)	2262	23.77%

Data source: Combined EFIGE-AMADEUS dataset

Note: Average operating revenue turnover in 2008= 22903.18 eur

4. Results

In this section, I report and comment on the results obtained from the empirical estimation of the model described in Section 3. I first analyze correlations, and then I explore the findings from the matching model and interpret them in the light of the theoretical predictions.

4.1. Correlations

With the purpose to investigate the relationship between outsourcing and markup, I first look at correlations. Results from the OLS regression are reported in Table 7, at the end of this subsection.

From the first two columns, it is possible to notice that outsourcing is positively correlated with markups, which is in line with the internationalization gains predicted by the literature. However, the positive relationship conceals the effect of different factors that could be claimed to be the drivers of markup gains. Indeed, as soon as I control for other relevant explanatory variables in the reduced form model, namely competition, size and age, the coefficient of the outsourcing variable loses significance, while remaining positive (column 3 and 4, Table 7).

Correlations between the included controls and markup are in line with what was expected. Revenue turnover is significantly positively correlated with markup. The coefficient of the age variable is also positive, even though not significant. In contrast with the non-significance of the coefficient, I expected younger firms to show higher markups, due to the fact that they are probably more flexible and could more easily adapt to new methods of production. By contrast, smaller firms (i.e. belonging to the first two size classes) show lower markups, accounting for the fact that they are probably less efficient and benefit less from scale economies. Adding a control for size also allows partially controlling for the self-selection problem; in this regard, one could indeed notice that the outsourcing coefficient slightly decreases. However, the solution is only partial, as with correlations the investigated effect is not causal. Finally, in column 5, I add country and sector fixed effects to control for heterogeneity.

Therefore, from regressions conducted in columns 1 to 5, for given firms' characteristics, the international outsourcing status does not seem to have a significant effect on firms' market power. However, correlations should be interpreted carefully as they do not identify a causal

relationship. The latter insignificant effect of outsourcing on markup in regressions 1 to 5 refers to the total effect of international outsourcing, which captures both the efficiency gains and the demand channels, controlling for some given characteristics. From the non-significance of the coefficient, one could infer that cost efficiency from outsourcing are completely passed on consumers, as there is no evidence for the effect of outsourcing on markup. However, one should bear in mind that the coefficient of outsourcing in the previous model also captures the effect that operates through price, which could influence the overall result.

In regressions from columns 6 to 10 of Table 7, I control for TFP in order to isolate the effect of outsourcing on markup that does not operate through efficiency gains. After clearing out the total effect from the cost-reduction channel, the coefficient of outsourcing changes direction, while remaining non-significant. By contrast, TFP significantly explains a large part of markup. The strong negative and significant correlation between TFP and markup is in contrast with what expected. Indeed, one would expect higher productivity to imply lower variable costs and, therefore, higher markups for a given final price. However, the result is not due to a mechanical reason. First, in the case of mechanical correlation, the coefficient would have rather been positive. Moreover, markup – in the way in which it was computed - depends on the cost of employees, while TFP is retrieved from a Cobb-Douglas production function and it is a function of the number of employees. However, the revenue-based measure of TFP could be highly correlated with sales, which are at the core of my measure for markup. Instead, one possible explanation of the negativity and high significance of the TFP coefficient could be related to demand shifters. In this regard, variable markup models naturally predict that firms producing higher quality products tend to charge higher markups (Antoniades, 2015). According to Crozet et al. (2012), for example, quality monotonically increases firm-level prices. Therefore, it could be the case that, for some firms, low TFP values are related to high costs required by the production of high quality final goods, rather than to inefficiency. If the provision of higher quality goods allows these firms to shift the demand and serve more inelastic consumer, they would indeed benefit from higher markups. This reasoning could explain the observed negative relationship between TFP and markups, particularly since I am not controlling for product quality for which I do not have an adequate measure. In support of this position, it is interesting to mention that the strong negative relationship between TFP and markup is not present in all the sectors. Indeed,

when running separate sectorial regressions, only some of them (namely sectors 2, 3, 7, 11, according to NACE classification) show a significant negative correlation between TFP and markup (Appendix E). Nevertheless, missing values in the TFP variable could lower the accuracy of the estimates.[9]

In column 8 to 10 from Table 7, I add interaction terms, respectively between competition in the home country and outsourcing, competition and TFP, and TFP and outsourcing. When adding the interaction between TFP and the dummy for competition, the coefficient for competition becomes significantly negative (having competitors at home lowers markups), while TFP loses significance. The significant interaction term suggests that having competitors at home lowers the effect of productivity on markup. Moreover, the interaction between TFP and outsourcing is positive and weakly significant, suggesting that, all else equal, TFP has an additional positive effect on markup for outsourcing firms. The same could be interpreted as outsourcing having an additional positive effect on markup, for a given TFP level. While not constituting a causal relationship, this result suggests that there could be evidence for an effect of outsourcing on markup that goes beyond cost reduction. However, I investigate the causal relationship and the direct effect of outsourcing on markup more formally with matching.

Finally, in some additional regressions in Appendix E, I correct for errors for cluster correlation between sectors and I include group means by sectors. Results do not significantly change, even though, when correcting for cluster correlation, standard errors shrink.

Overall, the insignificance of relevant variables and the low explanatory power of the reduced form model (R-squared is also very low) that characterize all the regressions lower the validity of the results. One possible reason is that the reduced form model does not account for the self-selection in internationalization and it only highlights correlations. To improve the goodness of the fit and better identifying the causal effect of outsourcing, I exploited propensity scores matching. Results are exposed in the next subsection.

[9] In this regard, Altomonte et al. (2012) restrict the sample to firms for which TFP is available. However, after checking the reason on missing values and that there was not self-selection in them, I preferred using a larger sample.

Table 7: Correlations. OLS estimation

VARIABLES	1	2	3	4	5	6	7	8	9	10
Outsourcer	2.401***	2.076***	0.239	0.208	0.0552	-0.469	-0.613	-1.070	-0.593	1.688
	(0.654)	(0.652)	(0.654)	(0.654)	(0.663)	(0.917)	(0.919)	(1.837)	(0.918)	(1.639)
TFP						-2.616***	-2.535***	-2.535***	-0.133	-2.660***
						(0.335)	(0.336)	(0.336)	(0.654)	(0.344)
Revenues		6.57e-06***	6.04e-06***	5.82e-06***	4.71e-06***		4.48e-06***	4.49e-06***	4.56e-06***	4.51e-06***
		(7.96e-07)	(7.86e-07)	(7.93e-07)	(8.77e-07)		(1.03e-06)	(1.03e-06)	(1.03e-06)	(1.03e-06)
Size 1			1.923***	1.248***	0.143		0.404	0.403	0.401	0.387
			(0.225)	(0.411)	(0.595)		(0.771)	(0.771)	(0.770)	(0.771)
Size 2			2.030***	1.377***	0.203		0.512	0.510	0.467	0.498
			(0.202)	(0.388)	(0.578)		(0.751)	(0.751)	(0.750)	(0.751)
Size 3			2.805***	2.232***	1.118*		1.380*	1.377*	1.343*	1.366*
			(0.307)	(0.419)	(0.600)		(0.765)	(0.766)	(0.765)	(0.765)
Comp home				0.703**	0.255		0.428	0.396	-2.020***	0.427
				(0.334)	(0.375)		(0.499)	(0.512)	(0.759)	(0.499)
Age 1				0.0580	-0.164		-0.190	-0.191	-0.189	-0.193
				(0.274)	(0.284)		(0.378)	(0.378)	(0.377)	(0.378)
comp_out								0.606		
								(2.109)		
comp_tfp									-3.067***	
									(0.717)	
tfp_out										2.220*
										(1.309)
Nation FE	NO	NO	NO	NO	YES	YES	YES	YES	YES	YES
Sector FE	NO	NO	NO	NO	YES	YES	YES	YES	YES	YES
Observations	8,912	8,912	8,912	8,911	8,911	6,694	6,693	6,693	6,693	6,693
R-squared	0.002	0.009	0.036	0.037	0.041	0.042	0.045	0.045	0.048	0.046

Standard errors in parentheses

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

Data Source: Combined EFIGE-AMADEUS dataset.

Note: Dependent variable: markup. Year: 2008.

4.2. Matching

A popular technique to investigate causal relationships is propensity scores matching. In this subsection, I report the result from testing a propensity scores matching model seeking for the effect of outsourcing on markups. The matching strategy is particularly useful since, for well-defined propensity scores, it enables accounting for the self-selection in international outsourcing. In the first place, I construct and test the model using the *psmatch2* command. I choose to use this command because it allows separately estimating propensity scores with a related ad hoc command (*pscore*), which might be useful for identifying the model.

However, for the sake of completeness, I then test again the model with an alternative recently developed command, namely *teffects psmatch*, which leads to a more accurate estimation. I decide to report the results for both the commands because, on one hand, *psmatch2* allows me to investigate in detail propensity scores; on the other hand, results from the *teffects psmatch* command are more precise. Therefore, for the analysis conducted in this thesis, the two commands should not be considered as alternative to each other, but rather complementary.

From a preliminary probit estimation of propensity scores, I can investigate the effect of the proposed regressors on the probability to outsource (Appendix C).[10] In particular, I find a significant effect for the proposed regressors, meaning that they can relevantly be included among the variables for building propensity scores. In particular, marginal effects highlight that having a smaller size (i.e. being in the size group 1 and 2) decreases the probability for firms to outsource internationally, as predicted by the literature. Moreover, the TFP is significantly and negatively correlated with outsourcing. This is in line with the fact that my measure of TFP does not distinguish between insourced and outsourced inputs; thus, the negative relationship between TFP and outsourcing could be driven by reverse causality. However, the conditional mean of operating revenue is not strongly significant. Nevertheless, I keep the latter variable in the construction of propensity scores since the unconditional mean of turnover is instead relevantly different between the treated and control group.

After building propensity scores based on the former analysis, I perform matching using the *psmatch2* command. In Table 8 I report the ATT (which captures the effect of outsourcing on markups), for three different specifications for the propensity scores, in order to investigate whether results change when accounting for self-selection, as driven by size. In particular, in the baseline specification reported in the first column, propensity scores are built on TFP, size and revenues. By contrast, the specifications in the second and third columns respectively exclude TFP and size from the baseline propensity scores model.

The average effect in the treatment group (first line in Table 8) is positive in all the specifications. However, the ATT is positive only for the baseline model, when propensity

[10] For the probit estimation of propensity scores, I use the *pscore* command, which is a command connected to *psmatch2*.

scores are built on TFP, revenues and size. Moreover, when not accounting for size, which is the main driver of self-selection, the difference between the treated and control group gets larger in absolute value, as the weights of the control group are missing an important explanatory variable for international outsourcing (column 3, Table 8). Nevertheless, in none of the specifications, the ATT is significant at the usual confidence levels (but only at less than 80% confidence level), even though significance increases with respect to correlations performed in Section 4.1. In particular, the low confidence level of the ATT in the baseline specification in column 1 is not sufficient to claim that outsourcing is a driver of markup for firms with the same probability to outsource, as resulting from size, turnover, and TFP characteristics.

Given the potential heterogeneity across sectors, in Appendix D, I repeat the estimation with propensity scores built also on sectors. Results do not differ too much: ATT is still positive and not significant, but standard errors are smaller.

Table 8: Average treatment effect in the treated group (*psmatch2*)

VARIABLES	1	2	3
_ treated	0.175	0.173	0.175
	(0.911)	(0.657)	(0.911)
Active_outsourcer (ATT)	0.226	-0.00921	-4.586
	(0.206)	(0.131)	(4.548)
Observations	6,694	8,912	6,694

Standard errors in parentheses

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

Data Source: Combined EFIGE-AMADEUS dataset.

Note: Propensity score matching, nearest neighborhood (k=1). Command used: *psmatch2*. Propensity scores estimated separately with probit, using the *pscore* command.

In a second step, I repeat the matching analysis using an alternative command for the same propensity scores model, namely *teffects psmatch* (Table 9). Indeed, while allowing for a separate and preliminary investigation of propensity scores and for balancing checks, the former methodology has a relevant drawback. In particular, the user-written *psmatch2* command and the inclusion of separately estimated propensity scores neglect the fact that propensity scores are estimated. Therefore, it might embrace estimation errors. Therefore, I consider opportune to test the model also with the recently developed *teffects psmatch* command that corrects for estimation errors and provides a more accurate estimation of the ATT. For the estimation of propensity scores, I rely on the variables identified before since

the *teffects psmatch* command does not allow a separate estimation. The technical differences between the two commands are explained more in detail in Appendix D.

Table 9: Average treatment effect in the treated group (*teffects psmatch*)

VARIABLES	(1)	(2)	(3)
Active_outsourcer	0.349**	-0.00921	-4.407
	(0.164)	(0.131)	(4.015)
Observations	6,694	8,912	6,694

Standard errors in parentheses

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

Data Source: Combined EFIGE-AMADEUS dataset.

Note: Propensity score matching, nearest neighborhood (k=1). Command used: *teffects psmatch*.

While using the same model for matching (propensity score) and building propensity scores on the same variables, the latter command delivers a significant ATT for the baseline-matching model (at 95% confidence level) and no significant ATT in specifications 2 and 3.

The reason why the positive coefficient for the ATT found in Table 8 acquires significance is probably that the newly developed command accounts for the estimation error incorporated in propensity scores and delivers estimations that are more accurate. In particular, the ATT obtained from the latter estimation suggests that, for firms that do not differ in size, TFP and revenues, outsourcing leads to a higher markup. Therefore, in the light of the model described in Section 3, the result provides evidence for a direct effect of outsourcing on firms' markup, which does not operate through efficiency gains. Indeed, as propensity scores in the baseline specification account for TFP, the effect of outsourcing goes beyond variable cost reduction. Moreover, as firms are matched by size, the result is not biased by self-selection, which is not the case when running correlations.

In contrast, ATTs from columns 2 and 3 do not significantly differ from the results obtained in Table 8. In particular, there is no evidence for an overall effect of outsourcing on markup when not controlling for TFP gains in the second specification. Similarly, there is no evidence for an effect of outsourcing on markups when not accounting for self-selection in the third specification, i.e. when not including the size variable among propensity scores. Results from columns 2 and 3 are therefore in line with what found in correlations (Section 4.1). Compared to the significantly positive ATT from the baseline model, findings suggest that

self-selection plays an important role in international outsourcing since results change when addressing it with matching.

In conclusion, recalling that in general a positive relationship between markup and outsourcing could be justified by either self-selection in internationalization, cost savings (i.e. TFP gains) and a direct effect of outsourcing, the result provides some evidence for the latter effect, when addressing self-selection through matching and controlling for the TFP channel. The remaining effect is indeed the effect of outsourcing on markup derived from product differentiation or supply of higher quality products, which has been found to be significant when using a more precise command for matching.

5. CONCLUSIONS AND FURTHER RESEARCH

In this thesis, I empirically investigated whether there is evidence for an effect of international outsourcing on firms' markup. The research question, which could be relevant both from the point of view of International Trade and Industrial Organization, has been addressed through the development of an empirical model which aimed at disentangling two main channels through which there could be an effect of outsourcing on the markup. In particular, the model in Section 3.1 highlighted two possible effects of outsourcing, namely a cost effect (operating through the availability of cheaper inputs and indirect cost efficiencies) and a price effect (operating through product differentiation and quality improvements).

Using firm-level data from the combined EFIGE-AMADEUS dataset, I first looked at the overall correlation between outsourcing and markup, without distinguishing between the two mentioned channels. I regressed markup on a dummy for international outsourcing and I controlled for some relevant firms' characteristics, namely, revenues, age, domestic competition, size, country and sector of belonging (Section 4.1). The positive pure correlation between outsourcing and markup loses significance as soon as I added relevant controls. The non-significance of the coefficient suggests that there is no evidence for an overall effect of international outsourcing on markup, after controlling for firms' characteristics. This could eventually suggest that TFP gains from outsourcing do not suffice for explaining the overall effect on markup, which could provide evidence for the fact that the achieved efficiency gains are passed on consumers. However, the interpretation is not immediate as the coefficient of outsourcing captures the total correlations between outsourcing and markup, and not only the efficiency gains' effect. Unfortunately, I could not isolate the latter since the analysis would have required data about insourced and outsourced inputs' costs, which were not available. This could be desirable for future work. Moreover, one should recall that the OLS estimation only identifies correlations.

In the second set of correlations, I controlled for TFP in order to isolate the price effect of outsourcing that operates through the demand. Even though still not significant, the coefficient of outsourcing changes direction, while TFP appears to be a relevant explanatory variable of markup, showing a strongly significant negative coefficient. Therefore, there is not enough evidence significant correlation for the direct effect of outsourcing on markups. However, when including the interaction term between outsourcing and TFP, the interaction

is significantly positive, suggesting that, for a given level of TFP, outsourcing has an additional positive effect on markup (or, conversely, higher productivity for outsourcing firms has an additional positive effect on markup). The direct effect of outsourcing on markup has been then investigated in a more accurate way through matching.

Finally, I attempted to address self-selection in internationalization practices and look for a causal relationship between outsourcing and markup by constructing a propensity scores matching model. In particular, I matched firms based on size, TFP and revenue turnover. Findings support evidence for self-selection and for a positive direct effect of outsourcing on markups, even though the significance of the average treatment effect on the treated considerably depends on the statistical command used. Indeed, on one hand, when using the standard psmatch2 command, (which I preferred since it allows separately investigating propensity scores), the ATT is positive but not significant at the standard levels, even though more significant than the correlation's coefficient. On the other hand, when moving to the more precise *teffects psmatch* command, the ATT gains significance. However, in both cases, the inclusion of the size variable among propensity scores has been found essential in order to account for self-selection. While the significance of the former estimate is too low to claim that outsourcing directly increases markup, the latter result provides evidence for an effect of outsourcing that goes beyond efficiency gains and that is not biased by self-selection. This suggests that self-selection is indeed a matter and that outsourcing might have a direct effect on markups, too. The different result between the *psmatch2* and *teffects psmatch* command is probably because the latter command accounts for the fact that propensity scores as estimated. However, future studies could fruitfully explore this issue from an econometric point of view and try to replicate the analysis with different measures for propensity scores.

In conclusion, the analysis contributes to the existing literature to the extent that it attempts to distinguish between the different channels through which outsourcing might have an effect on firms' markup. In particular, findings suggest that there could be a potential pass-through of TFP gains from outsourcing, while the matching analysis support the theoretical prediction that international outsourcing might have a positive direct effect on markup that does not operate through cost reduction. Theoretically, the latter effect could be outlined as a demand effect arising from the relocation of the production function towards differentiated and/or

higher quality goods, after the outsourcing of non-core activities to more specialized suppliers. This effect, which is specific for outsourcing, could indeed eventually lead to a competitive advantage on the market and allowing firms to target consumers with higher willingness to pay, thus rising markups. Finally, the analysis provides evidence for the importance of self-selection and for the need to address it through counterfactual models. However, I am aware that some weakness of the empirical strategy could threaten the validity of the results, while leaving room for future improvements and research.

First, firms' heterogeneity could be an issue as far as firms might differently respond to outsourcing and follow different production and pricing strategies. Indeed, even though I constructed markup from sector-specific production function and controlled for the sector of belonging, I did not account for firms' heterogeneity within sectors. Future studies could fruitfully explore this issue further by exploiting more detailed data and controls for sectorial characteristics, which were not sufficiently available in the EFIGE dataset.

A second potential issue concerns the employed measure for TFP. Indeed, since TFP is retrieved from a production function where output is proxied by value-added, it is a revenue-based measure. In this regard, I have to urge a note of caution and recognize that results could suffer from estimation bias since TFP could be mechanically correlated to markup. Optimally, one would like to have a proxy for output in the production function that is not correlated with sales. However, neither quantities are not directly observed nor single prices in order to deflate revenues. Some alternative measures for assessing competitiveness have been employed in the literature, for example, Unit Labor Cost-based measures (UCL). In particular, UCL is defined as the ratio between the cost of employees and value added. Nevertheless, this measure would still be correlated with revenues and with markup through the cost of employees, too.

Finally, the analysis does not take into consideration the date at which firms start to outsource, which is unknown (the outsourcing variable is a dummy referring to 2008). While not being strictly necessary for the construction of the counterfactual model, which refers to 2008, this prevents from controlling for firms' productivity before outsourcing. Knowing the date at which firms started to outsource, indeed, would allow controlling for spillover effects of outsourcing that arise over time (e.g. investments, etc.), which could be particularly relevant for the price effect. In light of that, I should be careful in interpreting the drivers of

the effect of outsourcing on markup that operates through the demand. Indeed, it is true that product differentiation is a possible explicator, but other forces might have a role. Interesting research questions for future research that can be derived from this is the disentanglement of the competitive effect, which would, however, require more information (like the specific level of competition and conduct on the market).

6. APPENDIXES

6.1. APPENDIX A: Production function and markup estimation

The variable Markup 2008 is constructed following De Loecker (2016) estimation method. More specifically, markup is defined as the ratio between industry-specific output elasticity of labor and the revenue share of labor.

(9)

$$\mu_{2008} = \frac{\beta_l^j}{Revenue\ Share\ of\ Labor}$$

Where the revenue share of labor is defined as the ratio between the cost of employees and sales in 2008.

(10)

$$Revenue\ Share\ of\ Labor_{2008} = \frac{Cost\ of\ employees_{2008}}{Sales_{2008}}$$

The output elasticity of labor β_l^j for the industry j is retrieved from the estimation of heterogeneous, industry-specific Cobb Douglas production functions, as in Altomonte et al. (2012).

In particular, I have retrieved output elasticity of labor from heterogeneous, industry-specific Cobb Douglas production functions using data from AMADEUS and controlling for TFP 2008, which was available in the EFIGE dataset. More details regarding the production function estimation and the TFP estimation according to Levinsohn and Petrin estimation technique are available in Appendix 2 in Altomonte et al. (2012).

6.2. APPENDIX B: Restricted sample

Table 10 shows results from the OLS regression performed on the sample restricted to France, Italy and Spain. I restricted the sample to these countries as they show the least number of missing values for the markup. Results do not significantly differ.

Table 10: Correlations, sample restricted to France, Spain, Italy.

VARIABLES	1	2
Active_outsourcer	-0.0103	-0.972
	(0.836)	(1.143)
tfp2008		-2.788***
		(0.354)
Revenues	8.92e-06***	1.05e-05***
	(1.10e-06)	(1.19e-06)
size1	0.794	1.641
	(0.808)	(1.015)
size2	0.829	1.652*
	(0.795)	(1.002)
size3	1.997**	2.633**
	(0.840)	(1.058)
ag1	6.247**	-2.220**
	(2.533)	(1.116)
Competitorsinhomecountry	0.353	0.839
	(0.483)	(0.630)
Country Fixed Effects		
Sector Fixed Effects		
Observations	8,037	6,135
R-squared	0.044	0.046

Standard errors in parentheses

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

Data Source: Combined EFIGE-AMADEUS dataset.

Note: Dependent variable: markup. Year: 2008.

6.3. APPENDIX C: Propensity scores estimation

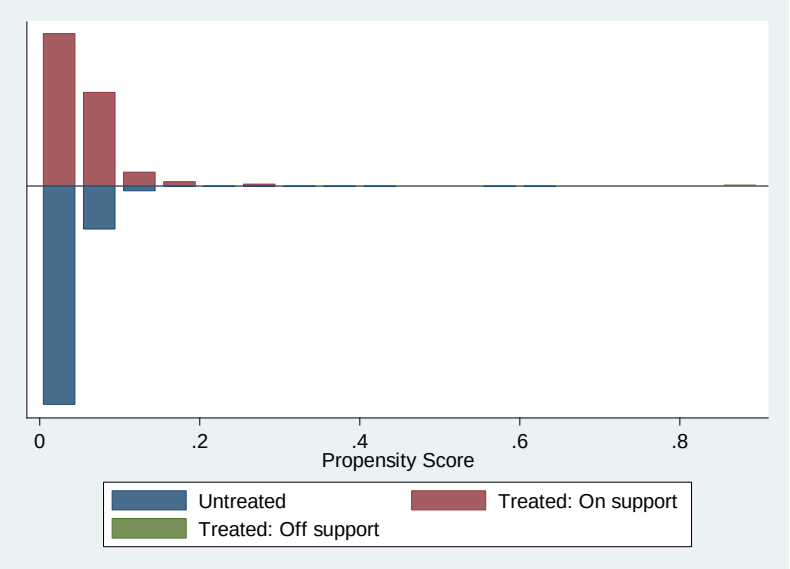
Table 11

VARIABLES	Model 1	Model 2	Model 3	Model 4
Tfp2008	-0.312***		-0.343***	-0.256***
	(0.0414)		(0.0412)	(0.0471)
Revenue	3.72e-08	1.20e-08	1.25e-07*	2.10e-07
	(8.56e-08)	(8.44e-08)	(6.90e-08)	(1.49e-07)
Size1	-0.551***	-0.555***		-0.532***
	(0.0991)	(0.0785)		(0.105)
Size2	-0.367***	-0.439***		-0.341***
	(0.0922)	(0.0741)		(0.0975)
Size3	-0.193**	-0.237***		-0.169*
	(0.0961)	(0.0788)		(0.100)
Sector FE				-0.228
				(0.209)
Constant	-1.703***	-1.360***	-2.065***	-1.864***
	(0.0904)	(0.0656)	(0.0477)	(0.172)
Observations	6,999	11,044	6,999	6,987

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Data Source: Combined EFIGE-AMADEUS dataset

Note: Treatment: active outsourcing; model: probit; command: *pscore*



Note: pstest for propensity scores, run after pscore

6.4. APPENDIX D: Alternative procedures for matching

In the current appendix, I clarify the main difference between the two alternative commands for matching, namely *psmatch2* vs *teffects psmatch*. Moreover, I also find necessary to further explain the reasons behind the choice to rely on one or the other command. Finally, in the current appendix, I also report some results relative to alternative procedures for matching.

6.4.1. *Psmatch2* vs *teffects psmatch*: two alternative commands for matching

The estimation technique for matching followed at the beginning in Section 4.2 and the estimation of propensity scores rely on the user-written command *psmatch2,* which is the one commonly used for (propensity scores) matching to estimate the ATT. Indeed, developed by Edwin Leuven and Barbara Sianesi, it is the standard tool for propensity score matching in Stata, as it allows estimating separately propensity scores through the related command *pscore* and performing a bunch of post estimations and balancing tests. The command automatically delivers the ATT and uses probit for estimating propensity scores, if not otherwise specified. However, the command has an important drawback, i.e. it does not take into account the fact that propensity scores are estimated rather than known.

In order to account for this problem, a new command for propensity scores matching has been recently developed, which relies on the work by Abadie and Imbens (2011): the *teffects psmatch* command. By taking into account the fact that propensity scores are estimated when calculating standard errors, the new command leads, in this sense, to more accurate estimates. Indeed, as far as propensity scores are estimated, the matching scheme is an estimate as well. Therefore, "running regressions after matching is essentially a two-stage regression model, and the standard errors from the second stage must take the first stage into account, something standard regression commands do not do. This is an area of ongoing research."(<https://www.ssc.wisc.edu/sscc/pubs/stata_psmatch.htm>). However, the *teffects psmatch* command is less flexible and does not allow separately identifying propensity scores, which are instead automatically computed through a logit model by Stata (or probit if specified). Some other less relevant differences concern the fact that, by default, the *teffects psmatch* reports the ATE, but it is possible to add an option for retrieving the ATT.

While relying on the same underlying model, it could be therefore the case that the two commands deliver different results. For the sake of completeness, in this thesis, I decided to follow both the alternatives and report the results for both (investigating the ATT in both the cases). Indeed, on one hand, *psmatch2* allowed me to investigate in detail propensity scores and to consciously choose the variable for building weights. On the other hand, results from the *teffects psmatch* command are more precise. The two commands, therefore, should not be considered as alternative to each other, but rather complementary for the analysis conducted in this thesis.

6.4.2. Including sector dummies in the estimation of propensity scores

One potential issue for which it would be necessary to consider when performing matching is firms' heterogeneity across sectors. To this end, Graph 1 in Section 3.3 showed that the heterogeneity of the outsourcing distribution across sectors is reduced when looking at the share of outsourcing firms by sector, but it persists. Therefore, I found appropriate to repeat the matching analysis using propensity scores computed accounting also for sectors of belonging. However, results do not significantly change from what found in Section 4.2 (ATT=0.256, still not significant at the standard levels).

6.4.3. Alternative matching techniques: nearest neighborhood matching

In the current Appendix, I also report the results for the ATT when using, as an alternative matching procedure, k-nearest neighborhood matching, with the *psmatch2* command. The different matching strategy is thus just a different way to weight the counterfactuals. As before, propensity scores (*pscore*) have first been estimated and then they have been used as controls in the matching procedure.

Table 12: Nearest neighborhood matching

VARIABLES	(1)	(2)	(3)	(4)
Active_outsourcer	0.226	-0.00921	-4.586	0.256
	(0.206)	(0.127)	(4.566)	(0.180)
Observations	6,694	8,912	6,694	6,685

Standard errors in parentheses

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

Data Source: Combined EFIGE-AMADEUS dataset.

Note: Dependent variable: markup. Column 4 reports the ATT with propensity scores that include sectors too

The ATT does not change with the computational methodology employed for computing propensity scores and it is the same that I got when performing propensity scores matching using the *psmatch2* command (ATT=0.226, non-significant at usual levels).

6.5. APPENDIX E: Accounting for sectorial heterogeneity

In this section, I report the output of some alternative models of correlations, which account, in different ways, for sectorial heterogeneity.

Table 13 reports the coefficients for TFP and outsourcing from sectorial regressions that separately test the OLS reduced form model. In particular, I regress markup on outsourcing, TFP, turnover, age, competition at home and size.

Table 13: Correlations by sector

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
VARIABLES	**sector1**	**sector2**	**sector3**	**sector4**	**sector5**	**sector6**	**sector7**	**sector8**	**sector9**	**sector10**	**sector11**
1.Active_outsourcer	0.689	0.937***	-2.600	0.917		-1.557	-0.506	-0.189	0.235	0.854*	0.319
	(0.907)	(0.266)	(5.070)	(1.188)		(1.150)	(0.328)	(0.468)	(0.252)	(0.436)	(0.575)
tfp2008	0.367**	-0.406***	-11.05***	-0.147	-37.97	-0.269	-0.783***	-0.204	-0.0378	-0.264	-1.058***
Observations	740	821	1,030	305	9	276	439	1,618	793	225	437
R-squared	0.031	0.098	0.042	0.060	0.866	0.285	0.076	0.039	0.029	0.082	0.145
Standard errors in parentheses											
*** p<0.01, ** p<0.05, * p<0.1											

Data Source: Combined EFIGE-AMADEUS dataset.
Note: Dependent variable: markup. Year: 2008.

In Table 14, I test the model correcting for standard errors cluster correlation, with clusters built on sector and country of belonging, in order to account for potential intra-sectorial and intra-country correlation in unobserved features. When firms are clustered along sectors and countries, it can happen that measurement on units within a cluster are more similar than measurements on units in different clusters. In that case, an appropriate variance correction should account for both the dimensions.

Table 14: OLS regression correcting for *vce* cluster correlation

VARIABLES	(5)	(7)
Active_outsourcer	0.0552	-0.613
	(0.292)	(0.797)
TFP		-2.535
		(2.228)
Revenues	4.71e-06***	4.48e-06***
	(1.39e-06)	(1.31e-06)
Comp home	0.255	0.428
	(0.190)	(0.375)
Size 1	0.143	0.404
	(0.223)	(0.304)
Size 2	0.203	0.512*
	(0.220)	(0.274)
Size 3	1.118	1.380*
	(0.684)	(0.750)
Age 1	-0.164	-0.190
	(0.380)	(0.473)
Nation FE	YES	YES
Sector FE	YES	YES
Observations	8,911	6,693
R-squared	0.009	0.018

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Data Source: Combined EFIGE-AMADEUS dataset.

Note: Dependent variable: markup. Year: 2008.

Finally, in Table 15, I include group means by sector in the OLS regression, following the Mundlak approach. The purpose of this specification is to control for unobserved heterogeneity across groups from a different perspective. On one hand, sector dummies are removed to avoid multicollinearity. On the other hand, country dummies are kept in the model in order to account for geographical heterogeneity.

Table 15: Regression with group-mean by sector

VARIABLES	(5)	(7)
Active_outsourcer	0.0383	-0.677
	(0.661)	(0.917)
TFP		-2.539***
		(0.336)
Revenues	4.68e-06***	4.46e-06***
	(8.77e-07)	(1.03e-06)
Age 1	-0.167	-0.207
	(0.284)	(0.378)
Comp HOME	0.253	0.430
	(0.375)	(0.499)
Size1	0.105	0.382
	(0.594)	(0.771)
Size2	0.167	0.502
	(0.577)	(0.750)
Size3	1.082*	1.371*
	(0.599)	(0.765)
M_Size	-1.194	-1.089
	(1.615)	(2.118)
M_Tfp		1.477*
		(0.887)
M_Comphome	-1.770	-0.906
	(4.050)	(5.542)
M_Rev	3.53e-06*	4.68e-06*
	(2.07e-06)	(2.65e-06)
M_Age	-4.652	-0.187
	(4.331)	(7.121)
Country FE	YES	YES
Observations	8,911	6,693
R-squared	0.008	0.017

Standard errors in parentheses

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

Data Source: Combined EFIGE-AMADEUS dataset.

Note: Dependent variable: markup. Year: 2008.

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