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HETEROGENEITY OF MARKUPS AT THE FIRM LEVEL AND CHANGES DURING THE GREAT RECESSION: THE CASE OF SPAIN (*)

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Abstract

We broaden the conceptual framework of estimating markups at the sectoral level developed by Roeger (1995), and extended by Crépon *et al.* (2005) with labour market imperfections, to account for firm-level heterogeneity derived from differences in productivity. We estimate this model with a comprehensive panel of Spanish non-financial corporations for the period 2001-2007 to find that perfect competition is widely rejected in the data. More interestingly, within each sector, firms with higher productivity present higher markups. Further, we use this empirical setting to estimate changes in firm-level markups over the course of the crisis (2008/2012). Our results indicate that for around 50% of sectors average markups increased, following a decrease in the number of firms, while for around 35% of industries the relevance of within-sector markup heterogeneity decreased at the same time that the variance of within-sector TFP increased. This last result suggests that the simple changes in the number and composition of competing firms cannot explain within-sector markups and we require additional factors to account for recent developments. For instance, we provide evidence that both an increase in consumer product substitutability and in fixed entry costs during the crisis might be a good explanation.

Keywords: markups, production function, market power, heterogeneity.

JEL classification: C23, C26, D24, E31, L11, L16.

Resumen

Incorporamos heterogeneidad empresarial en productividad dentro del marco de estimación tradicional de márgenes desarrollado por Roeger (1995) y ampliado por Crépon *et al.* (2005) para dar cabida a fricciones en la negociación salarial. Calculamos márgenes a escala de empresa con un panel completo de sociedades no financieras españolas para el período 2001-2007, mostrando que existe competencia imperfecta generalizada en España. Asimismo, dentro de cada sector, las empresas con mayor productividad presentan márgenes más elevados. Finalmente, se utiliza el mismo marco para analizar cómo han variado los márgenes en el período de crisis entre 2008 y 2012. Nuestros resultados indican que alrededor del 50 % de los sectores incrementaron márgenes medios a raíz de una reciente disminución en el número de empresas, mientras que alrededor del 35 % de las industrias mostraron incrementos en los diferenciales de márgenes entre empresas simultáneos al incremento de la varianza de la PTF sectorial. Este último resultado sugiere que, si bien son un factor importante, los cambios en el número y la composición de las empresas competidoras no pueden explicar la totalidad de la evolución de los márgenes y se requiere de factores adicionales para explicar los últimos acontecimientos. Una hipótesis coherente con el anterior resultado vendría por el lado de la demanda y estaría relacionada con la disminución de la posibilidad de sustitución de diferentes variedades de consumo intrasectoriales.

Palabras clave: márgenes, función de producción, poder de mercado, heterogeneidad.

Códigos JEL: C23, C26, D24, E31, L11, L16.

1 Introduction

Many scholars have recently emphasized the substantial implications derived from a significant degree of firm-level heterogeneity within-sector. This idea has been underpinned by important breakthroughs on trade theory (e.g. Bernard et al (2003), Melitz (2003), Melitz and Ottaviano (2008)) and on firm dynamics and factor reallocation (see, e.g., Bartelsman *et al.* (2013) and the references therein). These approaches highlight that there is a significant degree of heterogeneity in productivity, size, and other firms' characteristics, even within narrowly defined industries that have major consequences for the performance of many variables, such as aggregate productivity or export performance. This business heterogeneity has also received increasing attention, especially in the area that analyzes the strategic behaviour of firms, as it will definitely affect firm's pricing policies. In particular, in most models of oligopolistic competition regardless of whether the competition is done via quantities or prices or the degree of differentiation of the products, firms with lower marginal costs must charge higher markups. This is the case because more efficient firms expect a weaker competition from their competitors knowing that their marginal costs are likely to be higher. Hence, the strength of competition and as a consequence the average markup will depend in both the amount and the characteristics of potential competing firms.

This paper takes up changes in the composition of firms, both within and across sectors, with the aim of studying its potential role in Spanish firms' pricing behavior, paying particular attention to the period 2008-2012, where aggregate price-cost margins increased a lot (Figure 1). In order to account for this firm level heterogeneity, we will enrich a traditional methodology for estimating sector-level markups of prices over marginal costs –that of Roeger (1995)– to obtain distributions of firm-level markups within sector that depend on certain firm-specific characteristics.

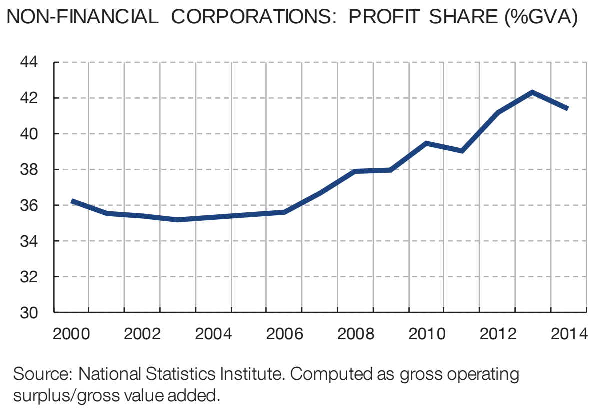

Figure 1: Profit share of Spanish non-financial corporations.

Consistent with the evidence shown in Figure 1 and in Montero and Urtasun (2014), we show that in around 50% of sectors average markups increased in Spain when comparing the boom phase (2001-2007) with the period of crisis (2008-2012).

When analyzing the evolution of Spanish price-cost markups over time, we will follow a different approach to that in Montero and Urtasun (2014). These authors argue that in a context characterized by extreme financial tensions, many firms were not able to raise external funds, so they had to raise price-cost markups to get internal cash, even in the face of weak demand, in order to be able to meet their ongoing financial commitments, as well as to build buffers of internal funds to finance investment projects. They provide empirical evidence that, indeed, the increase in markups since 2008 in Spain may have been driven, among other factors, by a change in pricing strategies by financially-constrained firms. In this paper we explore an additional channel that works through changes in the number and in the composition of active firms and that might provide a complementary explanation. In particular, financial restrictions during the crisis have also brought about an increase both in fixed costs of entry and in the rate of business destruction, leading to an important decrease in the number of active businesses and, thus, in the degree of product market competition (see Figure 2). This, in turn, contributed to the rise in average markups.

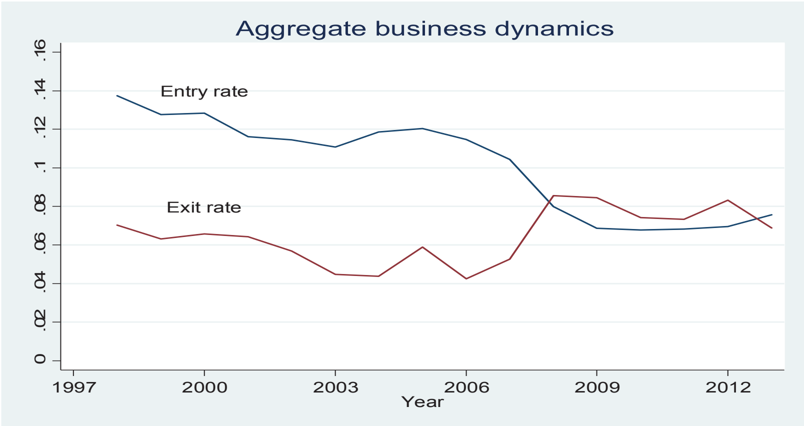

Figure 2: Evolution of entry and exit rates (% of active firms), 1998-2013.

At the same time, active firms have been more polarized in terms of productivities (the variance of TFP has increased notably in most sectors during the crisis, see Figure 3). These results are consistent with those in Kalemli-Ozcan *et al.* (2015) and in García-Santana *et al.* (2015). This increase in productivity dispersion –which is a proxy for resource misallocation– should reinforce the abovementioned increase in average markups (Bernard *et al.* (2003), Melitz and Ottaviano (2008), Peters (2011)). Complementary, the increase in the variance of TFP should have increased the variance of markups within sector, all else equal. However, in our empirical section we provide some evidence that for 1/3 of the industries considered the sensitivity of markups to productivity heterogeneity across firms decreased.

The rest of the document is organized as follows. Section 2 spells out the theoretical background and section 3 will define the empirical approach. Section 4 describes the main characteristics of the database, in Section 5 and 6 discuss several estimation results for the period 2001-2007 and the great recession respectively. Finally, Section 7 interprets the results and section 8 concludes.

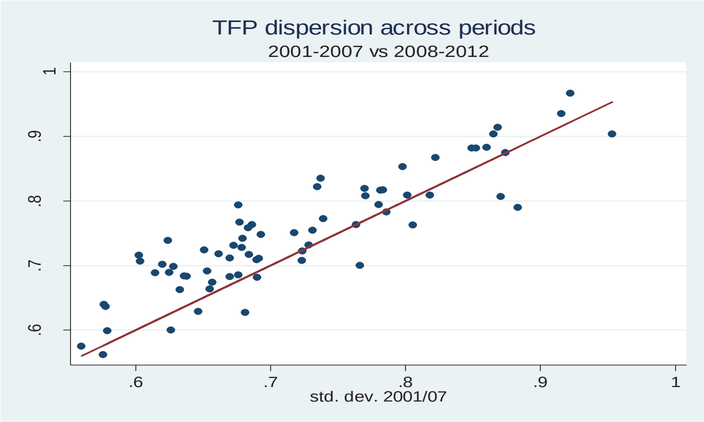

Figure 3: Evolution of sectoral TFP dispersion.

2 Theoretical background

There are many empirical papers that study the (cyclical) evolution of price-cost markups over time, in particular for the US. There are different types of models that explain movements in markups over the cycle: models of variable demand elasticity, models of variable entry, models of sticky prices, models of investment in market share and financial frictions and models of implicit collusion.[1] However, to the best of our knowledge, none of these contributions take into account the role played by firm-level heterogeneity, which, as stated in the introduction, may have substantial implications for the performance of many variables and has gain momentum in the macro literature.

In particular recent macro papers (Bernard et al (2003), Melitz and Ottaviano (2008), Peters (2011)) model firm level markups as a random variable depending on the characteristics of the potential competitors (number and distribution of marginal costs) and certain parameters of the demand function. Those models usually depart from a model of oligopolistic competition of differentiated goods where producers of a particular good compete ala Bertrand within their own variety. In this case, markups will be determined on the one hand by the distance of the most efficient firm and their best competitors, and on the other by the degree of substitutability of the differentiated goods. As a result, within a sector more productive firms will charge higher markups and, as it is clear in Peters (2011), the variance of markups will be clearly determined by the variance of the distribution of potential competitors' marginal costs.

Those two results are pretty general in many industrial organization models. We illustrate this point using Vogel (2008) who develops a model with endogenous horizontal product differentiation and heterogeneous firms. He sets out a game of two stages (first, location, and second pricing) and solves for a subgame perfect Nash equilibrium (SPNE) allowing firms to reallocate in terms of varieties in the first stage. Vogel shows that in an SPNE in a sector *s* with $\mathrm{n^s}$ varieties, a shipping cost τ^s –to ship a good to a consumer located at a point *z*– and a cost of shopping $\mathrm{t^s}$ –which reflects either the cost the consumer incurs traveling to and from the firm, or the utility a consumer loses purchasing a good that differs from his ideal variety– a firm *i* sets its price $\mathrm{p_i^s}$ given its marginal cost $\mathrm{k_i^s}$ and the average marginal cost $\overline{\mathrm{k^s}}$ as in equation [1]:[2]

$$\mathrm{p_i^s} - \mathrm{k_i^s} = \frac{\mathrm{t^s}+\tau^s}{\mathrm{n^s}} - \alpha_1(\mathrm{t^s},\tau^s)\left(\mathrm{k_i^s} - \overline{\mathrm{k^s}}\right) \qquad \textbf{[1]}$$

$$\mathrm{var}(\mathrm{p_i^s} - \mathrm{k_i^s}) = \alpha_1(\mathrm{t^s},\tau^s)^2\mathrm{var}(\mathrm{k_i^s}) \qquad \textbf{[2]}$$

As it happened in the abovementioned macro models, according to equation [2] the variance of the markup will be related to the variance of the marginal cost. However, notice that the relationship is not 1 to 1 and the degree of substitutability of goods might also affect the variance of markups.

1 See the seminal contribution by Rotemberg and Woodford (1999) for a comprehensive survey. Montero and Urtasun (2014) share the same spirit of those papers in their study the Spanish case.

2 Although Vogel's model is set in terms of marginal costs, the overall spirit is in terms of efficiency and, indeed, he uses interchangeably marginal costs and productivity. Therefore, we will assume that there is a relation between marginal costs and TFP of the type $\mathrm{k_i^s} = \mathrm{a_0} - \mathrm{a_1 tfp_i^s}$ which will allow us to identify markups in the empirical exercise. Hence, the terms marginal costs and productivity (or TFP) will be used interchangeably throughout the text as well.

In equilibrium, within a sector, firms with lower marginal costs are more isolated –i.e. face lower competition from neighbor varieties–, because neighboring firms adjust their locations to avoid harsh competition from low-cost firms, which in turn can charge higher markups. Also, a change in the marginal cost of any competing firm (keeping constant the number of firms and all the other marginal costs/productivities) is translated to all markups through a change in the average marginal cost of the market. This is the case because, according to the previous result, productivity and isolation go together. Therefore, if one firm increases its own productivity it becomes more isolated and all the other firms must be closer to each other to avoid competition with that firm.

Finally, as in the typical spatial competition model (Salop (1979), Lancaster (1979) and Economides (1989)), more firms lead to lower markups. Interestingly, in a sector with high shopping costs, the importance of firms' heterogeneity in marginal costs is lower, i.e. $\alpha_1(t^s, \tau^s)$ is smaller, and the magnitude of average markups $\frac{t^s+\tau^s}{n^s}$ is higher.[3] To see this one would need to compute the equilibrium number of firms. Although this is not done in Vogel (2008), we can make an intuitive approximation.[4] Following Syverson (2004) one might think of entry as the first stage decision of a sequential game before firms know their level of marginal cost k_i^s (afterwards they decide its final location and markup). Hence, entry will equate expected profits with fixed costs of entry (e^s) and therefore $n^{s*} = \sqrt{\frac{L^s t^s}{e^s}}$ where L^s is the size of the demand.[5]

Summing up, changes in shopping costs (t^s) are negatively related to the importance of marginal costs among firms in determining markups ($\alpha_1(t^s)$) and positively related to changes in average markups and the number of active firms. On the other hand, changes in fixed costs of entry are positively related to average markups due to an implied decrease in the number of active firms.

This setting provides an overall framework for studying the determination of markups by sector which is well related to previous literature.[6] Notice that the average markup will positively depend on the size of demand, the (im)possibility to substitute for consumers one particular product by another, and fixed entry costs. As regards the degree of substitutability, this characteristic of demand provides certain market power to all firms in the sector and generates a downward sloping demand curve for each firm. A sector with many homogeneous products will face a low markup compared to a sector with highly differentiated goods.[7] Poor substitutability might arise from different reasons, such as horizontal differentiation, as in the Hotelling (1929) or d'Aspremont, Gabszewicz and Thisse (1979) model, vertical differentiation with products differentiated by quality (Gabszewicz and Thisse (1979), Shaked and Sutton (1982)), and high switching costs (Syverson (2004)) that prevent consumers from changing products over time –thus providing a certain degree of monopoly to the incumbent firms–. Fixed entry costs are connected with the existence of barriers to entry, which can adopt different formulations. From a supply-side point of view, they include factors such as control over essential inputs, the existence of economies of scale and network effects, and the presence of fixed sunk costs. In sum, high costs of entry tend to

[3] See proposition 1 in Vogel (2008).

[4] From now on, we will abstract from transport costs and set $\tau^s = 0$.

[5] Hence, average markups for sector s are $t^s/n^s = \sqrt{t^s e^s / L^s}$.

[6] It has to be recognized that changes in markups are not only driven by changes in marginal costs and/or in the degree of competition. Heterogeneity in firm's demand (due to innovation, network effects, etc) can be relevant as well.

[7] Substitutability is also related with the size of the market, as stressed by Blanchard and Giavazzi (2003) and Melitz (2003), who point to the negative impact on prices and markups when markets are opened to foreign competition.

generate some sort of economies of scale leading to different markups across sectors, because in equilibrium, firms entering production require to recover these costs in the future (Shaked and Sutton (1983)). There are additional barriers to entry derived from public intervention, regulations, etc (Blanchard and Giavazzi (2003)).[8]

Firm-level sources of cost efficiency are many and varied, but can be summarized in three main factors: productivity, access to credit markets and labour market flexibility. In this paper we will focus on productivity, as measured by TFP, as it is the variable that captures all those factors that affect the efficiency with which a firm combines factors of production in order to get a final output, which result in costs savings (or equivalently, in improvements of product quality). In order to proxy for productivity at a firm level, we will estimate TFP following the control function method developed by Olley and Pakes (1996) and Levinsohn and Petrin (2003).

Thus, once we have estimated firm-specific TFP, markups of equation [1] will be determined in the following way:

$$p_{i,t}^{s} - k_{i,t}^{s} = \beta_{0t} + \beta_{1t}\left(TFP_{i,t}^{s} - \overline{TFP_{t}^{s}}\right) \qquad \textbf{[3]}$$

where $0 < \beta_0 < 1; \beta_1 > 0$. Notice that the left hand side of equation [3] is unobservable, so we require a methodology to estimate them that will be spelled out in the following section.

Regarding labour market flexibility, for the time span of the data we use (2001-2012), we can fairly assume that work-related flexibility is quite similar across firms in a given sector, as in the Spanish case it is heavily reliant on institutions governing the labour market at the sector level (see Bentolila *et al.* (2012)). As we will show below, in section 3, this feature will translate into a modification of the empirical model, in order to take into account some of the institutional characteristics of the Spanish labour market. However, this modification will not enter directly into equation [3].

More difficult to tackle is the issue of access to the financial sector. In this case, we adopt a pragmatic approach and enlarge the baseline model in an *ad hoc* fashion to include some of the proxies used by the financial pressure literature, in particular, the leverage ratio (liabilities over assets) –see equation [4] below.[9] Since results are similar to the ones presented in the paper, and since the main focus is on heterogeneity derived from productivity, they will not be presented, but are available upon request.

$$p_{i,t}^{s} - k_{i,t}^{s} = \beta_{0t} + \beta_{1t}\left(TFP_{i,t}^{s} - \overline{TFP_{t}^{s}}\right) + \beta_{2t}\left(Debt_{i,t}^{s} - \overline{Debt_{t}^{s}}\right) \qquad \textbf{[4]}$$

[8] A final type of barriers to entry is related to the exclusionary practices developed by incumbent firms, understood as strategic behavior to deter entry, e.g. investing in extra capacity, bundling, price discrimination, etc.

[9] As shown by Holmstrom and Tirole (1997), credit might be affected on the demand side by the balance-sheet strength of the firms, which can be proxied by the capital ratio position (or the inverse of the ratio of liabilities over assets).

3 Empirical methodology

Firm-specific markups during the expansion period 2001-2007

We introduce the previous setup in an empirical model to obtain firm-level markups relying on standard cost minimization conditions for variable inputs free of adjustment costs in a Neoclassical setting. This is, essentially, the approach developed by Robert Hall in successive papers (1986, 88, 90), and which is the basis for many papers trying to estimate price-cost markups relying on microdata from accounting information. Formally, we have a firm with the typical production function Q = A·F(K,L,M), where Q is total production, A is technical progress and K, L and M are capital, labour and intermediate goods, respectively. Assuming that the production function is differentiable, then it holds that:

$$\Delta q = \varepsilon_k \Delta k + \varepsilon_l \Delta l + \varepsilon_m \Delta m + \Delta a \qquad \textbf{[5]}$$

where $\varepsilon_K = \frac{\partial Q}{\partial K}\frac{K}{Q};\ \varepsilon_L = \frac{\partial Q}{\partial L}\frac{L}{Q};\ \varepsilon_M = \frac{\partial Q}{\partial M}\frac{M}{Q}$ represent the output elasticity with respect to the different inputs, and lower case variables denote the logs of those variables.

Moreover, if the production function has constant returns to scale, it must hold that:

$$1 = \varepsilon_k + \varepsilon_l + \varepsilon_m \qquad \textbf{[6]}$$

Finally, if we assume that the firm has some market power, it will face a downward sloping demand curve $Q^d(P)$ and will maximize its profit given that demand. In that case, the maximization problem will lead to the following conditions:[10]

$$\varepsilon_K = s_K \mu(f);\ \varepsilon_L = s_L \mu(f);\ \varepsilon_M = s_M \mu(f) \qquad \textbf{[7]}$$

where $s_K = \frac{rK}{PQ};\ s_L = \frac{wL}{PQ};\ s_M = \frac{p^m M}{PQ}$ represent the expenditure share of each factor in total production and μ(f) is defined as the firm's markup of price over marginal cost, which might vary across firms due to different factors (denoted by *f*) related to the structure of demand, the type of competition, the technology available and the regulation setting. As it will be made clearer later, here is where the theoretical framework discussed above will enter.

With these set of assumptions, and noting that $\mu(f) = \frac{1}{1-B(f)}$ –where B(f) represents the Lerner index ($(P-MC)/P \approx p_i - k_i$)–, equations [5]-[7] imply the following relationship:

$$SR = \Delta q - (1 - s_L - s_M)\Delta k - s_L \Delta l - s_M \Delta m = B(f)(\Delta q - \Delta k) + (1 - B(f))\Delta a \qquad \textbf{[8]}$$

To the extent that technical progress is not correlated with the cycle, e.g. $\Delta a_t = \theta + u_t$, where u_t is an iid technological disturbance, the existence of market power amplifies the movements of output generated by changes in other inputs.[11] However, in reality there are many reasons why one could think that technical progress might be correlated with the cycle and that is why

[10] Under the maintained assumption of no adjustment costs.

[11] Notice that equation [8] could be rewritten as: $(\Delta q - \Delta k) = \mu s_L(\Delta l - \Delta k) + \mu s_M(\Delta m - \Delta k) + \frac{1}{\mu}\Delta a$

scholars approached the estimation of [6] from an instrumental variables perspective.[12] In this paper, acknowledging the difficulty of searching for good instruments in this setting, we follow another strategy initiated by Roeger (1995). He realized that under constant returns to scale a similar expression to [8] could be obtained in terms of prices, for the so-called "dual" Solow residual:

$$\mathrm{SR^d} = \Delta p - s_L \Delta w - s_M \Delta p_m - (1 - s_L - s_M)\Delta r = B(f)(\Delta p - \Delta r) + B(f)'\Delta f - (1 - B(f))\Delta a \qquad \textbf{[9]}$$

Therefore, adding [8] and [9][13] we get an expression where the technological progress is cancelled out, so that instrumental variables would not be needed anymore:

$$\mathrm{SR} + \mathrm{SR^d} = B(f)[(\Delta p + \Delta q) - (\Delta r + \Delta k)] + B(f)'\Delta f \qquad \textbf{[10]}$$

At the end of the day, as expression [10] shows, we just need to compute the Solow residual in nominal terms and relate it to the difference of the value of production and the nominal cost of capital services in order to attain an estimate of the price-cost markup.

As it has been discussed in the previous section, we assume that imperfections in the labour market have a similar effect on all firms within a sector. In order to incorporate this idea, we enlarge the previous model by adding imperfect competition in the labour market as in Crépon *et al.* (2005) or Dobbelare (2004).[14] Under imperfect labour markets, wages and the number of workers are simultaneously chosen according to a standard efficient bargaining problem. Denoting $0<\phi<1$ as the workers' bargaining power ($\phi=0$ corresponds to competitive labour markets) in a typical Nash bargaining framework that involves sharing the surplus between firms that maximize profits and workers whose utility depends on employment and wages, it could be shown that expression [10] can be rewritten as:

$$\mathrm{SR} + \mathrm{SR^d} = B(f)[(\Delta p + \Delta q) - (\Delta r + \Delta k)] + B(f)'\Delta f + \frac{\phi}{1-\phi}(s_L - 1)[(\Delta w + \Delta l) - (\Delta r + \Delta k)] \qquad \textbf{[11]}$$

All in all, the empirical counterpart of equation [11] that will be estimated in the paper with firm-level data by each 2-digit sector *s* is:

$$\Delta y_{it}^s = \left[\beta_0^S + \beta_1^S\left(tfp_{it-1}^s - \overline{tfp}_{t-1}^s\right)\right]\Delta x_{it}^s + \rho^s \Delta tfp_{it-1}^s + \delta^s \Delta z_{it}^s + \gamma^s \cdot D_t^s + \varepsilon_{it}^s \qquad \textbf{[12]}$$

where Δy is the nominal Solow residual; $\Delta x = \Delta pq - \Delta rK$; $\Delta z = \Delta wl - \Delta rK$; D_t^s is a set of time dummies. We have substituted B(f) for equation [3], i.e. $B(f) = \beta_0 + \beta_1(tfp - \overline{tfp})$, making markups depend on a sector-specific constant (β_0^S) –which will capture average sectoral markups– and on the difference between firm-specific TFP and average TFP of a given sector *s*, which will account for firm-level heterogeneity along the lines discussed in the previous section.

[12] In the case of Hall (1988), he chose national GDP growth as an instrument for the industry labour growth

[13] The term $B(f)'\Delta f$ in equation [9] appears because of the assumption that markups are a function of factors *f*. See, for a derivation, Thum-Thysen and Canton (2015).

[14] Many papers have used this framework before. See, inter alia, Abraham *et al.* (2009), Amador and Soares (2013) or, for the case of Spain, Estrada (2009) and Moreno and Rodriguez (2011). To the best of our knowledge, none of them introduces firm heterogeneity the way we do, with the purpose of obtaining estimates of firm-level markups.

Changes in firm-specific markups during the crisis 2008-2012

As we want to analyze whether the estimated coefficients of equation [12] have changed over the crisis, we have to first deal with a relevant confounding factor that took place in 2008, namely, a major change in general accounting rules that could potentially have affected the way firms reported the variables needed to construct $\Delta y, \Delta x, \Delta z$. This factor may have been compounded by the fact that it happened amidst a deep economic and financial crisis, which generates incentives for firms to manage their accounts in order to improve their financial position. One way to tackle this problem is by assuming that there is a measurement error in the way firms report the variables underlying $\Delta y, \Delta x, \Delta z$, leading to some biases in the estimation of coefficients in equation [12]. To see how this problem may affect our results, let's assume that Δx is observed with measurement error $u_{it}^{s} \sim N(0, \sigma_u^s)$.[15] Let's assume that the measurement error is classical within each sector, therefore, it is uncorrelated with all dependent and independent variables and the error term of each particular sector. Consequently, we would observe:

$$\widehat{\Delta x_{it}^{s}} = \Delta x_{it}^{s} + u_{it}^{s} \quad \text{if } t < 2008 \qquad [\mathbf{13}]$$

If we restrict the sample to the period 2001-2007 and we plug equation [13] into [12] we have:

$$\Delta y_{it}^{s} = \beta_{0,<2008}^{S}\widehat{\Delta x_{it}^{s}} + \beta_{1,<2008}^{S}\left(tfp_{it}^{s} - \overline{tfp_{t}^{s}}\right)\widehat{\Delta x_{it}^{s}} + \cdots + \varepsilon_{it}^{s} + \beta_{0,<2008}^{S} u_{it}^{s} +$$

$$+\beta_{1,<2008}^{S}\left(tfp_{it}^{s} - \overline{tfp_{t}^{s}}\right)u_{it}^{s} \quad \text{if } t < 2008$$

As a consequence, both the estimated average levels of markups and their sensitivity to the TFP distributions will be biased downwards, which has to be taken into account when interpreting the results, unless the variance of the measurement error is 0. Algebraically:

$$\text{plim}\widehat{\beta_{0,<2008}^{S}} = \beta_{0,<2008}^{S}\frac{var(\Delta x_t^s)}{var(\Delta x_t^s) + \sigma_u^s}$$

$$\text{plim}\widehat{\beta_{1,<2008}^{S}} = \beta_{1,<2008}^{S}\frac{cov(\Delta x_t^s, tfp_t^s)}{cov(\Delta x_t^s, tfp_t^s) + \sigma_u^s}$$

Turning to the crisis period, let's assume that the change in accounting rules affected the way Δx is reported and hence what is observed by the econometrician is:

$$\widehat{\Delta x_{it}^{s}} = \begin{cases} \Delta x_{it}^{s} + u_{it}^{s} & \text{if } t < 2008 \\ \Delta x_{it}^{s} + v_{it}^{s} & \text{if } t \geq 2008 \end{cases}$$

where $v_{it}^{s} \sim N(0, \sigma_v^s)$ comes from a different distribution than the one affecting variables until 2008. If both U^s and V^s are classical measurement errors, the difference in their variances will determine the change in estimated coefficients between both periods. In particular, if the variance of the measurement error is higher after the accounting rule change ($\sigma_v^s > \sigma_u^s$) –which seems plausible–, then estimated coefficients (including markups) would go down without the need of any real change in pricing strategies. In other words:

$$\text{plim}\widehat{\beta_{0,<2008}^{S}} = \beta_{0,<2008}^{S}\frac{var(\Delta x_t^s)}{var(\Delta x_t^s)+\sigma_u^s} > \beta_{0,\geq 2008}^{S}\frac{var(\Delta x_t^s)}{var(\Delta x_t^s)+\sigma_v^s} = \text{plim}\widehat{\beta_{0,\geq 2008}^{S}}$$

$$\text{plim}\widehat{\beta_{1,<2008}^{S}} = \beta_{1,<2008}^{S}\frac{var(\Delta x_t^s tfp_t^s)}{var(\Delta x_t^s tfp_t^s)+\sigma_u^s} > \beta_{1,\geq 2008}^{S}\frac{var(\Delta x_t^s tfp_t^s)}{var(\Delta x_t^s tfp_t^s)+\sigma_v^s} = \text{plim}\widehat{\beta_{1,\geq 2008}^{S}}$$

15 The argument will hold as well for errors in the measurement of Δz affecting the parameter capturing union's bargaining power. Errors in Δy do not affect the estimation.

In order to identify a genuine change in structural parameters over the crisis, we will compare estimated coefficients of two sub-periods within the 5 years available with the new accounting rules. To be more specific, we make two assumptions that will help us identify a possible change in firms' pricing behavior across industries. First, we assume that changes in accounting rules affected the same way all firms within a sector. Second, we assume that the adaptation to the new accounting rules is rather immediate, taking a couple of years (2008 and 2009), whereas changes in pricing strategies require some time to materialize and begin in 2010, once the first stage of the crisis is over. All in all, this means that the estimated regression for the evolution of price-cost markups over the crisis is as follows:

$$\Delta y_{it}^{s} = \left[\beta_{0,0}^{S} + \beta_{0,1}^{S} \cdot D_{t}^{2008/12} + \beta_{0,2}^{S} \cdot D_{t}^{2010/12} + \beta_{1,0}^{S} \cdot (f_{it-1}^{s}) + \beta_{1,1}^{S} \cdot (f_{it-1}^{s}) \cdot D_{t}^{2008/12} + \beta_{1,2}^{S} \cdot (f_{it-1}^{s}) \cdot D_{t}^{2010/12}\right]\Delta x_{it}^{s} + \rho^{s}\Delta tfp_{it-1}^{s} + \left[\delta_{0,0}^{s} + \delta_{0,1}^{s} \cdot D_{t}^{2008/12} + \delta_{0,2}^{s} \cdot D_{t}^{2010/12}\right]\Delta z_{it}^{s} + \gamma^{s} \cdot D_{t}^{s} + \varepsilon_{it}^{s} \quad \textbf{[14]}$$

where $D_{t}^{2008/12}$ is a dummy variable taking the value 1 for the period 2008-2012 and $D_{t}^{2010/12}$ is a dummy variable taking the value 1 for the period 2010-2012. Besides, f^{s} is defined as $tfp_{it}^{s} - \overline{tfp}_{t}^{s}$. In this setting, we interpret the term $\beta_{0,0}^{S} + \beta_{1,0}^{S} \cdot (f_{it-1}^{s})$ as a lower bound for the distribution of firm-specific markups and the term $\beta_{0,0}^{S} + \beta_{0,2}^{S} \cdot D_{t}^{2010/12} + \beta_{1,0}^{S} \cdot (f_{it-1}^{s}) + \beta_{1,2}^{S} \cdot (f_{it-1}^{s}) \cdot D_{t}^{2010/12}$ would provide the direction of the change in the distribution of firm-specific markups during the crisis free of changes in accounting rules.

4 Database

Our dataset combines information from several data sources, although the main source will be the Central Balance Sheet Data Office (CBSO) of the Banco de España. These data are collected from two sources: first, a CBSO's own database elaborated from a yearly survey and balance-sheet information of firms collaborating on voluntary grounds[16] –which shall be called CBA–; and second, data from financial statements deposited yearly in official Mercantile Registries by all active companies –which we will label CBB–.[17] We assembled an unbalanced panel of non-financial corporations covering almost all (two-digit) industries for the period 1995-2012 (see table in the Appendix A for a list of sectors).[18]

One of the advantages of combining both databases is that we achieve a selection of firms reasonably representative of the population, in terms of the shares of firms by both sector of activity and firm size. A second advantage is that we attain a sample with a very good coverage rate, of over 40% of nonfinancial corporations' value added (see CBSDO (2014)).

Although the quality of the data is reasonably good as it passes numerous filters, we were very careful with outliers and/or incoherencies. In our study only operating firms with positive operating costs (labour, material and capital expenditures) throughout the year have been included. We dropped all observations that did not report the required variables, as well as those with strange values, such as negative figures of employment, capital stock, sales or assets, or extreme ones.[19] After cleaning the data, we were left with an unbalanced panel of firms covering the period 2001-2012,[20] with information for a median (mean) of 5 (4.5) years of 1,063,713 firms (potentially 6,055,080 observations in total). The basic characteristics of this sample of firms are displayed in Table 1.

[16] The reporting firms fill in a questionnaire with detailed accounting information, as well as some other additional information on employment, breakdown of the workforce in terms of skills, type of contracts, spending on training or R&D expenditures. For a complete description of both CBA and CBB databases refer to the CBSO's Annual Report: http://www.bde.es/bde/en/secciones/informes/Publicaciones_an/Central_de_Balan/anoactual/ .

[17] CBB's (and CBA's) observations consist mainly of individual entrepreneurs, public corporations and limited liability companies which are required by law to deposit their annual accounts at the Mercantile Registries. However, a large number of small firms do not fulfill the reporting requirement because it is costly for them and the associated fines are small. Moreover, self-employed workers are excluded, as they are not required to report to the Mercantile Registries.

[18] We exclude the primary sector –agriculture, forestry and fishing, and mining and quarrying– because its performance is heavily distorted by regulations and public subsidies. Also, because of lack of enough observations, we also remove businesses from the following sectors: manufacture of tobacco products, manufacture of coke and refined petroleum products, and activities of membership organizations.

[19] We removed observations with excessive changes of gross output, labour costs, intermediate inputs and capital stock, defined as those outside the percentiles p1 and p99, for each year and two-digit industry. We also dropped firms with extreme labour and materials shares over gross output (above the p99).

[20] The coverage of 2012 is only partial with over 471,000 observations compared with about 531,000 observations on average for the period 2004-2011.

Table 1: Main summary statistics. Period 2001-2012

Main summary statistics. Period 2001-2012.							
Variable	**Mean**	**Std. Dev.**	**Min**	**Max**	**Q1**	**Q2**	**Q3**
(thousands €)							
Gross output	2152.9	56105.5	0.02	1.76E+07	112.8	289.3	818.0
Labour costs	350.2	6944.9	0.01	2.19E+06	32.0	78.2	192.7
Fixed capital	954.2	52864.0	0	3.97E+07	11.3	52.0	229.0
Intermediate cons.	1609.6	45411.0	0.01	1.60E+07	55.7	165.2	529.6
(growth rate)							
Gross output	0.012	0.434	-4.779	6.921	-0.147	0.014	0.166
Labour costs	0.047	0.385	-3.621	6.731	-0.077	0.031	0.161
Fixed capital	0.007	0.468	-4.534	6.440	-0.186	-0.043	0.069
Intermediate cons.	0.014	0.517	-4.858	8.178	-0.184	0.010	0.200
(ratio)							
Lshare	0.345	0.343	1.95E-06	87.7	0.157	0.291	0.461
Mshare	0.639	0.377	1.81E-05	65.6	0.457	0.642	0.803

#Observations: 6055080 (in levels)

The output variable is measured in gross terms, i.e. inclusive of intermediate consumption, while we take into account the presence of 3 productive inputs: capital, intermediate inputs and labour. Labour refers to the average number of employees in each firm for each year, and materials refer to intermediate consumption. The capital stock includes both physical and intangible capital, and is measured by the net book value of fixed assets, as reported in the firm's balance sheet. It is deflated with the corresponding (2-digit NACE rev.2) value added deflator.[21]

Additionally, the estimation of markups using Roeger's (1995) methodology –see equation [10]– requires also information on the user cost of capital (*r*), which is the price of hiring or purchasing one unit of capital services and includes a measure of the financial cost of capital and the depreciation rate. One of the advantages of our database is that, unlike most studies in the literature, this cost can be calculated at the firm-level, which is likely to reduce measurement error. Following Jorgenson and Hall (1967), the user cost of capital of firm *i* in year *t* is defined as:

$$r_{it} = (i_{it} - \pi_t^I + \delta)P_t^I \qquad \textbf{[15]}$$

where i_{it} is the financial cost of capital, δ the depreciation rate and $P_{t,I}$ and $\pi_{t,I}$ represent the level and growth rate of the price of investment goods, respectively. The firm level depreciation rate has been fixed at 8%, which is the standard in the literature.[22] The price of investment goods has been approximated with a 2-digit industry level gross fixed capital formation deflator that has been built with information from National Accounts.[23]

On the other hand, constructing a proxy for the financial cost of capital which is reasonably homogeneous across businesses is a more complex task. In order to maximize the sample period available for estimation, we defined the financial cost of capital as the ratio between

[21] We are aware of the problems that this generates, because they are valued at historical prices, but this is the only proxy we have at our disposal.

[22] It is in line, *inter alia*, with Amador and Soares (2013), or Christopoulou and Vermeulen (2012). Besides, another argument in favor of fixing the depreciation rate is the well-known fact that accounting-based firm-level measures of depreciation tend to overestimate the true economic depreciation due to fiscal incentives.

[23] These deflators have been constructed by combining information from the matrices of gross capital formation at a 2-digit industry level in order to build the shares of each type of investment (structures, buildings, etc) with information from deflators for each type of investment.

interest (and other financial) charges and (all) financial liabilities for each firm and year, as we do not have information on costly and non-costly liabilities for the whole period. This way we are underestimating the true financial cost of capital because we are including non-costly financial liabilities, such as suppliers and other trade credits.[24] Further, and in order to avoid a substantial loss of observations, as well as distortions brought about by extreme observations, the financial cost of capital has been imputed for some firms. To be more specific, the implicit interest rate for firms that report no debt, or no interest payments or ratios outside the [0, 1] range was imputed with the median of the respective 2-digit industry in each year and by firm size.

We attain an estimate of firm-level TFP, which, as discussed above, will be the main determinant of firm-level heterogeneity used with the aim of estimating price-cost markups. We follow the control function method developed by Olley and Pakes (1996) and Levinsohn and Petrin (2003) in order to estimate firm-level TFP, which has become a standard methodology for addressing endogeneity in production function estimations. We assume a Cobb-Douglas production function for value added, labour and the capital stock and use intermediate inputs instead of investment as a proxy variable for productivity shocks, along the lines of Alonso-Borrego (2010) and Hospido and Moreno-Galbis (2015), who also estimated firm-level TFP with CBSO data and to whom interested readers are referred to so as to get all necessary details of the estimation procedure.

Figure 4 shows the distribution of estimated TFP for all firms pooled together across two periods of time (before and during the crisis). It is worth highlighting that the shape of the distribution of firm productivity is far from being “Gaussian”: rather than having many firms centred around an ‘average’ performance level, with few very bad- or very good-performing ones symmetrically distributed around the mean in equal numbers, data show a large heterogeneity in performance, with many relatively low productive firms, but also a certain number of particularly high productive ones. As a result, median TFP is significantly below the mean, while the resulting distribution is characterized by a relatively long right tail (or skewness). According to the model of section 2, this distribution will be replicated in terms of markups up to a constant, since this is the only source of heterogeneity within sector.

Figures 5 show the evolution of the (unweighted) average of the estimated TFP in our sample. As it has been widely documented for the Spanish case (see, e.g., Hospido and Moreno-Gulbis (2015)), TFP has exhibited a continuously decreasing trend during the boom period, a pattern that has been reverted over the crisis.

[24] We have checked the robustness of this measure by estimating its correlation with a more precise measure, where the denominator of the ratio only includes costly financial liabilities, which is available only for the period 2008-2012. The estimated coefficient was 0.379 with a t-statistic of 59.13.

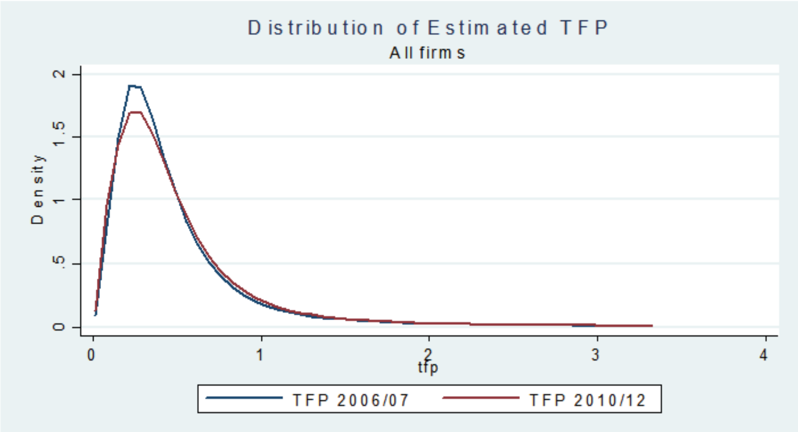

Figure 4: Distribution of estimated TFP

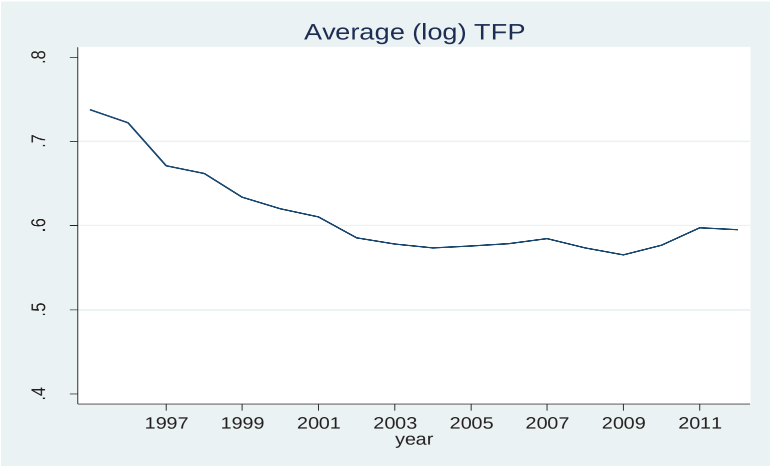

Figure 5: Evolution of estimated TFP

5 Firm-specific markups during the expansion period 1995-2007

We first begin by focusing on the results from estimating equation [12] for the period 2001-2007 for each of the seventy 2-digit sectors considered. This means analyzing 280 relevant coefficients. In order to organize the discussion, we first show an analysis of the statistical significance of all estimated coefficients at a 10% significance level (the dashed line in Figure 6). The distribution of p-values of each sector-specific regression for the period 2001-2007 are plotted in Figure 6. Each box contains the p-values of the 25th and the 75th percentile within the 70 regressions. Whiskers represent the interval p25-1.5*IQR and p75+1.5*IQR being IQR=p75-p25 the interquartile range. Dots are p-values for estimated coefficients that fall outside those intervals and might be considered as outliers. It is clear from Figure 6 that estimated parameters for the average markup, the sensitivity of markups to TFP differentials, and the bargaining power are mostly statistically significant across all sectors.

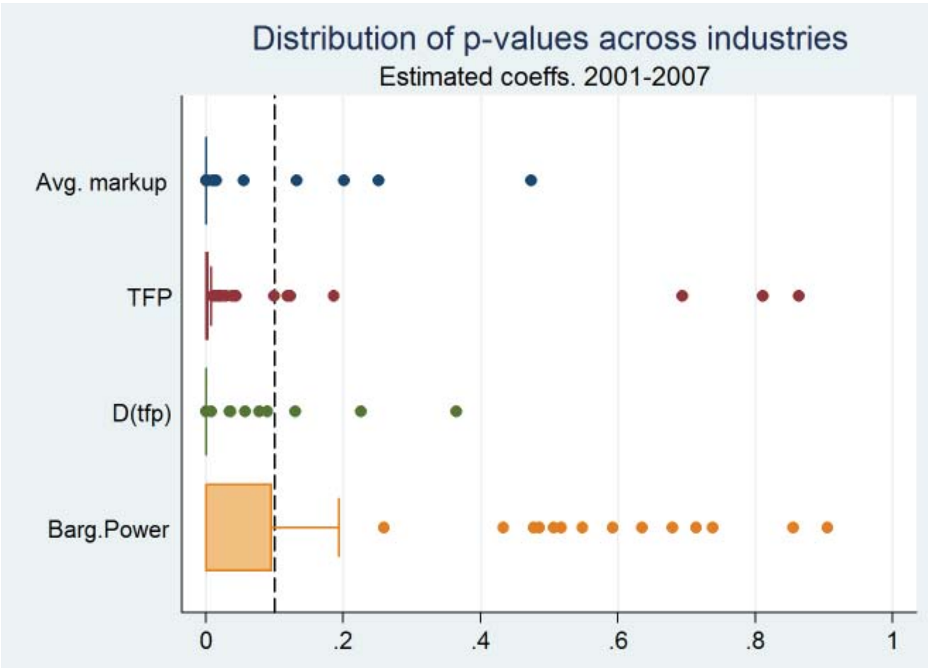

Figure 6: Significance of estimated coefficients

Figure 7 shows average markups (β_0^S) for the period 2001-2007 estimated for the 70 2-digit sectors. According to this figure, the (unweighted) average Lerner index of the Spanish economy is around 14%, although price-cost margins lay in an interval of between 0 and 0.42. This range is similar, for instance, to the one obtained in Estrada (2009) and in Moreno and Rodriguez (2011) with a similar empirical framework. Among the sectors that had higher average markups during the boom are electricity, gas, steam and air conditioning supply; remediation activities and other waste management services; rental and leasing activities; accommodation services; water collection, treatment and supply; and architectural and engineering services. On the other hand, those sectors with the lowest markups are construction of buildings; services to buildings and landscape activities; manufacture of wearing apparel; manufacture of leather and related products; and social work activities without accommodation.[25]

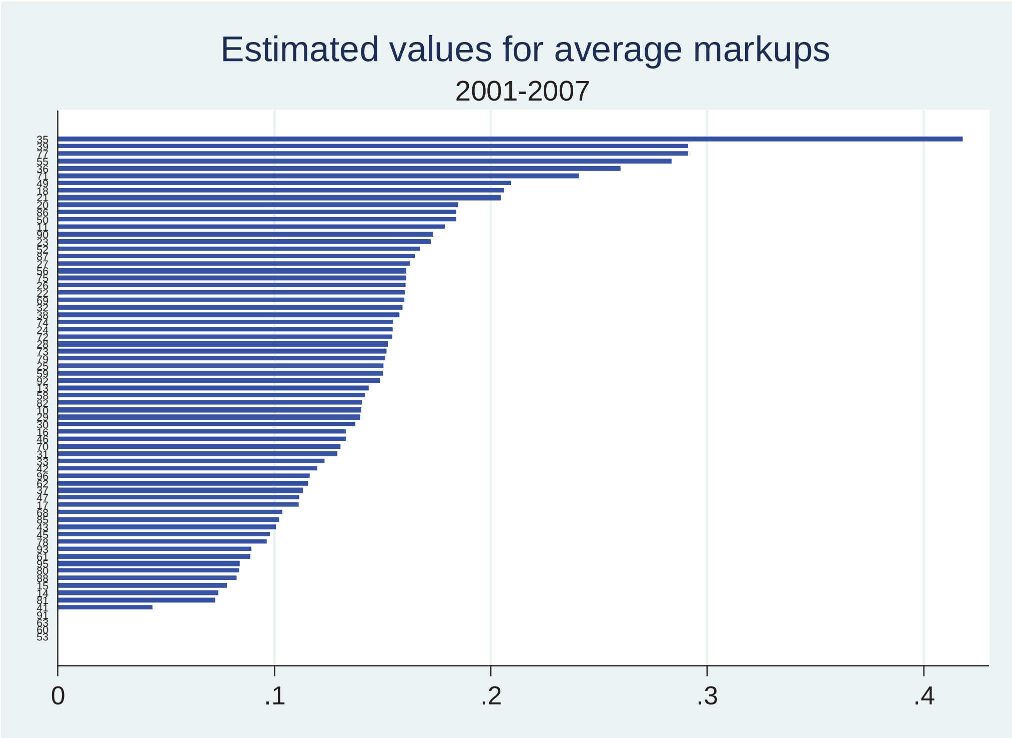

Figure 7: Estimated average markups

Figure 8 presents the estimated sensitivities of markups with respect to firm-level TFP differentials. The estimated coefficients for TFP are positive and statistically significant across (almost) all sectors, meaning that firms with higher relative TFP vis-à-vis average TFP are able to charge higher markups. This is consistent with the theory presented in section 2 and would lend support to the models where more productive firms acquire more market power. All in all, these results would overall be consistent with models that allow for heterogeneity at the firm level.

Among the sectors that had higher sensitivity to productivity differentials of firms during the boom are real estate activities; programming and broadcasting activities; health service activities; sewerage; rental and leasing activities; and legal and accounting activities. On the other hand, those sectors with the lowest differentials are other manufacturing; manufacture of food products; food and beverage service activities; land transport and transport via pipelines; manufacture of leather and related products.

[25] Those sectors with non-significant coefficients, in other words, with a situation close to a competitive setting, are: libraries, museums and other cultural activities; information service activities; broadcasting activities; and postal and courier activities.

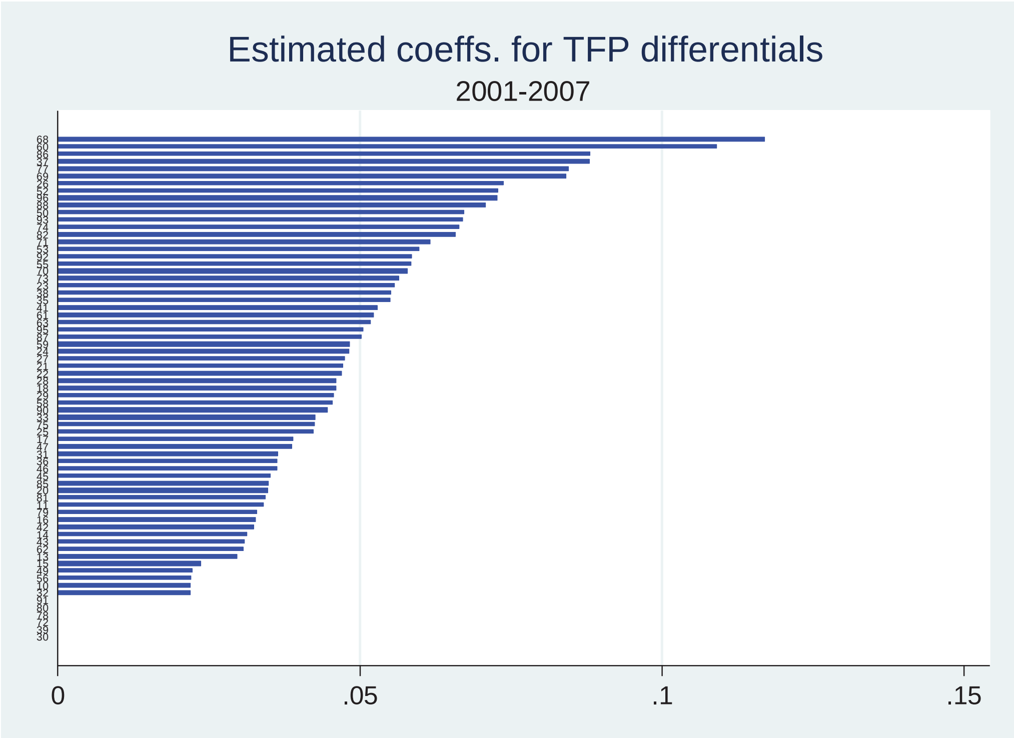

Figure 8: Estimated elasticities of markups w.r.t. TFP differentials

One lesson from the evidence above is that markups are heterogeneous across firms. Appendix B presents some graphs of the distribution of markups within major sectors and their evolution over time. The distribution of estimated markups is far from being Gaussian and is mostly characterized by having a relatively long and thick right tail, which is partially inherited from the distribution of firm-specific TFP.

6 Direction of changes of firm-specific markups during the Great Recession

Figure 9 presents the distribution of p-values for the interaction of all regressors with the dummy for the period 2010-2012 ($D_t^{2010/12}$), which tries to account for potential changes in structural parameters –which could be linked to variations in pricing strategies– over the crisis that would be free of changes in accounting rules. In this case, it can be seen that in most dimensions the degree of significance of estimated coefficients is low, affecting only a few sectors, except for average markups, which seem to vary in almost 50% of the industries considered, and to a less extent for the elasticity of markups with respect to TFP differentials (which differ for around 35% of sectors).

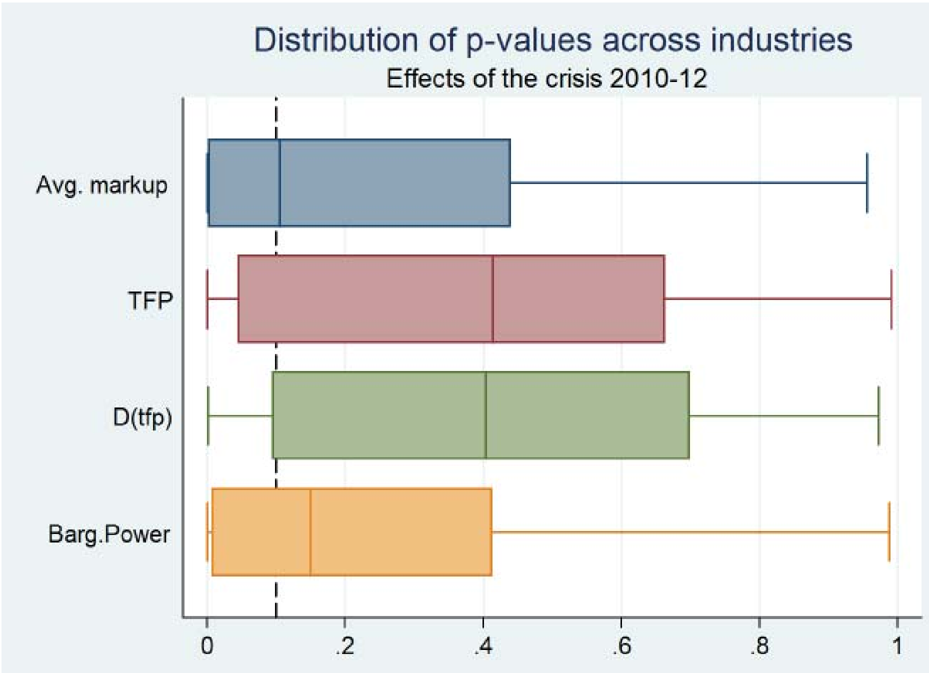

Figure 9: Significance of the change over 2008-2012 of the estimated coefficients

Figure 10 shows that there seems to be a significant increase in average markups for the period 2010-2012 with respect to 2001-2007 –once we discount the effect of the changes in accounting rules– for around 50% of sectors. It is noticeable as well that there are no industries experiencing a statistically significant fall in average markups.[26] According to the estimations, the sectors where markups were raised the most are real estate; employment activities; other professional, scientific and technical activities; manufacture of beverages; and electricity, gas, steam and air conditioning supply.

Looking at the relevance of differences in markups within sector, it appears that TFP differentials (see Figure 11) became less important in around 35% of the sectors. The sectors in which it decreased the most are employment activities; manufacture of other transport equipment; air transport; waste collection, treatment, and disposal activities; and information service activities.

[26] Except for creative, arts, and entertainment activities, which display an abnormal drop, not reported to avoid distorting the figure.

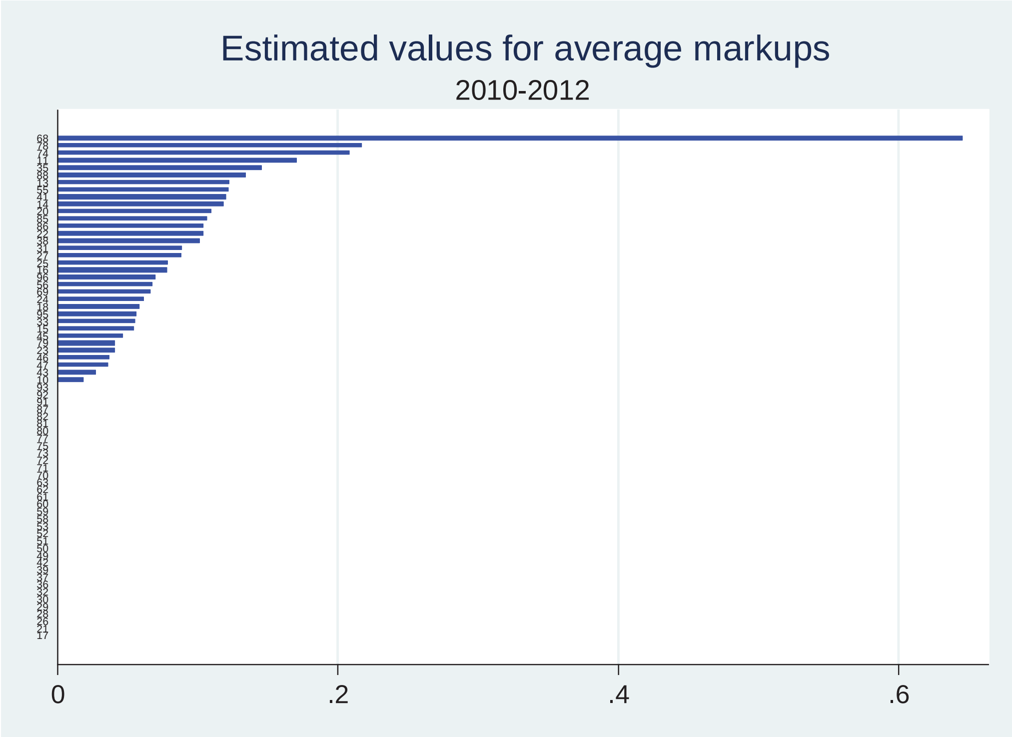

Figure 10: Change over 2010-2012 of the estimated average markups

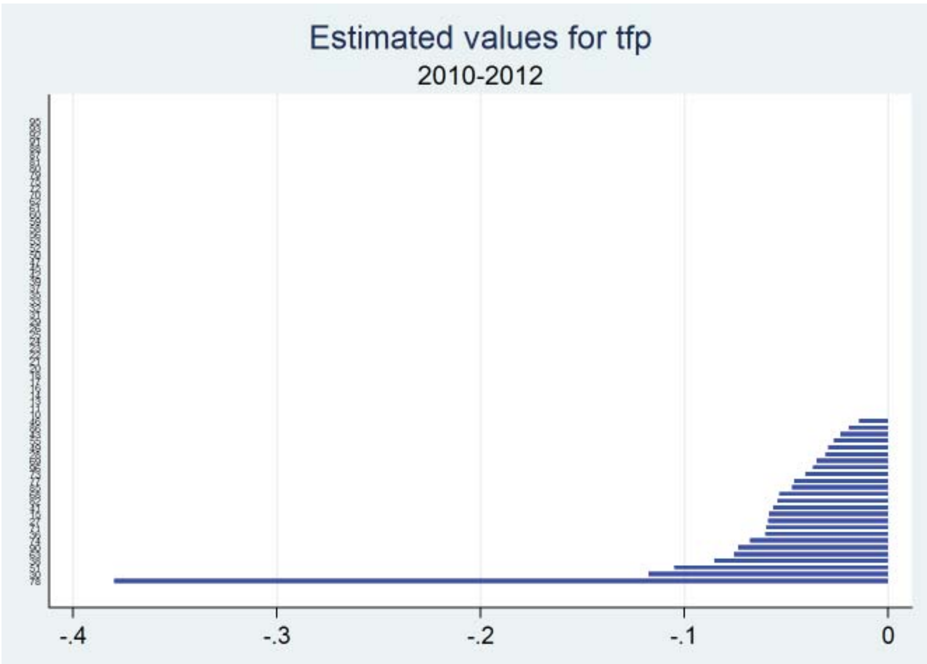

Figure 11: Change over 2010-2012 of estimated elasticities of markups w.r.t. TFP differentials

7 Interpretation of results

The previous within sector decrease in markup differentials by TFP is at odds with the increase in the variance of TFP unless some other parameters might have changed.

According to the model set out in section 2, in a given sector s, changes in the number of firms in equilibrium ($n^s = \sqrt{L^s t^s / e^s}$) are determined by changes in the size of demand (L^s), in the degree of product substitutability (t^s) and in the fixed costs of entry (e^s). Since we have access to a good proxy for the changes in the number of firms, which is the net entry rate of businesses between 1998 and 2012 by 2-digit sectors, we can dig further into the interpretation of our results.

As we showed in Figure 2, there has been a sharp fall in net entry rates during the crisis. Therefore, we have to reconcile several pieces of information, namely, i) an increase in average markups ($\frac{t^s}{n^s} = \sqrt{\frac{t^s e^s}{L^s}}$) –as displayed in Figure 10–, with ii) a decrease in the elasticity of markups with respect to (within-sector) productivity differentials ($\alpha_1(t^s),\ with\ \alpha_1(t^s)' < 0$) –as shown in Figure 11– and iii) a sharp fall in net entry rates. Consistent with our model, the observed decline in the elasticity of markups vs productivity differentials would point to a rise in the degree of product differentiation. Hence, the fall in net entry rates could only be reconciled with the increase in average markups if it is driven by either a reduction in the size of demand or an upsurge in the fixed costs of entry –or in other words, an increase in fixed costs of entry per unit of demand (e^s/L^s) –.

Thus, we have indirect evidence of a rise in product substitutability and a relative increase in fixed entry costs vis-à-vis the size of demand. If we look at our estimations results, we find that in roughly a third of the sectors there is a change in both average markups and markup sensitivity to productivity differentials. Moreover, we have another third each with a change in either one or the other parameter. In the former case, besides, the change in the average markup is negatively correlated with the change in the coefficient of productivity differentials (Figure 12).

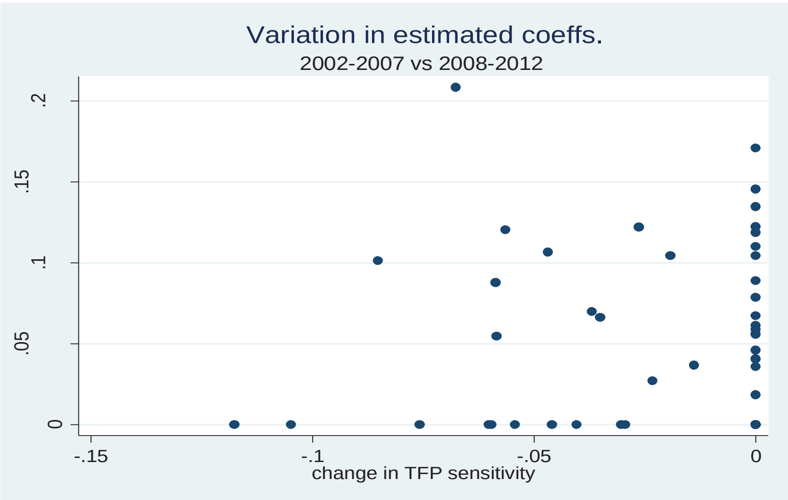

Figure 12: Changes in estimated parameters (2001-2007 vs 2008-2012)

Table 2 provides additional insight regarding the interpretation of our results. It shows that there is a clear pattern of correlation between those changes in estimated parameters and variations in net entry rates. In particular, those sectors in which there was an important decrease in the number of firms, tended to experience a rise in average markups and a decline in their sensitivity to productivity differentials. Moreover, these results would be consistent with the idea that entry barriers –relative to the market size– tended to rise for about 50% of the sectors, leading to higher average markups. Additionally, within those sectors, about two thirds underwent an increase in their shopping costs (or in other words, a fall in product substitutability) which contributed to producing an even higher rise in markups.

Table 2. Correlation between changes in average markups and productivity elasticities and net entry rates (Tobit model)

	Change 2010-2012 vs 1995-2007	
Variable	*Average markup*	*Productiviy differences*
changes net entry	-0,508	0.519***
	(0.3641)	(0.1595)
Constant	0,000	0.016
	-0,0235	(.0166)
Observations	62	62
R2	0,168	0,002

*** Significant at 1%; ** Significant at 5%; * Significant at 10%. Robust standard errors in parentheses.

Finally, we present another way to check the consistency of our results. The idea is to run a regression of the change in estimated average markups across industries on some proxies for the change in the degree of product differentiation and in the fixed costs of entry –relative to the market size–. As regards the former, as we mentioned above, we have an indirect proxy which is the estimated change in the productivity elasticities, whereas for the latter, a reasonable proxy frequently used in the literature is the sectoral capital intensity –defined as the ratio between the stock of capital and output at a sector level–. Results for this estimation exercise are presented in Table 3, where it can be seen that, consistent with the predictions of our model, there is a positive relation between average markups and product substitutability (collected through the negative sign in the coefficient estimated for the change in the productivity elasticity). Besides, the coefficient for the change in capital intensity is positive and statistically significant, again in harmony with our model's predictions.

Table 3. Sectoral regression for average markups (changes 2001/07 vs 2008/12).

Variable	**Average markup**
Prod. diffs.	-0.377
	(0.193)**
Cap. intensity	0.105
	(0.023)***
Constant	0.022
	(0.012)**
Observations	70
R2	0.266

8 Conclusions

A competitive business environment is a key ingredient for achieving an efficient allocation of resources and, thus, for understanding the drivers of countries' productivity and long term growth. Measuring the degree of competition is a first step in any effort at understanding the (in)efficiency in the process of resource allocation across firms. In this regard, a natural starting point in order to measure the extent of competitiveness in a given industry is, from a theoretical point of view, the notion of market power. Market power is the ability of a firm to set prices above marginal cost –the welfare-maximizing reference under perfect competition–. Thus, policy makers are used to analyzing changes in market power through the lens of changes in average markups. However, scholars in industrial organization have shown that markups could be very heterogeneous across firms, so composition effects will contaminate any policy implication derived from the cyclical behavior of markups at a sectoral level. Also, from a policy perspective it is important to analyze whether changes in pricing strategies occur within or between sectors.

This paper delivers a way of analyzing firm-specific markups over time. In order to account for markup heterogeneity within sector, we expand Roeger's (1995) methodology by including the main sources of cost efficiency of firms within sector (TFP differentials), as derived from the theoretical model of spatial competition developed by Vogel (2008). This is useful because by accounting for changes in markup differentials across firms will help in distinguishing demand and supply factors affecting markup changes. As we have shown, we can disentangle these two forces because demand factors (summarized by changes in the degree of substitutability among varieties) affect both the average markup and markup differentials among firms with different productivity levels, whereas supply-side factors (reflecting mostly barriers to entry) only affect average markups.

We find that the assumption of perfect competition in Spanish product markets is widely rejected. The estimated price-cost margin ranges between 0 and 0.4 on average across sectors in the Spanish economy. Moreover, we can use these estimated markups to establish a ranking of sectors in terms of degree of competition, finding that the less competitive ones are electricity, gas, steam and air conditioning supply; remediation activities and other waste management services; rental and leasing activities; accommodation services; water collection, treatment and supply; and architectural and engineering services. Additionally, it is confirmed, as implied by our reference theoretical background, that there is substantial heterogeneity in price-cost margin estimates within markets, as firms with higher relative TFP present higher markups.

We look into the temporal dimension and try to disentangle whether pricing strategies changed between 2001-2007 and 2008-2012, a period which is characterized by a huge destruction of firms. Our results indicate that for around 50% of sectors average markups increased, while for around 35% of industries the relevance of within-sector markup heterogeneity decreased. We provide evidence showing that these results, along with a sharp fall in net entry rates, can be rationalized within our theoretical framework, and are indicative of an increase in both product substitutability and in fixed entry costs over the crisis. Further research should be devoted to understanding what is behind this shift in the behaviour of demand, as well as in the evolution of entry costs.

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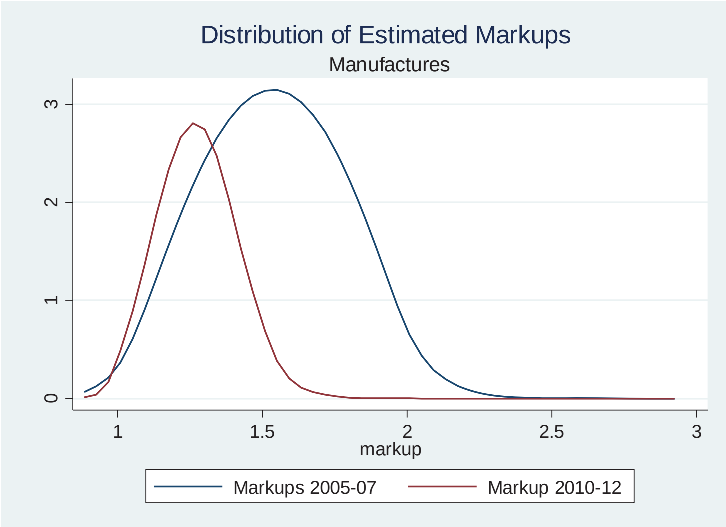
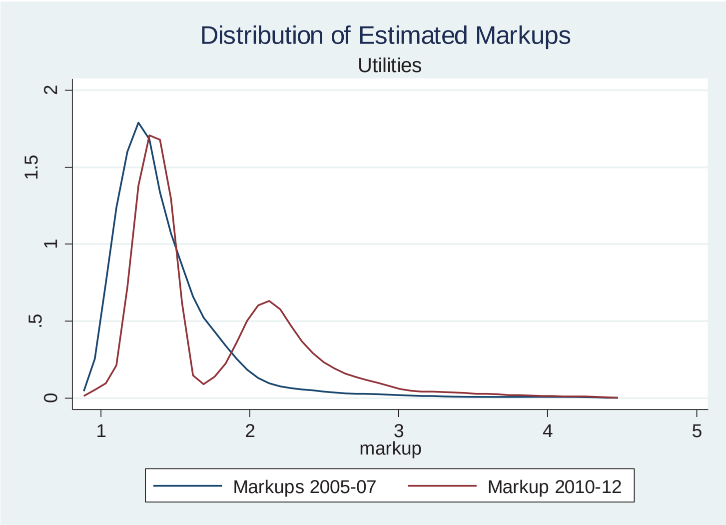
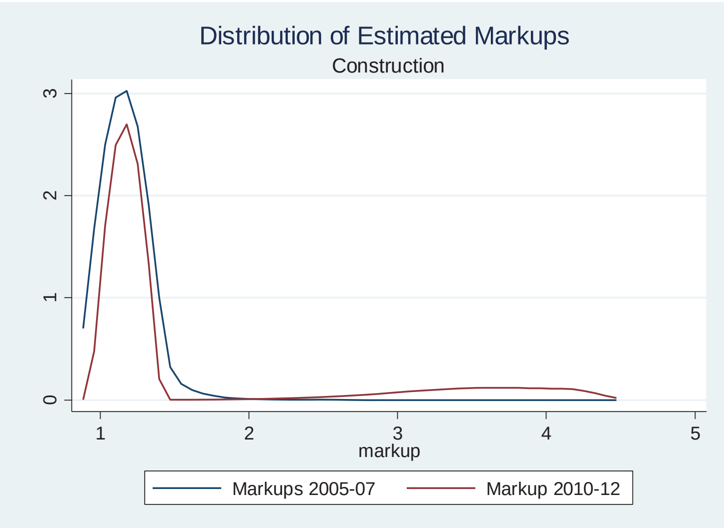
Appendix A: Sector classification

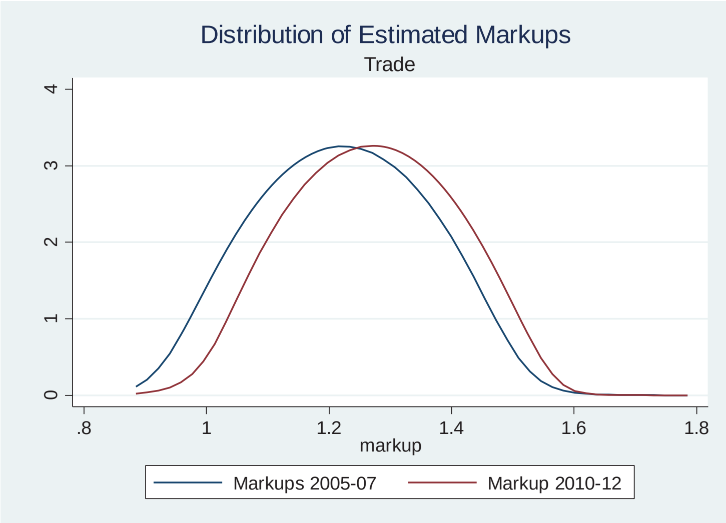
Code	Description	Code	Description
C	Manufacturing	10	Manufacture of food products
		11	Manufacture of beverages
		12	Manufacture of tobacco products
		13	Manufacture of textiles
		14	Manufacture of wearing apparel
		15	Manufacture of leather and related products
		16	Manufacture of wood and of products of wood and cork, except furniture
		17	Manufacture of paper and paper products
		18	Printing and reproduction of recorded media
		20	Manufacture of chemicals and chemical products
		21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
		22	Manufacture of rubber and plastic products
		23	Manufacture of other nonmetallic mineral products
		24	Manufacture of basic metals
		25	Manufacture of fabricated metal products, except machinery and equipment
		26	Manufacture of computer, electronic and optical products
		27	Manufacture of electrical equipment
		28	Manufacture of machinery and equipment
		29	Manufacture of motor vehicles, trailers and semitrailers
		30	Manufacture of other transport equipment
		31	Manufacture of furniture
		32	Other manufacturing
		33	Repair and installation of machinery and equipment
D, E	Public Utilities	35	Electricity, gas, steam and air conditioning supply
		36	Water collection, treatment and supply
		37	Sewerage
		38	Waste collection, treatment and disposal activities; materials recovery
		39	Remediation activities and other waste management services
F	Construction	41	Construction of buildings
		42	Civil engineering
		43	Specialised construction activities
G	Wholesale and retail trade;repair of motor vehicles and motorcycles	45	Wholesale and retail trade and repair of motor vehicles and motorcycles
		46	Wholesale trade, except of motor vehicles and motorcycles
		47	Retail trade, except of motor vehicles and motorcycles
H	Transportation and storage	49	Land transport and transport via pipelines
		50	Water transport
		51	Air transport
		52	Warehousing and support activities for transportation
		53	Postal and courier activities
I	Accommodation and food service activities	55	Accommodation
		56	Food and beverage service activities
J	Information and communication	58	Publishing activities
		59	Motion picture, video and television programme production, sound recording and music publishing
		60	Programming and broadcasting activities
		61	Telecommunications
		62	Computer programming, consultancy and related activities
		63	Information service activities
L	Real estate activities	68	Real estate activities
M	Professional, scientific and technical activities	69	Legal and accounting activities
		70	Activities of head offices; management consultancy activities
		71	Architectural and engineering activities; technical testing and analysis
		72	Scientific research and development
		73	Advertising and market research
		74	Other professional, scientific and technical activities
		75	Veterinary activities
N	Administrative and support service activities	77	Rental and leasing activities
		78	Employment activities
		79	Travel agency, tour operator and other reservation service and related activities
		80	Security and investigation activities
		81	Services to buildings and landscape activities
		82	Office administrative, office support and other business support activities
P, Q, R, S	Other Services	85	Education
		86	Human health activities
		87	Residential care activities
		88	Social work activities without accommodation
		90	Creative, arts and entertainment activities
		91	Libraries, archives, museums and other cultural activities
		92	Gambling and betting activities
		93	Sports activities and amusement and recreation activities
		95	Repair of computers and personal and household goods
		96	Other personal service activities

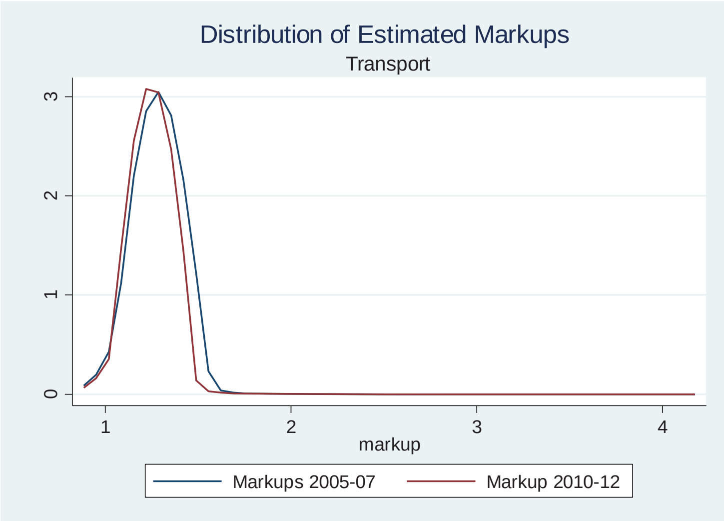
Appendix B. Distribution of firm-specific markups across macro-sectors

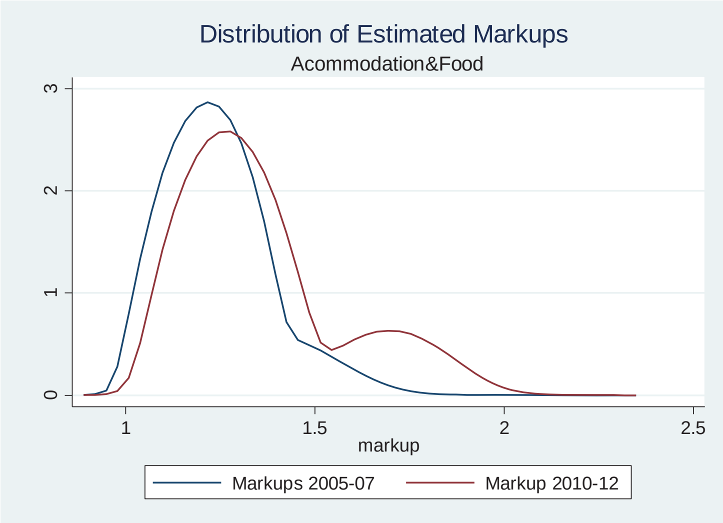


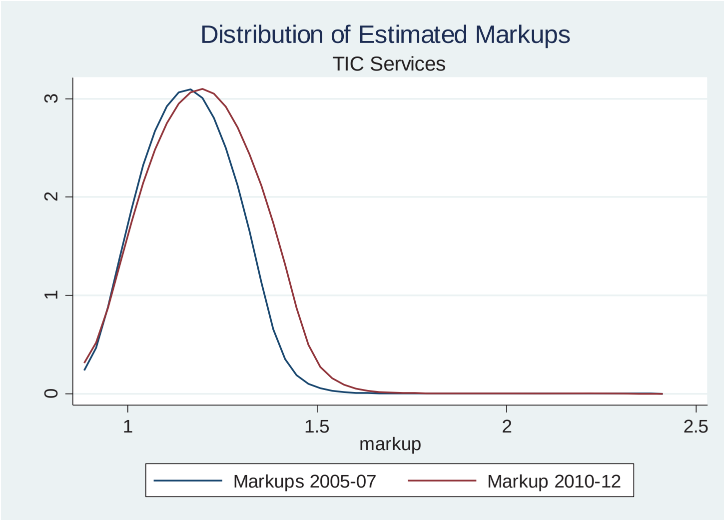


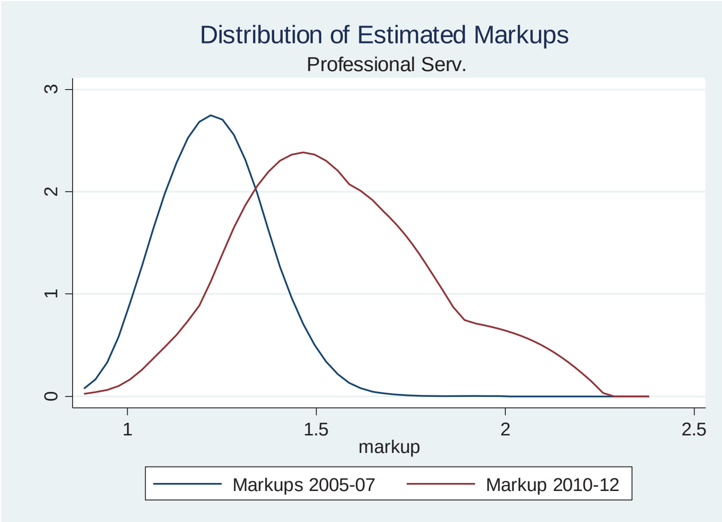


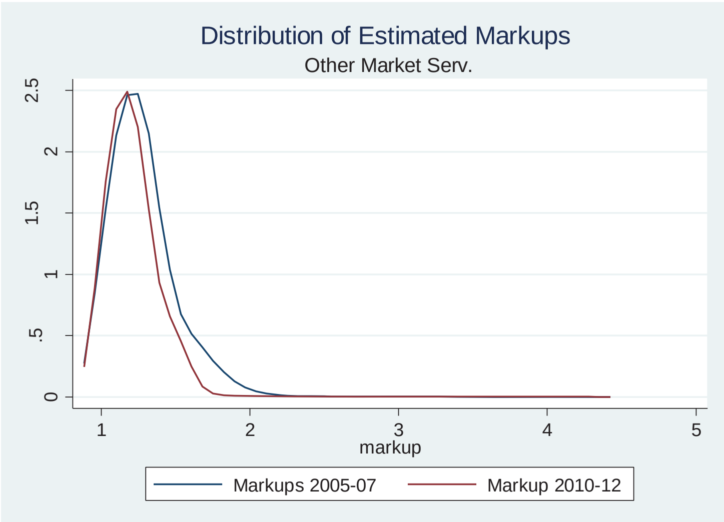

Distribution of Estimated Markups
Trade
0
1
2
3
4
.8
1
1.2
1.4
1.6
1.8
markup
Markups 2005-07
Markup 2010-12

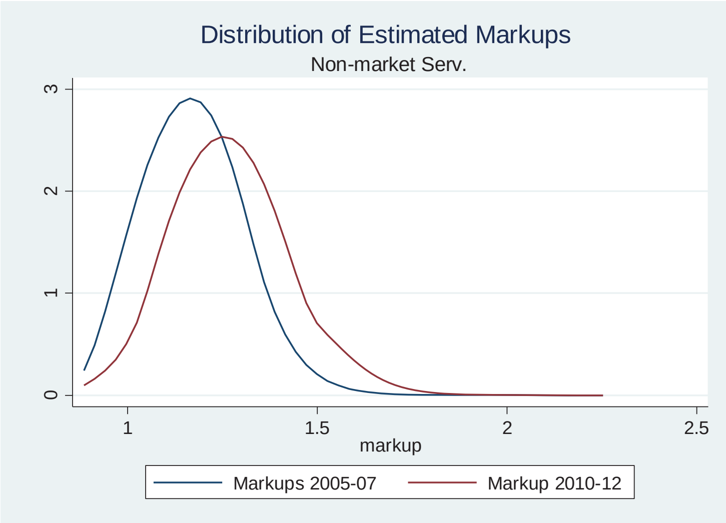

Distribution of Estimated Markups
Transport
0
1
2
3
1
2
3
4
markup
Markups 2005-07
Markup 2010-12


Distribution of Estimated Markups
Acommodation&Food
0
1
2
3
1
1.5
2
2.5
markup
Markups 2005-07
Markup 2010-12


Distribution of Estimated Markups
TIC Services
0
1
2
3
1
1.5
2
2.5
markup
Markups 2005-07
Markup 2010-12


Distribution of Estimated Markups
Professional Serv.
0
1
2
3
1
1.5
2
2.5
markup
Markups 2005-07
Markup 2010-12


Distribution of Estimated Markups
Other Market Serv.
0
.5
1
1.5
2
2.5
1
2
3
4
5
markup
Markups 2005-07
Markup 2010-12



Distribution of Estimated Markups
Non-market Serv.
0
1
2
3
1
1.5
2
2.5
markup
Markups 2005-07
Markup 2010-12

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