M&A, Uncertainty, and Bargaining Power: Evidence from the German Retail Sector

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Abstract

Market concentration has been suggested as an enhancer of bargaining power imbalances for vertical commercial relationships. However, the empirical literature has not yet explored in which way this market concentration, as a result of -for instance- a M&A operations, could affect the negotiations with agents in vertical related markets; in particular, in frictional multi-product commercial relationships, in which uncertainty may play a role of such negotiations. The present work proposes an explanation to this matter, by analyzing the strategic incentives and uncertainties that arise in this kind of commercial relationships from the announcement of an horizontal M&A operation, and the way these expectations could influence the bargaining power redistribution among players after the operation; opening the discussion on a dynamic analysis of bargaining outcomes.

1 Introduction

The discussion on unfair trading practices (UTPs)[1] within the food retail industry has intensified in the last decades, sparking attention to the posible existence of bargaining power disparities within vertical relationships in this industry [See, e.g. OECD (2015), OECD (2014), European Commission

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[1]According to the European Commission, the Unfair Trading Practices (UTPs) *"(...) are practices that grossly deviate from good commercial conduct and are contrary to good faith and fair dealing. UTPs are typically imposed in a situation of imbalance by a stronger party on a weaker one (...)"*, See European Commission (2013) p. 3.

(2013)], even resulting in regulation proposals in different countries [See, e.g. European Commission (2018), Fałkowski et al.(2017), Junta de Regulación de la Ley Orgánica de Regulación y Control del Poder de Mercado (2017), Australian Competition and Consumer Commission (2015), Competition Commission (2008)]. The European Commission (2013) stated that under such bargaining disparities weaker bargainers may fear losing the commercial relationship if they do not agree to such unfavourable conditions, and that high switching costs or the lack of other more *trust worthy* commercial alternatives may encourage stronger players to take advantage of their bargaining position.[2] The market concentration trend of the different stages of this supply chain has been suggested to contribute to the bargaining power disparities [See, e.g. OECD (2015), OECD (2014)], due to the resulting reduction of commercial alternatives. In this context, in which market concentration may derive in bargaining power issues, monitoring of M&A operations becomes an important tool in this kind of markets in order to assess the implications of such operations throughout the food industry.

Despite the claimed relation between market concentration and distribution of bargaining power and the suggested existence of this *"fear factor"* among bargainers, empirical literature has not yet considered in the analysis of bargaining power outcomes and M&A operations, the uncertainty that seems to be part of the negotiations of this kind of frictional commercial relationships. In this way, the aiming of the present work is to propose an explanation on how the bargaining power get redistributed when market concentration increases, by analyzing the catalyst role that uncertainty may play in this readjustment.

The impact on consumers of the gained leverage through horizontal M&A operations is suggested to depend on different factors. While Kim and Singal (1993) found that the increased concentration of the airforce industry due to mergers allowed the merging firm to enhance their performance, through the exert of market power, and this effect off-setted the potential benefits from efficiency. Chipty (1995) found that a larger sized firm charged lower prices, explaining this finding to the leverage gain against suppliers. However, both results could depend on the level of substitutability of the competing products and the markets' pass-through rate of benefits from the increase in bargaining power against suppliers [Dobson and Waterson (1997), Gaudin (2016), Gaudin (2017)].

Despite the effects on consumers, there is literature supporting that M&A operations boost merging firms' performance through increased in bargaining power, as it was suggested by Moatti

[2]See European Commission (2013) pp. 6 - 7

et al.(2015). And there is evidence of benefiting not only the merging firms but also the remaining firms in the market, as suggest by Prager (1992). Also, Allain et al. (2017) found that an increase in prices of the merging firms triggers the same in competitors. Being all of this consistent with the deep changes in managerial processes and approaches that M&A operation triggers as noted by Capron et al.(2001), and the imitation behaviors at the management level [e.g. Palley (1995), Lieberman and Asaba (2006)]. However, this potential increase in bargaining power through increase of the firm's size may be hinder if the firm becomes pivotal buyer of their suppliers, as pointed out by Raskovich (2003), and may benefit more the competitors of the pivotal firm by paying for most of the suppliers production costs.

In this way, under a vertical-related firm (e.g. a supplier) point of view, an horizontal M&A operation translate not only in a smaller set of players to negotiate with, but also in tougher negotiations afterwards with the remaining players in the market, and not only the ones involved in the operation. In this context, and considering multi-product bilateral relationships, such as the ones in the retail sector, in which different brands/products could be negotiated separately- i.e. several negotiations could be held between the same pair of players- the implications on how the outcome of a negotiation could affect another from the same bilateral commercial relationship - in particular regarding disagreement - could not only generate them uncertainty on the repercussions of not reaching an agreement, but also could predispose them to take an stronger bargaining approach in order to avoid losing their take in the margin distribution, attitude that the counterparties may expect, facing both parties in this way renegotiations under uncertainty.

The M&A operation push players to renegotiations of their products, that challenges their *status quo*, facing bargainings under an uncertain environment regarding the strength of their counterparty; having both players the incentives to portrait a strong position, consistent with literature on crisis bargining under uncertainty [Fey and Ramsay (2011)].

In spite of this potential change of bargaining strategy after an increase of market concentration, and the uncertainty on the repercussions of a disagreement, empirical analysis on the bargaining outcomes of M&A operations has not yet consider this element in the analysis; neither the incentives that players have to beforehand assess the bargaining scenarios they may face given the possibility of a forthcoming M&A operation.

The present work aims to fill this gap, by including uncertainty in the empirical bargaining analysis of M&A operations, due to the potential strategic advantage given the change in the market structure. At the same time, contributing by offering an explanation on the process of developing expectations and its conection with the redistribution of bargaining power among players.

Structural econometric approaches on bargaining outcomes has been based on a Nash-in-Nash bargaining [Collard-Wexler et al. (2019)], assuming that in negotiations bargainers have *passive beliefs*, meaning players assume that the failure of their current negotiation would have no repercussions on other players' negotiations taking place at that moment; which in markets with single-product bilateral commercial relationships would mean that competitors' negotiations are independent from each other, i.e. no other negotiation taking place in the market affects the current one and vice versa. Under these assumptions has been analyzed the effects of different situations, such as bundling products, product characteristic, mergers, among others, on the bargaining outcomes of markets as for instance: subscription-based television services [Crawford and Yurukoglu (2012)], medical devices [Grennan (2013)], health insurance [Ho and Lee (2017), Gowrisankaran et al. (2015)]; retail milk market [Bonnet and Bouamra-Mechemache (2015)], retail coffee market [Draganska et al.(2010)], among others.

However, assuming *passive beliefs* in multi-product bilateral relationships such as the retail industry, could not reflect other factors that may intervene in these negotiations, such as the uncertainty regarding the implication of disagreement within the commercial relationship as noted by Klein and Rebolledo (2020a, 2020b). In Klein and Rebolledo (2020a) was analyzed bargaining outcomes when there is a temporary threat in the market, generating uncertainty regarding the disagreement profits. And, given the temporal characteristic of the uncertainty, in their study firms had the choice of reaching an agreement under uncertainty or delaying the negotiation until the uncertainty disappears to reach then a new agreement under certainty conditions; preferring to bargain under uncertainty only if the outcome reach under this conditions was at least as good as the expected agreement profit without uncertainty, incentive condition introduced by Chun and Thomson (1999a, 1999b, 1999c).

Even though, Klein and Rebolledo (2020a) also considered an uncertain bargaining environment, the present work differs from it, given it analyzes a bargaining environment in which there is no option to delay negotiations, due once the M&A operation is cleared renegotiations are set to happen; being the source of uncertainty a consequence from something that already happen, rather than a temporary threat as in Klein and Rebolledo (2020a). And given that the threat considered is inevitable, in order to face negotiations as prepared as they can, bargainers should beforehand form their beliefs on their counterparties' bargaining approaches with the information they have available.

On the other hand, Klein and Rebolledo (2020b) analyzed bargaining outcomes including the uncertainty on the disagreement profits but lifting the assumption of asymmetric bargaining power among players; which may be better suited for bilateral negotiations in which, due to the high concentration of the markets at both ends, the analysis of bargaining power differences may not be as important as to analyze the interactions and expectations of players and the credibility of their threats. The present work also considers the uncertainty on the disagreement outcomes; however, it differs not only on considering a market in which assuming an even bargaining power distribution may be restrictive, but also by including an intertemporal nuance to the analysis of bargaining outcomes, as well as adding into the analysis the players' learning process regarding the expectations they develop on their counterparties.

It is also included in the present analysis a *multi-store/multi-outlet* environment, which is a current characteristic of this industry, in which retail firms owns several formats of stores/outlets under different brand names, this feature of the industry - previously considered by Aguirregabiria and Vicentini (2016) to analyze the competition among retailers - adds flexibility to the analysis of M&A operations and bargaining outcomes, given it distinguishes stores/outlets from the retail firm that owns them.

In order to perform this analysis, a well-known M&A case in the German retail industry was used. In november 2007 the largest German retailer announced its willingness to take over the discounter chain of one of its competitors, the fifth most prominent firm in the industry [Bundeskartellamt (2008a)], due to the concentration of the German retail market, not only at the selling but also at the procurement level, this operation was conditioned by the Bundeskartellamt -German antitrust authority-, and was finally cleared by the end of 2008 after the fulfillment of the imposed requirements. This case led to a subsequent investigation on *"wedding rebates"*, in which former suppliers of the acquired-store were asked special benefits in favor to the acquisitor [See, OECD (2014) pp. 179, Bundeskartellamt (2018)]; hinting us the strong renegotiation environment lived after this M&A operation.

Through this case is exemplified the proposed approach to the analysis of the bargaining outcomes before and after a M&A operation, including the uncertainty under which market players would have to bargain after the operation, and the expectations they would have had about those negotiations before the operation was in place; proposing, in this way, not only an explanation on how bargaining power readjust to this kind of changes in market structure, but also finding an intertemporal conection between bargaining outcomes, in which the uncertainty may be the catalyst to the readjustments; opening the discussion on the intertemporal dynamics of bargaining outcomes.

This article develops as follows in section 2 the model on bargaining under uncertainty in a multi-store and multi-product environment is introduced. In section 3 the case and the identification strategy is explained. The dataset and estimation results are found in section 4. Finally, section 5 concludes.

2 M&A and bargaining under uncertainty: The Model

Consider a market consisting of upstream and downstream firms that interact through vertical negotiations; each upstream firm offers a set of products (brands), which after being sold to the downstream firms are resold through the differentiated outlets of the downstream firms to the final consumer.

Given that the downstream firms offer differentiated outlets to consumers, then buying the same product/brand through two different outlets, even though these outlets belong to the same downstream firm, constitutes two different options/alternatives, Figure 1 in Appendix A exemplifies the alternative formation in a market of two up- and downstream firms, five brands and five differentiated outlets. In this way, both up- and downstream firms have a multi-product portfolio, just as upstream firms offer multiple products/brands, the downstream firms offer differentiated outlets.

Denote as Z^m the set of alternatives produced by the upstream firm m, and as Z^r the set of alternatives sold to final consumers through the outlets of downstream firm r, where $\bigcup_m Z^m = \bigcup_r Z^r = Z$ in which Z is the total number of alternatives available to consumers.

Consider that each downstream firm has a centralized procurement system, i.e. the downstream firm buys upstream firms' products and then place these products in each of the its outlets. Also it is considered that each product offered by the upstream firm is bargained separately with downstream firm. In this way, the same pair of bargainers have as many bilateral negotiations with each other as products are exchanged between them.

The set of alternatives produced by upstream firm m and sold through the outlets of downstream firm r is denoted by Z^{mr}, where $\bigcup_{mr} Z^{mr} = Z$. Similarly, Z^{mr_j} is set of alternatives that share the same product/brand with alternative j and are sold through the outlets of the same downstream firm as the mentioned alternative. Notice that all alternatives in Z^{mr_j} share the same wholesale price.[3] Additionally, N represents the number of bilateral negotiations that are held between up- and downstream firms.

Denoting as $w_{Z^{mr_j}}$ the wholesale price of the alternatives in Z^{mr_j}, which is determined through a vertical bilateral negotiation between upstream firm m and downstream firm r over the product/brand to which j belongs.[4]

Now consider that an M&A operation takes place in the downstream market, which increases the concentration of this market, without loss of generality it is considered in this setting an acquisition of an outlet from one downstream firm to one of its competitors, e.g. in Figure 1 downstream firm r_1 takes over outlet o_2 from firm r_2.

While negotiating, both up- and downstream firms are assumed to hold *passive beliefs* regarding the results of their competitors, i.e. the result of their negotiations would not affect the result of the negotiations of their competitors and vice versa [Draganska et al. (2010), Collard-Wexler et al. (2019), Klein and Rebolledo (2020a, 2020b)]. However, given the imminent change in the market structure due to M&A operation, which would suppose a reduction of differentiated outlets where to place upstream firms' products - reducing therefore the alternatives available in the market, this would have implications on bargainers' expectations regarding the potential results from the negotiations, in particular with respect to their outside options. This change in the market structure becomes in an opportunity that can be strategically capitalize at the negotiation table.

As noted by former studies, M&A operations trigger deep changes at the managerial level [Capron et al.(2001)], changes that could include the bargaining approach to suppliers considering the findings on increasing bargaining power of merging firms after the operation [Moatti et al

[3]For instance, in Figure 1 alternatives 10 and 11 belong to a same set of products Z^{mr_j}, even though they are sold thorugh two different outlets, because they resulted from the negotiation between upstream firm m_2 and downstream firm r_2 over brand b_5; hence, both alternatives have the same wholesale price.

[4]Notice, if alternatives j and k share the same brand/product and are sold through the outlets of the same downstream firm, then $w_j = w_k = w_{Z^{mr_j}}$.

(2015)]. Even though, through the M&A operation only one firm is increasing its size, the others also benefit from the disappearance of a competitor and, at the same time, gain relative strength against suppliers. Hence, and given that the merging firm may have an stronger approach in negotiations against suppliers, the other remaining firms would have incentives to behave in a similar manner, in order not to fall behind when competing in the down-stream market, imitation behavior consistent with the findings in former studies [e.g. Palley (1995), Lieberman and Asaba (2006)]; which considering the evidence that M&A operations could not only benefit the merging firms but also the others in the market [Prager (1992)]; if renegotiations are set to happen it is likely that market players would be uncertain of the bargaining approach of all their counterparties.

Given the potential change in the bargaining approach of the downstream market firms in renegotiations, and regardless of the real strenght of the upstream firms, the latter could also have the incentive to present an stronger bargaining approach, in order not to lose their margin; hence, downstream firms would also be uncertain of the bargaining approach of their counterparties, situation that is consistent with the incentives in crisis bargaining under uncertainty regarding the strenght of the opponent [Fey and Ramsay (2011)].

Therefore, the possibility that a firm could use the conjuncture to its favor generates uncertainty regarding the approach that the counterparty would have while bargaining, uncertainty that is particularly present while assessing the disagreement profit; given that the counterparty could retaliate in the other negotiations within the same commercial relationship if renegotiations regarding a particular product are not successful.

In this way, at the renegotiation table a firm could approach disagreement in two different ways: a) a disagreement in the negotiation of a particular product/brand would have no implication on the other negotiations within the same bilateral relationship, being then the disagreement profit $d_{J^{rm_j}}$ (*weak approach*); b) a disagreement in the negotiation of a particular brand/product would imply a break-up in the negotiations of the other brands/products within that bilateral commercial relationship, being then the disagreement profit $d_{J^{rm}}$ (*strong approach*). Notice that regardless the approach that the counterparty would have while bargaining, if agreement is reached it is assumed that there is no potential effect on other negotiations within the bilateral relationship. Figure 2 in Appendix A presents an extensive-form representation of the renegotiations over product/brand of alternative j between upstream firm m and downstream firm r.

Hence, both up- and downstream firms have to develop beliefs on the bargaining approach of their counterparty. By denoting the beliefs of the up- and downstream firms on facing a *weak approach* in the negotiation of the brand/product of alternative j as $\delta_{Z^{mr_j}}$ and $\theta_{Z^{mr_j}}$ respectively, where both $\delta_{Z^{mr_j}}$ and $\theta_{Z^{mr_j}} \in [0,1]$ [5]; then and similar to Klein and Rebolledo (2020a) the Nash bargaining product of this uncertain bargaining environment is:

$$\underset{w_{Z^{mr_j}}}{\text{Max}} \left(\pi^r_{Z^{mr_j}} - E(d^r_{Z^{mr_j}})\right)^{\lambda_{Z^{mr_j}}} \left(\pi^m_{Z^{mr_j}} - E(d^m_{Z^{mr_j}})\right)^{(1-\lambda_{Z^{mr_j}})} \tag{1}$$

being $E(d^m_j) = \delta_{Z^{mr_j}} d^m_{Z^{mr_j}} + (1-\delta_{Z^{mr_j}}) d^m_{Z^{mr}}$, similarly for the downstream firm[6]; in which the agreement and disagreement profits in each scenario are the following:

Table 1: Agreement and Disagreement Profits

Agreement Profits

Upstream firm	$\pi^m_{Z^{mr_j}} = \sum_{j\in Z^{mr_j}} \Gamma_{Z^{mr_j}} s_j M + \sum_{\substack{k\in Z^m \\ k\notin Z^{mr_j}}} \Gamma_{Z^{mr_k}} s_k M$
Downstream firm	$\pi^r_{Z^{mr_j}} = \sum_{j\in Z^{mr_j}} \gamma_j s_j M + \sum_{\substack{k\in Z^r \\ k\notin Z^{mr_j}}} \gamma_k s_k M$

Disagreement Profits

	Weak Approach Scenario	Strong Approach Scenario
Upstream firm	$d^m_{Z^{mr_j}} = \sum_{\substack{k\in Z^m \\ k\notin Z^{mr_j}}} \Gamma_{Z^{mr_k}} s_k^{-Z^{mr_j}} M$	$d^m_{Z^{mr}} = \sum_{\substack{k\in Z^m \\ k\notin Z^{mr}}} \Gamma_{Z^{mr_k}} s_k^{-Z^{mr}} M$
Downstream firm	$d^r_{Z^{mr_j}} = \sum_{\substack{k\in Z^r \\ k\notin Z^{mr_j}}} \gamma_k s_k^{-Z^{mr_j}} M$	$d^r_{Z^{mr}} = \sum_{\substack{k\in Z^r \\ k\notin Z^{mr}}} \gamma_k s_k^{-Z^{mr}} M$

where s_j is the share of alternative j in the downstream market, $\Gamma_{Z^{mr_j}}$ represents the upstream firm's margin from an alternative in Z^{mr_j}, being $\Gamma_{Z^{mr_j}} = w_{Z^{mr_j}} - c^m_{Z^{mr_j}}$ and $c^m_{Z^{mr_j}}$ the marginal cost of producing an alternative in Z^{mr_j}. Likewise γ_j is the downstream firm's margin from alternative j, which $\gamma_j = p_j - w_{Z^{mr_j}} - c^r_{Z^{mr_j}}$, representing p_j the price of alternative j in the downstream market and $c^r_{Z^{mr_j}}$ the marginal cost of the downstream firm r from selling an alternative in Z^{mr_j}. In this way, the maximization of (1) unfold the following expression:

[5] Consequently, the up- and downstream firms' beliefs on facing a different scenario are $(1-\delta_{Z^{mr_j}})$ and $(1-\theta_{Z^{mr_j}})$ respectively.

[6] $E(d^r_j) = \theta_{Z^{mr_j}} d^r_{Z^{mr_j}} + (1-\theta_{Z^{mr_j}}) d^r_{Z^{mr}}$

$$\left(\pi^m_{Z^{mr_j}} - E(d^m_{Z^{mrj}})\right)\frac{\partial \pi^r_{Z^{mr_j}}}{\partial w_{Z^{mr_j}}} = -\frac{(1-\lambda_{Z^{mr_j}})}{\lambda_{Z^{mr_j}}}\left(\pi^r_{Z^{mr_j}} - E(d^r_{Z^{mrj}})\right)\frac{\partial \pi^m_{Z^{mr_j}}}{\partial w_{Z^{mr_j}}} \tag{2}$$

Given that $\frac{\partial \pi^r_{Z^{mr_j}}}{\partial w_{Z^{mr_j}}} = -\sum_{j\in Z^{mr_j}} s_j M$ and $\frac{\partial \pi^m_{Z^{mr_j}}}{\partial w_{Z^{mr_j}}} = \sum_{j\in Z^{mr_j}} s_j M$, then expression (2) leads to the following:

$$\begin{aligned} &\sum_{j\,\in Z^{mr_j}} \Gamma_{Z^{mr_j}} s_j - \sum_{\substack{k\in Z^m \\ k\notin Z^{mr_j}}} \Gamma_{Z^{mr_k}} \Delta s_k^{-Z^{mr_j}} - \tilde{\delta}_{Z^{mr_j}} \left(\sum_{\substack{k\in Z^m \\ k\notin Z^{mr}}} \Gamma_{Z^{mr_k}} s_k^{-Z^{mr}} - \sum_{\substack{k\in Z^m \\ k\notin Z^{mr_j}}} \Gamma_{Z^{mr_k}} s_k^{-Z^{mr_j}} \right) \\ &= \tilde{\lambda}_{Z^{mr_j}} \left[\sum_{j\in Z^{mr_j}} \gamma_j s_j - \sum_{\substack{k\in Z^r \\ k\notin Z^{mr_j}}} \gamma_k \Delta s_k^{-Z^{mr_j}} - \tilde{\theta}_{Z^{mr_j}} \left(\sum_{\substack{k\in Z^r \\ k\notin Z^{mr}}} \gamma_k s_k^{-Z^{mr}} - \sum_{\substack{k\in Z^r \\ k\notin Z^{mr_j}}} \gamma_k s_k^{-Z^{mr_j}} \right) \right] \end{aligned} \tag{3}$$

where s_j represents the same as before, $\tilde{\delta}_{Z^{mr_j}} = (1-\delta_{Z^{mr_j}})$, $\tilde{\theta}_{Z^{mr_j}} = (1-\theta_{Z^{mr_j}})$ and $\tilde{\lambda}_{Z^{mr_j}} = \frac{(1-\lambda_{Z^{mr_j}})}{\lambda_{Z^{mr_j}}}$. In addition, $s_k^{-Z^{mr_j}}$ represents the share of alternative k when j and the other alternatives in Z^{mr_j} are not longer available in the downstream market, $s_k^{-Z^{mr}}$ is the share of alternative k when there is no exchange of products within the bilateral relationship of m and r, i.e. the alternatives in Z^{mr} are not longer in the market. Finally, $\Delta s_k^{-Z^{mr_j}} = s_k^{-Z^{mr_j}} - s_k$ and $\Delta s_k^{-Z^{mr}} = s_k^{-Z^{mr}} - s_k$.

In this way, expression (3) can be represented in matrix notation as follows:

$$(\mathfrak{T}^m * D^j)\hat{\mathbf{\Gamma}} - \hat{\tilde{\boldsymbol{\delta}}} * \left[\left(\mathfrak{T}^m * (S^{Z^{mr}} - S^j)\right)\hat{\mathbf{\Gamma}}\right] = \hat{\tilde{\boldsymbol{\lambda}}} * \left[(\mathfrak{T}^r * D^j)\boldsymbol{\gamma} - \hat{\tilde{\boldsymbol{\theta}}} * \left[\left(\mathfrak{T}^r * (S^{Z^{mr}} - S^j)\right)\boldsymbol{\gamma}\right]\right] \tag{4}$$

where $\mathfrak{T}^r$ is an square matrix of dimension Z with general element $\mathfrak{T}^r[t,z] = 1$ if both alternatives t and z are sold through the outlets of the same downstream firm and $\mathfrak{T}^r[t,z] = 0$ otherwise. Similarly, $\mathfrak{T}^m$ of dimension Z, which general element is $\mathfrak{T}^m[t,z] = 1$ if both alternatives t and z are produced by the same upstream firm and $\mathfrak{T}^m[t,z] = 0$ otherwise.

D^j is an square matrix of dimension Z of shares and shares differences, which general element is $D^j[t,z] = s_z$ if z belong to the same set of products Z^{mr_t} as t, $D^j[t,z] = -\Delta s_z^{-Z^{mr_t}}$ otherwise.

Futhermore, the square matrix S^j of dimension Z, which general element is $S^j[t,z] = 0$ if z belong to the same set of products Z^{mr_t} as t, $S^j[t,z] = s_z^{-Z^{mr_t}}$ otherwise. While in matrix $S^{Z^{mr}}$, also of dimension Z, the general element $S^{Z^{mr}}[t,z] = 0$ if z belong to the same set of products Z^{mr_t} as t, $S^{Z^{mr}}[t,z] = s_z^{-Z^{mr}}$ otherwise.

While $\boldsymbol{\gamma}$ is the vector of downstream-firm margins as of dimension (Z x 1), $\hat{\boldsymbol{\Gamma}} = \mathcal{I}_N\boldsymbol{\Gamma}$ where $\mathcal{I}_N$ is the negotiation matrix of dimension (Z x N), which general element $\mathcal{I}_N[t, n] = 1$ if alternative t is part of negotiation n and 0 otherwise, while $\boldsymbol{\Gamma}$ is the (N x 1) vector of upstream firm's margins. Similarly, $\hat{\tilde{\boldsymbol{\delta}}}$ and $\hat{\tilde{\boldsymbol{\theta}}}$ are the (Z x 1) vectors, where $\hat{\tilde{\boldsymbol{\delta}}} = \mathcal{I}_N\tilde{\boldsymbol{\delta}}$ and $\hat{\tilde{\boldsymbol{\theta}}} = \mathcal{I}_N\tilde{\boldsymbol{\theta}}$, being both $\tilde{\boldsymbol{\delta}}$ and $\tilde{\boldsymbol{\theta}}$ of dimension (N x 1) and representing the up- and downstream firms' beliefs on the *strong* approach scenario respectively. Likewise, $\hat{\tilde{\boldsymbol{\lambda}}} = \mathcal{I}_N\tilde{\boldsymbol{\lambda}}$, where $\tilde{\boldsymbol{\lambda}}$ is the vector of bargaining parameter ratios of dimension (N x 1).[7]

Notice these expressions are similar to the ones introduced by Klein and Rebolledo (2020a) but developed in a multi-store/multi-outlets environment, which is present in industries such as the retail, as noted by Aguirregabiria and Vicentini (2016) in their analysis of the competition among retailers.

The inclusion in the present work of this multi-store environment is embodied by matrix $\mathcal{I}_N$, which indicates the common owner of several outlets, who is the one in charge of each brand negotiation against the suppliers. Note that if each store/outlet were independent from each other, i.e. each belong to a different owner, matrix $\mathcal{I}_N$ become in an identity matrix resulting in the model presented by Klein and Rebolledo (2020a), becoming that model in an special case of the one presented in this section.

3 Case and Identification Strategy

After months of negotiations, in november 2007 was announced a prominent M&A operation in the German retail sector, the leading German food retailer was willing to take over a chain of discounters from the fifth most important retailer, aiming to merge it with its own discounter chain [See, Koch (2007), Bundeskartellamt(2008a)].

The agreement between these firms was subject to the approval of the Bundeskartellamt - the German competition agency; entity that in their revision highlighted the high concentration of the German food retail market, in which 90% of its volume belonged to five firms, two of them involved in the evaluated operation. Concentration that was also present at the food procurement level, rais-

[7] $\tilde{\boldsymbol{\lambda}} = \begin{pmatrix} \frac{1-\lambda_1}{\lambda_1} \\ \vdots \\ \frac{1-\lambda_N}{\lambda_N} \end{pmatrix}$

ing concerns regarding the potential effects on the distribution of bargaining power among players in that market. Given this environment, this German agency conditioned the acquisition aiming to reduce the potential harms in those markets [Bundeskartellamt (2008a)]. The clearance of the operation came by end of 2008, after the fullfilment of the Authority's requirements [Bundeskartellamt (2008b)].

However, negotiations in this industry are known to be tough, and concerns regarding unfair trading practices within the food chain have moved the discussion to a supranational level, where the lack of certainty and disparities in bargaining power among actors of the chain have been moving forward legislative proposals in the last years [See, European Commission (2018a)].

Considering this context, negotiations between suppliers and retailers were expected to become tougher, given that the new market structure should have risen the incentives of the market players to strategically take advantage of the conjuncture and display stronger bargaining approaches, in order to increase (or keep) their margins; expectations that were met as suggested by the findings of the Bundeskartellamt's investigation on *"wedding rebates"*, case in which unjustified special benefits were asked to suppliers of some products after the acquisition of the discounter chain [See, OECD (2014) pp. 179, Bundeskartellamt (2018)].

It is worth to highlight that even before the announcement of this M&A operation, it was known the willingness of selling this outlet chain; therefore, bargainers knew of a potential change in the market structure and should have been assessing their bargaining environment if an agreement between these firms take place and, consequently, not having any other option than facing renegotiations under this new market structure.

Hence, and including this plausible thinking-ahead attitude of market players, the analysis can be divided in two periods: 1) *Before Acquisition (Before M&A)*, period in which this operation is not yet announced, and therefore, the negotiations between retailers and suppliers over the different products develop in an uncertainty-free environment; however, given the known willigness to sell an outlet, players should also have been trying to assess the bargaining approaches of their counterparties if the acquisition takes place, assessment done with the information available to them until that point in time, forming beliefs on the different possible bargaining strategies of their counterparties; 2) *After Acquisition (After M&A)*, in which the operation was already cleared, and the transition period is taking place, and with it the renegotiations between retailers and suppliers, which would be developing in a new market structure. This new market environment could influence the players' disposition regarding their approaches on negotiations to increase their take in the margin distribution, using their reaction when facing disagreement as a threat, given the strategic opportunity opened through this M&A operation. Players could take a mild disposition toward disagreementin a negotiation, meaning that not reaching an agreement would have no implications on the other negotiations within the same bilaretal commercial relationship. However, players could also take a tougher disposition toward disagreement, breaking not only the exchange of the bargained product but also the exchange of the others products within the commercial relationship. Therefore, actors would have to resort to the beliefs they formed previously (in the Before M&A period) in order to be better prepared to face their current renegotiations; renegotiations that will give also as a result a redistribution of the bargaining power among players.

In this way, in the *Before M&A* period the bargaining power distribution is obtained by following a Nash-in-Nash bargaining in which players assume inter- and intrarelationship passive beliefs as presented in former studies [e.g. Crawford et al. (2018), Ho and Lee (2017), Bonnet and Bouamra-Mechemache (2015), Grennan (2013), Crawford and Yurukoglu (2012), Draganska et al. (2010)]. However, in that same period, firms should be assessing their counterparties bargaining approaches if the acquisition is cleared, to this purpose they would use the information they have available until that moment, including their bargaining power distribution. Being this assessment done in a similar fashion as in Klein and Rebolledo (2020a) but including a multi-product and multi-store commercial relationship environment, as presented in section 2. In this way, and by knowing the bargaining power distribution of this period the beliefs on their counterparties' possible bargaining strategies can be recovered by using equation (4).

While in the *After M&A* period, bargainers have not other option than to renegotiate under a new market structure, and therefore, under the uncertainty regarding their counterparties' bargaining approaches; and being the previously assessed beliefs the tool that allows them to estimate their disagreement profits and face better prepared the renegotiations, where new bargaining power distribution will be determined.

In each period the bargaining outcomes are solved by backward induction; estimating first each period's demands, from which the demand elasticities and marginal effects are derived. Afterwards, the retailers margins are assessed assuming a Nash-Bertrand competition among outlets. At last, and for the case of the *before M& A* period, the bargaining distributions and manufacturer's margins are computed, and the assessment of the beliefs are performed as mentioned above. While, in the *after M& A* period, the results from considering the assumptions of certainty and uncertainty in the negotiations are compared, in order to see which model adjusts better to the analyzed situation.

Finally, in this analysis was excluded the period between the announcement and the clearance of the M&A operation, given that in this period the acquisition could have been either not approved or not cleared by the authorities, and therefore intervening other sources of uncertainty that are out of the scope of the present study.

3.1 Demand Model

In order to estimate the demand of each period, taking into account how consumers choose among the differentiated alternatives available in the market, a random coefficient logit model was implemented, due its flexibility and its capability of controlling for consumer's preference heterogeneity.

Hence, following discrete choice models literature [e.g. Berry et al.(1995), Nevo (2001)], the utility function of consumer i from the consumption of alternative j at time t was defined as:

$$U_{ijt} = \sum_{c \in \mathcal{C}} \beta^c c + \beta_i^p p_{jt} + \varepsilon_{ijt} \tag{5}$$

where c is an alternative's time invariant characteristic included in set $\mathcal{C}$ - e.g. brand, retailer, package size, and fat level - which its effect on consumer i utility is captured by β^c.

The price of the alternative j at time t is represented by p_{jt}, and its disutility on consumer i by β_i^p, which is a random coefficient that account for consumer heterogeneity, where $\beta_i^p = \beta^p + \sigma_{\beta^p} \vartheta_i$, being ϑ_i the consumer's devitation from the mean, that is independently and normally distributed. Meanwhile, ε_{ijt} denotes a random shock on the utility, which is assumed to be i.i.d. type I extreme value distributed.

With the purpose of taking into account for the possibility that consumers choose an alternative outside the Z available in the market, an outside option was included, and the consumer's derived utility from the consumption of this alternative is normalized to zero, i.e. $U_{i0t} = \varepsilon_{i0t}$.

Hence, the consumer i's probability of buying alternative j on time t would be:

$$s_{ijt} = \frac{exp(\sum_{c \in \mathcal{C}} \beta^c c + \beta_i^p p_{jt})}{\sum_{k=0}^{J} exp(\sum_{c \in \mathcal{C}} \beta^c c + \beta_i^p p_{jt})}$$

Finally, the cross- and own-price elasticities were computed, from the marginal effects obtained through the simulation process suggested by Cameron and Trivedi (2010)[8].

3.2 Retailer Margin

Once the periods' demands were estimated, retailers' margins can be computed. Notice that at this stage bargainings between retailers and manufacurers are already in the past; in this way, retailers would take the wholesale price as given. Therefore, the previously existing uncertainty does not longer affect the pricing process of the alternatives, as noted by Klein and Rebolledo (2020a).

Similar to previous literature, the alternatives' price setting process, followed by retailers, is assumed to respond to a Bertrand-Nash competition among outlets [e.g. Draganska et al. (2010), Bonnet and Bouamra-Mechemache (2015), Klein and Rebolledo (2020a, 2020b)], where the prices maximize retailer's profits as follows:

$$\underset{p_j}{\text{Max}}\,\pi^r = \sum_{j\in Z^r} \left[p_j - w_j - c_j^r\right] s_j(p) M \tag{6}$$

as before Z^r denotes the set of alternatives sold through the outlets of retailer r; while p_j and c_j^r are the price and marginal cost of alternative j respectively, and w_j is the wholesale price of this alternative. The market size is denoted by M, while s_j is the market share of alternative j.

By representing the retailer's margin of alternative j as γ_j, i.e. $\gamma_j = p_j - w_j - c_j^r$, then the alternative's Nash equilibrium prices are derived from the following expression:

$$s_j(p) + \sum_{k\in Z^r} \gamma_k \frac{\partial s_k(p)}{\partial p_j} = 0, \tag{7}$$

which can be represented in matrix notation as $(\mathcal{T}^r * \mathcal{D})\,\boldsymbol{\gamma} + \boldsymbol{s(p)} = 0$, where $*$ is the Hadamard product operator, $\mathcal{T}^r$ is the retailers ownership matrix, which element $\mathcal{T}^r[t,z] = 1$ if both alternatives t and z are sold through the outlets of the same retailer or $\mathcal{T}^r[t,z] = 0$ otherwise. $\mathcal{D}$ is an square matrix of dimension Z, which general element $\mathcal{D}[t,z] = \frac{\partial s_z(p)}{\partial p_t}$, $\boldsymbol{s(p)}$ is the vector of market shares, and $\boldsymbol{\gamma}$ is the vector of retailers margins [Draganska et al. (2010)]. Therefore, the retailers margins can be expressed as follows:

$$\boldsymbol{\gamma} = -\left(\mathcal{T}^r * \mathcal{D}\right)^{\dagger} \boldsymbol{s(p)} \tag{8}$$

[8]For more details see Cameron and Trivedi (2010) p. 353

where, $(\mathcal{T}^r * \mathcal{D})^\dagger$ is the Moore-Penrose inverse matrix of $(\mathcal{T}^r * \mathcal{D})$.

3.3 Manufacturer Margin

Once the retailers margin were obtained, the manufacturers margins and bargining power parameters can be estimated; however, and as mentioned before, the negotiations in each period would developed under different environments, which would require a different process for each period once these considerations are included in the analysis.

In the *Before M&A* period, as is explained in more detail below, it was not known when or whether this future market change will take place, therefore bargainers would have no imminent threat that make them reconsider the negotiation approach of their counterparty; in this way, the agreements reached in this period can be estimated y assuming complete *passive beliefs*, i.e. no uncertainty coming from any other negotiation taking place in the market [Collar-Wexler et al(2019), Draganska et al. (2010)]; which, as noted by Klein and Rebolledo (2020a), is a case of the uncertainty model, one in which both bargainers assume *inter-* and *intrarelationship passive beliefs*, i.e. they expect no retaliation coming from not reaching an agreement of anyother product.

However, it is important to notice that the market players know even before the announcement that the possibility of a M&A operation in the market exists, and therefore in this period they should be also forming beliefs regarding the strategic incentives of their counterparties given that possible new setting, and by using the information they have until that moment available - which includes the bargaining power distribution- to assess how negotiations would develop. Hence, the beliefs assessment process is estimated following specification in section 2 and using the information gathered until that period.

After the M&A operation took place, and given the new bargaining environment due to the change in the market structure, in which the actors have no other option than renegotiate their products, uncertainty regarding their counterparties bargaining approach arises; and therefore, in order to face renegotiations, they should estimate their disagreement profits by using the beliefs they formed the last time they assessed that bargaining environment (in the *Before M&A* period). From the new renegotiations the new bargaining power distribution will be set.

3.3.1 Before the M&A Operation

As mentioned, in the *Before M&A* period, even though may have been known the willingness to sell a certain outlet, its ocurrence was yet not set to happen, i.e. in the market was not an ineludible change in the market structure that could spark suspicion on the strategic bargaining approaches of the players in the ongoing negotiations; then the Nash-in-Nash bargaining over the wholesale price of alternative j in this period is the following [Collard-Wexler et al. (2019), Draganska et al. (2010)]:

$$\underset{w_{J^{mr_j}}}{\text{Max}} \left(\pi^r_{Z^{mr_j}} - d^r_{Z^{mr_j}}\right)^{\lambda_{Z^{mr_j}}} \left(\pi^m_{Z^{mr_j}} - d^m_{Z^{mr_j}}\right)^{(1-\lambda_{Z^{mr_j}})} \tag{9}$$

in which, as introduced in Table 1, $\pi^r_{Z^{mr_j}}$ and $\pi^m_{Z^{mr_j}}$ represent agreement profits from the set of alternatives Z^{mr_j} for the retailer and manufacturer respectively. On the contrary, $d^r_{Z^{mr_j}}$ and $d^m_{Z^{mr_j}}$ represent their disagreement profits when all alternatives in Z^{mr_j} are delisted from the retailer's outlets.

Notice that this negotiation environment is equivalent to the one in which both bargainers -retailer and manufacturer- are certain that their counterparty has a *weak approach* in the ongoing negotiation, i.e. $\delta_{Z^{mr_j}}$ and $\theta_{Z^{mr_j}}$ are both one; hence, from expression (4) we have that the manufacturer's margin can be expressed as: $\hat{\boldsymbol{\Gamma}} = (\mathcal{T}^m * D^j)^\dagger \left(\hat{\tilde{\boldsymbol{\lambda}}} * \left((\mathcal{T}^r * D^j)\boldsymbol{\gamma}\right)\right)$, where $(\mathcal{T}^m * D^j)^\dagger$ represents the Moore-Penrose inverse of matrix $(\mathcal{T}^m * D^j)$ and $\hat{\boldsymbol{\Gamma}}$ represents the same as in section 2. Denoting the general element of the vector $(\mathcal{T}^r * D^j)\boldsymbol{\gamma}[i,1]$ as b_i, then $\hat{\boldsymbol{\Gamma}}$ can be expressed as $\hat{\boldsymbol{\Gamma}} = C\hat{\tilde{\boldsymbol{\lambda}}}$, where C is an square matrix of dimension Z which general element is $C[t,z] = (\mathcal{T}^m * D^j)^\dagger[t,z]b_z$ [Klein and Rebolledo (2020a)]. [9]

As presented in section 2, $\Gamma_{Z^{mr_j}} = w_{Z^{mr_j}} - c^m_{Z^{mr_j}}$ and $\gamma_j = p_j - w_{Z^{mr_j}} - c^r_{Z^{mr_j}}$, then $\hat{\boldsymbol{\Gamma}} = \hat{\boldsymbol{w}} - \hat{\boldsymbol{c}}^{\boldsymbol{m}}$ and $\boldsymbol{\gamma} = \boldsymbol{p} - \hat{\boldsymbol{w}} - \hat{\boldsymbol{c}}^{\boldsymbol{r}}$, where $\boldsymbol{p}$ is the (Z x 1) vector of the alternative's price in the downstream market, while $\hat{\boldsymbol{w}} = \mathcal{I}_N\boldsymbol{w}$, $\hat{\boldsymbol{c}}^{\boldsymbol{m}} = \mathcal{I}_N\boldsymbol{c}^{\boldsymbol{m}}$ and $\hat{\boldsymbol{c}}^{\boldsymbol{r}} = \mathcal{I}_N\boldsymbol{c}^{\boldsymbol{r}}$, being $\boldsymbol{w}$, $\boldsymbol{c}^{\boldsymbol{m}}$ and $\boldsymbol{c}^{\boldsymbol{r}}$ vectors of dimension (N x 1) corresponding to the wholesale price, the manufacturers and retailers marginal cost, respectively [Draganska et al (2010), Bonnet and Bouamra-Mechemache (2016)]. In this way, $\hat{\boldsymbol{c}}^{\boldsymbol{m}} + \hat{\boldsymbol{c}}^{\boldsymbol{r}} = \boldsymbol{p} - \boldsymbol{\gamma} - \hat{\boldsymbol{\Gamma}}$, and assuming that $\boldsymbol{c}^{\boldsymbol{m}} + \boldsymbol{c}^{\boldsymbol{r}} = P\boldsymbol{\kappa} + \boldsymbol{\eta}$ where P is a matrix of dimension (N x H) in which each column of this matrix corresponds to a different input cost variable, and $\boldsymbol{\eta}$ is the error term vector of dimension (N x 1); having then the following specification:

[9] The process followed by Klein and Rebolledo (2020a) to get matrix C can be found in the Appendix B.

$$\boldsymbol{p} - \boldsymbol{\gamma} = \check{C}\tilde{\boldsymbol{\lambda}} + \hat{P}\boldsymbol{\kappa} + \hat{\boldsymbol{\eta}} \tag{10}$$

where $\check{C} = C\mathcal{I}_N$, while $\hat{P} = \mathcal{I}_N P$ and $\hat{\boldsymbol{\eta}} = \mathcal{I}_N \boldsymbol{\eta}$. Hence, from the above expression can be retrieved the bargaining power ratio ($\tilde{\boldsymbol{\lambda}}$) - and consequently the retailers' bargaining power ($\boldsymbol{\lambda}$), as well as the vector of manufacturers margins afterwards.

Beliefs Assessment

Given that it was known the willingness to sell an outlet, which in the future would suppose a change in the market structure, and create the incentives for taking advantage of the conjuncture by having a tougher bargaining approach to get better deals from the renegotiations; therefore, in the *Before M&A* period players would be forming beliefs regarding the bargaining approaches of their counterparties with the information they have available at that moment of the assessment, information that includes the bargaining power distribution in the *Before M&A* period.

In order to assess this process, expression (4) is applied, where $\tilde{\boldsymbol{\lambda}}$ is the above computed, and considering the manufacturers' and retailers' marginal costs ($\hat{\boldsymbol{c}}^{\boldsymbol{m}} + \hat{\boldsymbol{c}}^{\boldsymbol{r}}$), then similar to Klein and Rebolledo (2020a) we have the following specification[10]:

$$\boldsymbol{p} - \boldsymbol{\gamma} - (\mathcal{T}^m * D^j)^\dagger \left[\tilde{\boldsymbol{\lambda}} * \left[(\mathcal{T}^r * D^j)\boldsymbol{\gamma}\right]\right] = \hat{P}\boldsymbol{\kappa} + \check{\mathcal{E}}\tilde{\boldsymbol{\delta}} + \check{\mathcal{H}}\tilde{\boldsymbol{\theta}} + \sum_h \kappa_h \check{\mathcal{F}}_h \tilde{\boldsymbol{\delta}} + (\mathcal{G} + I)\hat{\boldsymbol{\eta}} \tag{11}$$

where $\mathcal{I}_N$ and $\hat{P}$ represent the same as before, while $\check{\mathcal{E}} = \mathcal{E}\mathcal{I}_N$, $\check{\mathcal{H}} = \mathcal{H}\mathcal{I}_N$, $\check{\mathcal{F}}_h = \mathcal{F}_h\mathcal{I}_N$; while $\mathcal{E}$, $\mathcal{H}$, $\mathcal{F}_h$ and $\mathcal{G}$ are the square matrices of dimension Z introduced by Klein and Rebolledo (2020a), where the general element of $\mathcal{E}$ is $\mathcal{E}[t,z] = (\mathcal{T}^m * D^j)^\dagger[t,z]\left(\sum_{k=1}^{Z} ts^m_{zk}(p_k - \gamma^r_k)\right)$, in which $ts^m_{zk} = (\mathcal{T}^m * (S^{Z^{mr}} - S^j))[z,k]$. Similarly $\mathcal{H}$ is an square matrix of dimension Z, which general element is $\mathcal{H}[t,z] = -(\mathcal{T}^m * D^j)^\dagger[t,z]y_z$ being y_z the element in position z of vector $\left[\left(\mathcal{T}^r * (S^{Z^{mr}} - S^j)\right)\boldsymbol{\gamma}\right]$. Additionally, the general element of $\mathcal{F}_h$ is $\mathcal{F}_h[t,z] = -(\mathcal{T}^m * D^j)^\dagger[t,z]\left(\sum_{k=1}^{Z} ts^m_{zk}P[k,h]\right)$, being ts^m_{zk} is the same as before. Finally the general element of $\mathcal{G}$ is $\mathcal{G}[t,z] = -\sum_{k=1}^{Z}(\mathcal{T}^m * D^j)^\dagger[z,k]\hat{\tilde{\delta}}_k ts^m_{kz}$, where $\hat{\tilde{\delta}}_k$ is the element k of vector $\hat{\tilde{\boldsymbol{\delta}}}$.

Through the above specification an assessment of bargainers' beliefs can be performed, values that will be used afterwards to estimate the new distribution of bargaining power after the clearance of the M&A operation.

[10]See Appendix C for more details on matrices $\mathcal{E}$, $\mathcal{H}$, $\mathcal{F}_h$ and $\mathcal{G}$

3.3.2 After the M&A Operation

Once the acquisition is cleared, the market have to adjust to this new structure, which will result in a redistribution of the bargaining power after the renegotiations of their contracts, renegotiations that would take place in an uncertain environment regarding the players bargaining approach, in particular towards disagreements, uncertainty present due to the incentives that bargainers could have to strategically take advantage of the conjuncture, by displaying a tough bargaining strategy.

It is worthy to stress, that in the analyzed context in the present work, bargainers have no other option than to face the renegotiations under this uncertain conditions, given that the uncertainty arises from a event that already took place in the market and facing these renegotiations - and the inherent uncertainty from this situation- is an inevitable consequence; in contrast to the situation analyzed by Klein and Rebolledo (2020a), which given the source of the uncertainty was in the future and was temporary, market players had the option of delaying negotiations until the uncertainty disappears to then reach an agreement under certainty conditions, being then needed to check the incentive condition proposed by Chun and Thomson (1990a,b,c).

In this way, the assessment of the disagreement profits become a key point in this new environment, where the previously assessed beliefs allow players to be better prepared for renegotiations.

In this multi-product and multi-store bargaining environment developed under uncertainty, the model presented in section 2 is applied to estimate the new distribution of bargaining power. Given that bargainers formerly assessed their beliefs of such a bargaining situation (the ones computed in section 3.3.1), then from equation (4) the manufacturer margin can be expressed as[11]: $\hat{\mathbf{\Gamma}} = Y\hat{\tilde{\boldsymbol{\lambda}}}$; where Y is an squared matrix of dimension Z which general element is $Y[t,z] = q_z\left((\mathcal{T}^m * D^j) - \mathcal{X}\right)^{\dagger}[t,z]$, in which q_z is the element in position z of vector $\left((\mathcal{T}^r * D^j)\boldsymbol{\gamma} - \hat{\tilde{\boldsymbol{\theta}}} * \left((\mathcal{T}^r * (S^{Z^{mr}} - S^j))\,\boldsymbol{\gamma}\right)\right)$. Afterwards, by implementing the distribution of marginal costs as before ($\hat{\boldsymbol{c}}^{\boldsymbol{r}} + \hat{\boldsymbol{c}}^{\boldsymbol{m}} = \mathcal{I}_N P\boldsymbol{\kappa} + \mathcal{I}_N\boldsymbol{\eta}$), then we get the following specification:

$$\boldsymbol{p} - \boldsymbol{\gamma} = \check{Y}\tilde{\boldsymbol{\lambda}} + \hat{P}\boldsymbol{\kappa} + \mathcal{I}_N\boldsymbol{\eta} \tag{12}$$

where $\check{Y} = Y\mathcal{I}_N$. Finally, we compute the new bargaining power distribution and surplus division among bargainers.

[11] See Appendix D for more details on equation (12)

4 Data and Results

4.1 Data

The consumer dataset used for the estimation of the product demand in each period came from the GFK Panelservice SE, which consists in a household-level scanner data of the yogurt purchases for the German market. Given that the M&A operation under analysis was announced for the first time in November 2007, the before M&A period considered in this analysis corresponded to the months from November 2006 to Octuber 2007; and taking into account the clearance of this operation took place by the end of 2008, the time frame for the after M&A period used was from January to December 2009. The information available through this source consisted on purchased quantities, amount paid, characteristic of the purchased product, such as outlet where it was bought, the retail firm to which the outlet belong, the brand of the product, the manufacturer, the date of the purchase, and if the purchase were done under any promotion. Additionally, through the description of purchased product that was also available, further characteristics, such if the product was organic or probiotic, were determined. Aside from product information, the dataset also provided general information on the household, such as their monthly net income, which was also considered in the demand estimation.

The before M&A period consisted of 680595 observations of yogurt purchases, while 947613 were the observations for the after period; from which 0.54% from the before and 0.49% from the after M&A period observations consisted of purchases done in wholesalers; given that the aim is to estimate the final consumer demands, those observations were not considered in the estimations.

As mentioned before, this work considers a multi-outlet environment, distinguishing therefore between outlets/stores and the retail firm as a whole. For instance, a retail firm called ABC-Group owns different "brands" of outlets, among them: Super, Discount, ABC-Center, etc; each of them would be considered as a different outlet/store from which the consumer can choose. However, the nonprevalent outlet "brands" within the same retail firm were grouped according to their kind of format[12], distinguishing three main kind of formats: supermakets, discounter and hypermarkets. This distintion gives flexibility to the outlet-acquisition analysis, given it allows to consider the inherent shift of owner of the acquired outlet. A multi-store retail firm environment has been

[12]The outlet "brands" that were considered as "prevalent" were the ones that in average had at least 1200 monthly observations.

considered by Aguirregabiria and Vicentini (2016), to analyze competition in the retail industry.

Even though, the final purpose of the analyzed acquisition was to merge the acquired outlet with the discounter brand belonged to the acquisitor firm, given the considered time frames, for which the negotiations regarding the potential adquisition were taking place (before M&A period) and transition to final merged outlet was taking place (after M&A period), both outlet brands coexisted in the market during both period of analysis. Therefore, for both periods both outlet brands are kept separate but with a common owner in the after M&A period. Given the aiming of this work is to incorpore the uncertainty factor of a M&A operation in the negotiations between manufacturers and retailers and its potential influence in the bargaining power distribution among market players, this consideration is without a loss of generality.

Similarly to the distintion made among outlet brands, each yogurt manufacturer in their portfolio of products could have more than one brand; in this way, the brands that were not prevalent were grouped within manufacturer[13], distinguishing them by level of fat, having three different levels of fat: low fat for yogurts with less than 1.8% of fat, normal fat for yogurts with fat levels between 1.9% and 9.9%, and high fat for yogurts with at least 10% of fat.[14].

It was considered that a consumer alternative was the result from the combination between an outlet brand and a yogurt brand, and the alternatives with a nonprevalent presence in the dataset were considered as the outside option[15].

In this way, the final dataset consisted of 38 brands, 13 outlet brands, resulting in 73 alternatives including the outside option. A brief distribution of the observations by type of products and periods can be observed in Table 2, further descriptive statistics can be found in Table 5 in Appendix E.

[13]The brands that were considered as "prevalent" were the ones that in average had at least 1200 monthly observations in both periods.

[14]See Table 4 in Appendix E for a description of the variables.

[15]Alternatives with an average monthly presence for both periods of less than 1500 observations, were included in the outside option.

Table 2: Descriptive Statistics by Period

Type of Brand	Before M&A		After M&A	
	Obs.	(%)	Obs.	(%)
Conventional	151377	22.36%	219534	23.28%
Private Labels	295341	43.63%	411805	43.67%
Outside Option	230227	34.01%	311646	33.05%
Total	676945		942985	

Additionally, for the demand estimation was also considered the influence of yogurt input costs, for this matter data on the german monthly raw-milk prices was used, which came from the German Federal Ministry of Food and Agriculture [16].

4.2 Results

As mentioned in section 3, the demand estimation is the first step to performed the analysis on bargaining power and uncertainties under a market structure change environment. In section 3.1 was described the yogurt demand determination strategy, consisting in the implementation of a random coefficient logit model, to estimate the consumer choice process described in equation (5); in which, the consumer decision on buying alternative j dependents on the price of the product as well as on other characteristics of the alternative. The characteristics considered were the product fat level, and if the product was bought under a promotion, other products characteristics were included as indicator variables, which considered if the alternative was a private label, if the retailer outlet in which the product was offered was a discounter, if the alternative was labeled as *organic*/*bio*, or as a *probiotic* product.

From the dataset described in section 4.1, a sample of 100000 observations for each period was randomly selected. It is assumed that purchases are independent of each other, i.e. each purchase was a result of an independent choice process. Notice that in order to consider decision making process that the consumer undergoes in each of its purchases, the model assumes that the consumer rejected all other alternatives when choosing alternative j. In this way, for each purchase all other

[16]See Table 4 in Appendix E for more information on the sources.

rejected alternatives are included in the dataset, for which the values of the variables considered in the regression corresponded to the monthly mean[17], while the dependent variable was zero, given they were not chosen.

Given the influence that inputs costs could have on the final product prices, and to prevent from potential endogeneity problems, the demand estimation was performed in a two-stage process. In the first stage, a control function was implemented, as suggested by Petrin and Train (2010), estimating the impact of the production costs over the yogurt-alternatives mean monthly prices, following the specification below:

$$\overline{p}_{jt} = \sum_{c \in \mathcal{C}} \tau^c c + \psi p_{jt}^m + v_{jt} \tag{13}$$

where τ^c gathers the time invariant effect on the mean monthly price of the yogurt alternative $(\overline{p}_{jt})$[18] of the characteristic c of the yogurt alternative, for all product characteristic $c \in \mathcal{C}$; the characteristics considered were the same included in the estimation of the demand. While $\boldsymbol{\psi}$ captures the effect of the input prices represented by p_{jt}^m, in this case the input price considered was the monthly raw-milk price lagged three months [19]. For more information on the variable raw-milk, see Appendix E., and v_{jt} represents the random shock of the regression. The results from this regression can be found at Table 6 in Appendix F.

Afterwards, the residuals of the first-stage estimation $(\hat{v}_{jt})$ were used in the second-stage as a control variable at the demand estimation. To control the influence of demographic effects on the decision making, several interactions between the product characteristic and the net monthly

[17]The price of the included alternatives corresponded to the mean monthly "normal" price of the alternative (mean monthly price of the alternative without any promotion). While in the case of indicator variables, such as promotion, organic, and probiotic, the monthly mean was considered, given these variables were either 1 or 0, the mean would control how likely these alternatives presented such charateristics during the month. For indicator variables, such as private label, discounter, brand, and outlet brand, given that those characteristics are inherent to the alternative, they were either 1 or 0 depending the case. Finally, for the included alternatives the size level considered was the result from the classification of the mean monthly size in the categories described in Table 4.

[18]The monthly price considered was the mean monthly price of the yogurt alternative when having no promotion.

[19]Several attempts were done with other inputs costs and lags, e.g. sugar prices, oil prices, steel prices, etc; however, the raw-milk price lagged three months was the one that proved not being a weak instrument in any of both periods, as can be observed at the F-value at Table 6, at Appendix E, is above the threshold suggested by Staiger and Stock (1997) for the rejection of a weak instrument hipothesis.

income of the household were included in the regression. The results from the demand estimation of both periods can be found at Table 7 in Appendix F.

As expected in both periods the price has a negative significant effect on the likelihood of choosing to buy a product. Also, the inclusion of an instrument to control for the potential endogeneity coming from the inputs prices are observed to be significant and positive. Characteristics such as fat level, that the product is a private label, that the product is labeled as *organic* or *probiotic* have significant effects and are consistent in both periods. On the other hand, that the alternative belongs to a discounter is observed to have a significant effect but this effect changes from negative to positive from one period to the other, relating this change with the accentuated negative effect of the price in the after period, this could hint us that the demand became more price sensitive after the M&A operation.

Once having the demand results, the elasticities were computed through the marginal effects obtained by the simulation process suggested by Cameron and Trivedi (2010)[20]. The mean own-price elasticities by manufacturer and retailer can be found at columns (1) and (7) of Table 8 in Appendix G. By comparing the results of the elasticities in the before and after periods, we can observe that the values increase in absolute terms, i.e. after the M&A operation consumers became more sensitive to the price, as it was already hinted by the demand results as mentioned above.

After having the marginal effects, and by following the process described in section 3.2, the retailers margins are computed for each period. At columns (2) and (8) of Table 8 in G are the mean retailer margins by manufacturer and retailer, and as can be observed the mean retailer margin slightly decreases for almost all retailers, except for two of them that kept their margin in the period after, it is worthy to mention that these retailers were not part of the M&A operation; when comparing the retailers margin by manufacturer, it can be seen a similar picture, in most cases there is a slight decrease of the retailers margin after the M&A operation, being able to keep their margin with three manufacturers, while with two of them their margin increased after the M&A operation. However, these changes in the retailer margin were not much remarkable, given that the overall average kept the same in both periods.

Then, and focusing on the before M&A period, the bargaining parameter is estimated following the model in equation (10). Notice that the bargaining power is estimated by negotiation, and not

[20]For more details see Cameron and Trivedi p. 353

by alternative, being a negotiaton between a manufacturer and a retailer over a particular brand and regardless in which outlets - *outlet brands* belonging to the retailer - this product is placed once the negotiation is sucessful. In this way, and as mentioned before, there were 60 negotiations (excluding the outside option). It is worthy to highlight, and as mentioned in section 3.3.1, in the before M&A period the negotiations are assumed to be held under no uncertainty regarding the negotiation strategy of the players, given that the observations coming from this period are likely to be the result from former negotiations were the rumors of the potential M&A operation were not yet well spread, or still being a not concrete possibility in order to trascend to the negotiation table.

Also, in the estimation of λ was assumed that in the negotiations between the two main German discounters and the manufacturers of their private labels, the discounters have full bargaining power ($\lambda = 1$), this assumption is made due the prevalence of these two discounters in the German market, the fact that private labels (brands) are owned by the retailer, and the importance of these labels in their offered portfolio of products.

In this way, equation (10) was estimated through a NLS, taking into account that each coefficient is $\tilde{\lambda}_j = \dfrac{1-\lambda_j}{\lambda_j}$ and given $\lambda_j \in [0,1]$ then the estimation of λ_j was constrained within these boundaries through a logistic function, also the input cost considerate was the raw milk price lagged three months but adjusted by the mean level of fat of the alternative[21], the mean results from this estimation can be found in column (4) of Table 8 in Appendix G. Once the bargaining power distribution was estimated, an recalling that $\hat{\boldsymbol{\Gamma}} = \boldsymbol{C}\hat{\tilde{\boldsymbol{\lambda}}}$, as shown in Appendix B, which is equivalent to $\boldsymbol{\Gamma} = \mathcal{I}_N^{\dagger}\check{\boldsymbol{C}}\tilde{\boldsymbol{\lambda}}$, where $\mathcal{I}_N^{\dagger}$ is the Moore-Penrose inverse of matrix $\mathcal{I}_N$; the manufacturer margin was computed, the mean results of the these margins for the before M&A period can be found at column (3) of Table 8 in Appendix G.

As mentioned, once the rumor of a potential M&A operation in the market, and given that this implies renegotiations of contracts, players may try to assess beforehand their upcoming bargaining environment when the M&A operation is already set. And given that the information they have available for this assessment is the one gathered until that moment, they would have to form their beliefs on the potential bargaining situation through their current information.

In order to simulate this process, the belief assessment model presented in section 3.3 is performed, through equation (11). Given that players would assess their beliefs with their current

[21]Interaction term between raw milk price and fat level.

information, which includes the bargaining power distribution, then the bargaining power estimated before are the one applied in equation (11). Notice that, if between retailers and manufacturers was already traded just one yogurt-brand, then there will be no uncertainty on the upcoming bargaining scenario, given that there would be no potential retaliation through the other brands negotiated within the bilateral comercial relationship if negotiations are not succesful, giving as a result that the corresponding row in matrix $(S^{Z^{mr}} - S^{j})$ is zero, and therefore for these cases the corresponding columns in matrices $\check{\mathcal{E}}$, $\check{\mathcal{H}}$ and $\check{\mathcal{F}}_h$ are also zero; being not needed to include these variables in the estimation, and being zero the beliefs on a retaliation - either for the manufacturer $(1-\delta)$ or the retailer $(1-\theta)$. Also to perform this estimation, and given that it would be assumed that the M&A operation is happening at the current moment, then the retailer ownership matrix $(\mathcal{T}^r)$ should already assume that the acquiree (outlet-brand) belongs to the acquirer (retailer), the same assumption should be made when computing matrices $S^{Z^{rm}}$ and S^{j}. Also a different retailer margin was recomputed under this assumption (γ) for the estimation of the beliefs.

In this way, equation (11) was performed through a NLS estimation, and taking into account that both beliefs are bounded between 0 and 1, the estimation of $(1-\theta)$ and $(1-\delta)$ was constrained within these boundaries through a logistic function. In this estimation was also considered as input cost the raw-milk prices lagged three months and adjusted by the mean level of fat of the alternative. The mean results from this estimation can be observed at Table 8 columns (5) and (6) in Appendix G.

As can be seen, in the before period the retailers margins are lower than the manufacturers for almost all manufacturers of conventional brands but for one; which can also be observed by analyzing the retailers bargaining power, which is lower than 0.5 for all manufacturers of conventional brands except one, i.e. manufacturers conventional brands seem to have a better bargaining position against retailers in the before period. By analyzing the beliefs assessment, it suggests that manufacturers would have a higher expectation on a retaliation than retailers in case of disagreement in negotiations if the M&A operation takes place; which could result in a manufacturers' defensive bargaining position in future negotiations in order to not lose their margins, and in a potential better assessment of their disagreement profit that allow them to evaluate better the offers at the negotiations.

Moving on to the after period, the analysis of bargaining position and manufacturers margins took place under two different assumptions: 1) market players are farsighted and assessed their possible bargaining situation beforehand in order to face their future renegotiations better prepared, i.e. they face the renegotiations with formed beliefs coming from the before M&A period; or, 2) market players trust their negotiation counterparties and have no suspicion on their reaction when facing dissagreement, i.e. no uncertainty assumption.

The estimation of the manufacturers margin and bargaining power under the first assumption were performed by following the proposed model in section 3.3.2, and using the estimated beliefs in the period before the M&A operation. Again as input cost it was used the raw-milk price lagged three months and adjusted by the level of fat of the alternative. And by performing and NLS estimation of equation (12) and taking in consideration the boundaries of λ by applying a logistic function, the bargaining power distribution under the first assumption was done. Then, the manufacturer margin was computed taking into account that $\hat{\boldsymbol{\Gamma}} = Y\hat{\tilde{\boldsymbol{\lambda}}}$, as shown in Appendix D, i.e. $\boldsymbol{\Gamma} = \mathcal{J}_N^{\dagger}\check{Y}\tilde{\boldsymbol{\lambda}}$. The mean results from the estimation of the retailers bargaining power and manufacturer margin under the first assumption can be observed at columns (10) and (9) of Table 8 respectively in Appendix G.[22]

On the other hand, and given the second assumption of no uncertainty regarding the reaction of the counterparty toward disagreement, then the negotiation would develop just as in the before M&A period; and therefore, the estimation of the bargaining distribution and manufacturers margin under this setting follows the model presented in section 3.3.1. In this estimation it was also used the raw-milk price lagged three months and adjusted by level of fat as a input cost, and the λ estimation considered the boundaries of this parameter by using a logistic function on the coefficients when performing equation (10) through a NLS estimation. The mean results of the estimated bargaining power distribution and the manufacturers margin can be found at columns (12) and (11) of Table 8 in Appendix G.[23]

From the results it can be observed that in most cases conventional brands continue to have a higher take in the margin distribution of this period regardless the model used (MM > RM). However, when comparing the results of both models regarding the distribution of bargaining power with the results of the before period, it can be observed that on average the changes coming from the

[22]This estimation kept the assumption that the retailer bargaining power for the negotiations belonging to the two main discounters against the manufacturers of their private labels was one.

[23]This estimation kept the assumption that the retailer bargaining power for the negotiations belonging to the two main discounters against the manufacturers of their private labels was one.

model assuming no uncertainty are larger than the ones from the proposed model, and in particular for the case of conventional brands; as can be also observed in Table 3 in a general manner.

Table 3: Bargaining power and margin Distribution by Type of Brand

Type of Brand	Before M&A					After M&A				
	RM	MM	λ	$(1-\delta)$	$(1-\theta)$	RM	MM	λ	MMc	λ_c
Conventional	0.04	0.10	0.37	0.10	0.02	0.03	0.11	0.29	0.13	0.24
PL	0.05	0.02	0.70	0.16	0.04	0.04	0.02	0.67	0.02	0.68
Mean	0.04	0.07	0.49	0.12	0.03	0.04	0.08	0.43	0.09	0.40

PL: Private Label, **RM:** Retailer Margin, **MM:** Manufacturer Margin, **$\boldsymbol{\lambda}$:** Retailer Bargaining Power, **MMc:** Manufacturer margin under certainty assumption, **$\boldsymbol{\lambda_C}$:** Retailer Bargaining Power under certainty assumption.

Comparing the results by retailer from both models, it is observed a generalized decrease of retailers bargaining power coming from the estimation assuming no uncertainty, which may not be an expected outcome considering the retailer market was getting more concentrated. On the contrary, and even though for most retailers a loss in bargaining power is suggested, the results from the proposed model including uncertainty, this reduction is milder than under the previous assumption, being there even a retailer which is in a better bargaining position after the M&A operation; although this retailer is not part of the mentioned transaction. This comparison could suggest that not including this kind of expectations - that such an operation creates in a market with multi-product and multi-bargaining bilateral relationships- may overlook the potential preparation that players may be doing in order to face a new bargaining environment, and therefore, may misestimate the bargaining redistribution among players.

On the other hand, and even though both assumptions estimate that the retailer bargaining power decrease even for the merging firm, which may seem as counterintuitive considering the increase in market concentration and relative size of the firms[24]; this outcome may be related to the literature of *pivotal buyers*. According to Raskovich (2003), once a buyer becomes pivotal to his supplier, his decision of buying takes a decisive role in the supplier output, given that now the pivotal

[24]i.e. this result hold regardless of the assumption of uncertainty done, in both models the bargaining power of the acquirer firm displayed a decreased, but being the decrement more prominent under the assumption of no uncertainty.

buyer would be covering most of production costs; and in this way, cross-subsidizing nonpivotal firms, hence decreasing the bargaining position of the pivotal firm. However, the theoretical literature has split opinions on the consequences of becoming pivotal on bargaining power, Adilov and Alexander (2006), argues that despite of the increase of the pivotal firms' contribution on suppliers' production costs, the bargaining position of a newly-merged pivotal firm may improve if there are asymmetries in bargaining power. In this way, the results of the present work may contribute to continue the discussion on this matter.

Finally, and even though the difference from the results of both models, in average and most cases, may appear mild, this far from being a weakness, it may constitute an strength of the model, given that contributes to the discussion of bargaining power distribution by presenting a model that estimate a smoother transition than the current used model, and it is adding in the analysis of bargaining solutions the learning process of players from their interactions, in particular regarding the expectations they develop of their counterparties; which contributes to dynamize the analysis of margin redistribution in this kind of changing and inevitable bargaining environments.

5 Conclusion

The present paper proposed a method to incorporate uncertainty regarding bargaining strategies in vertical relationships into the analysis of bargaining power distribution when there are changes of market structure that increase the market concentration, such as M&A operations; and how these uncertainties may become the catalyst to the bargaining power redistribution in the commercial relationships, giving an intertemporal nuance to the empirical analysis of bargaining power distribution.

In this document is analyzed vertical relationships in which a party of a commercial relationship exchange a portfolio of products that afterwards are resold through different outlets belonging to the buyer of the commercial relationship, such as in the retail industry; including, in this way, a multi-outlet environment which exists in different industries, giving flexibility to the model to consider M&A operations of outlets among competitors.

Horizontal M&A operations constitute a change in the market structure that decrease the number of potential buyers to the upstream firms (suppliers), and this decrease of buyers may appear as a potential strategic opportunity that players may want to capitalize in their favor in renegotiations once the M&A operation is set by displaying tougher bargaining approaches; potential threat their counterparties may be willing to assess beforehand to prepare themselves better for those possible future negotiations, in order to not lose in the margin distribution game, forming beliefs on the potential bargaining scenarios they may face.

The proposed model includes this market-player willigness to be prepared, by performing a beforehand assessment of the beliefs of the negotiation scenarios that may be applied afterwards once the M&A operation took place and renegotiations are ongoing, and compare the redistributions of bargaining power resulting from this setting against the results of a shortsighted negotiation environment, in which players do not prepare themselves for future negotiations and face them with no suspicion over their counterparties predisposition regarding a disagreement.

Even though, for the case analyzed, both models estimated in most cases a margin distribution in favor of suppliers after the M&A operation, in particular for suppliers of conventional brands, the size of this change is less prominent with the proposed model including uncertainties. At the same time, the results from the proposed model on the bargaining power redistribution even display that there are retailers increasing their bargaining position after the M&A operation, which does not happen with the model without uncertaint. Even though this increase in retailers bargaining position was not from the merging firms, these outcome may find an explanation on the literature of pivotal buyers, contributing, therefore, to the discussion on this matter.

The present work contributes to the empirical assessment of bargaining power outcomes by considering other factors that may lead the bargaining power redistribution, as the farsighted predisposition of the market players, and open the discussion on what leads the intertemporal bargaining power changes, as well as discuss the learning process of players regarding their interactions with theirs counterparties.

A Alternative Formation and Game representation

Figure 1: Alternative Negotiation

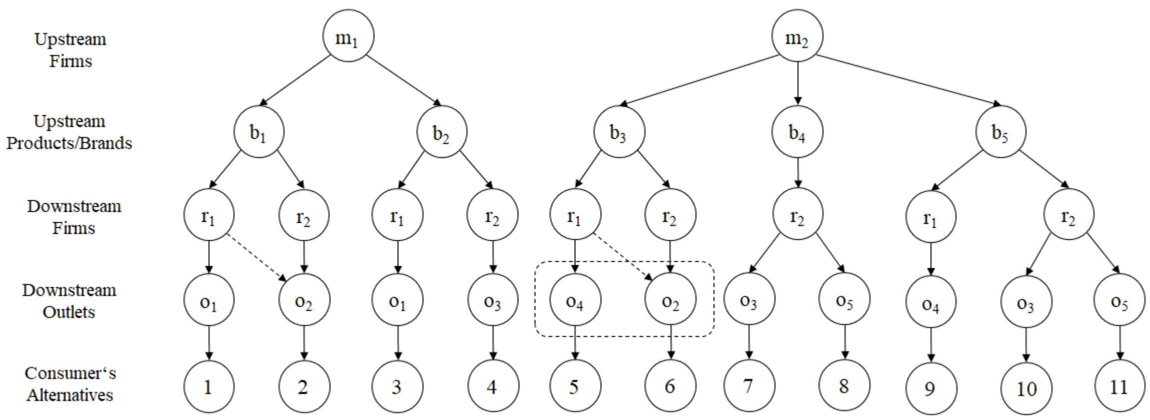
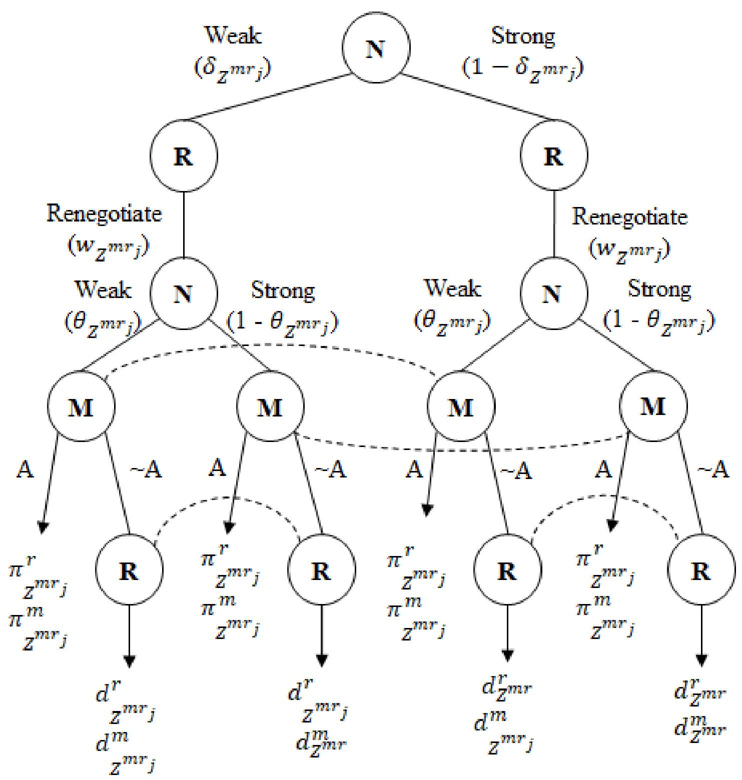


Figure 2: Game representation



B Matrix C in section 3.3.1

As presented in section 3.3.1 the manufacturers margin vector in a uncertainty free scenario can be expressed as follows:

$$\hat{\boldsymbol{\Gamma}} = (\mathcal{T}^m * D^j)^\dagger \left(\hat{\hat{\boldsymbol{\lambda}}} * \left((\mathcal{T}^r * D^j)\boldsymbol{\gamma}\right)\right)$$

where $(\mathcal{T}^m * D^j)^\dagger$ represents the Moore-Penrose inverse of matrix $(\mathcal{T}^m * D^j)$. In this way, the vector of manufacturers' margins can be expressed as $\hat{\boldsymbol{\Gamma}} = C\hat{\hat{\boldsymbol{\lambda}}}$, where C is an square matrix of dimension Z which general element is $C[t,z] = (\mathcal{T}^m * D^j)^\dagger[t,z]b_z$, where b_z is the element at position z of vector $(\mathcal{T}^r * D^j)\boldsymbol{\gamma}$, while $\hat{\hat{\boldsymbol{\lambda}}}$ and $\hat{\boldsymbol{\Gamma}}$ represent the same as in section 2.

Proof. By denoting the vector $(\mathcal{T}^r * D^j)\boldsymbol{\gamma}$ as $\boldsymbol{b}$, and its general element as $\boldsymbol{b}[t,1] = b_t$. Similarly, denoting just for the purpose of this proof the general element of matrix $(\mathcal{T}^m * D^j)^\dagger[t,z] = a_{tz}$, then:

$$\begin{aligned}
\hat{\boldsymbol{\Gamma}} &= (\mathcal{T}^m * D^j)^\dagger \left(\hat{\hat{\boldsymbol{\lambda}}} * \left((\mathcal{T}^r * D^j)\boldsymbol{\gamma}\right)\right) \\
\hat{\boldsymbol{\Gamma}} &= (\mathcal{T}^m * D^j)^\dagger (\hat{\hat{\boldsymbol{\lambda}}} * \boldsymbol{b}) \\
\hat{\boldsymbol{\Gamma}} &= \begin{pmatrix} a_{11} & \cdots & a_{1Z} \\ \vdots & \ddots & \vdots \\ a_{Z1} & \cdots & a_{ZZ} \end{pmatrix} \begin{pmatrix} \hat{\hat{\lambda}}_1 b_1 \\ \vdots \\ \hat{\hat{\lambda}}_Z b_Z \end{pmatrix} \\
\hat{\boldsymbol{\Gamma}} &= \begin{pmatrix} a_{11} b_1 \hat{\hat{\lambda}}_1 + \cdots + a_{1Z} b_Z \hat{\hat{\lambda}}_Z \\ \vdots \\ a_{Z1} b_1 \hat{\hat{\lambda}}_1 + \cdots + a_{ZZ} b_Z \hat{\hat{\lambda}}_Z \end{pmatrix} \\
\hat{\boldsymbol{\Gamma}} &= \begin{pmatrix} a_{11} b_1 & \cdots & a_{1Z} b_Z \\ \vdots & \ddots & \vdots \\ a_{Z1} b_1 & \cdots & a_{ZZ} b_Z \end{pmatrix} \begin{pmatrix} \hat{\hat{\lambda}}_1 \\ \vdots \\ \hat{\hat{\lambda}}_Z \end{pmatrix} \\
\hat{\boldsymbol{\Gamma}} &= C\hat{\hat{\boldsymbol{\lambda}}}
\end{aligned}$$

□

C Matrices $\mathcal{E}$, $\mathcal{H}$, $\mathcal{F}_h$, and $\mathcal{G}$ in section 3.3.1

Following Klein and Rebolledo (2020a), and recalling that $\hat{\mathbf{\Gamma}} = \boldsymbol{p} - \boldsymbol{\gamma} - (\hat{\boldsymbol{c}}^m + \hat{\boldsymbol{c}}^r)$ and after applying the distribution of the manufacturer's and retailer's marginal costs ($\boldsymbol{c^m} + \boldsymbol{c^r} = P\boldsymbol{\kappa} + \boldsymbol{\eta}$), then equation (4) can be expressed as follows:

$$\begin{aligned} \boldsymbol{p} - \boldsymbol{\gamma} - (\mathcal{T}^m * D^j)^\dagger \left[\hat{\tilde{\boldsymbol{\lambda}}} * \left[(\mathcal{T}^r * D^j)\boldsymbol{\gamma}\right]\right] = {} & \hat{P}\boldsymbol{\kappa} + (\mathcal{T}^m * D^j)^\dagger \left[\hat{\tilde{\boldsymbol{\delta}}} * ((\mathcal{T}^m * (S^{Z^{mr}} - S^j))(\boldsymbol{p} - \boldsymbol{\gamma}))\right] \\ & - (\mathcal{T}^m * D^j)^\dagger \left[\hat{\tilde{\boldsymbol{\delta}}} * ((\mathcal{T}^m * (S^{Z^{mr}} - S^j))\hat{P}\boldsymbol{\kappa})\right] \\ & - (\mathcal{T}^m * D^j)^\dagger \left[\hat{\tilde{\boldsymbol{\theta}}} * \hat{\tilde{\boldsymbol{\lambda}}} * ((\mathcal{T}^r * (S^{Z^{mr}} - S^j))\boldsymbol{\gamma})\right] \\ & - (\mathcal{T}^m * D^j)^\dagger \left[\hat{\tilde{\boldsymbol{\delta}}} * ((\mathcal{T}^m * (S^{Z^{mr}} - S^j))\hat{\boldsymbol{\eta}})\right] + \hat{\boldsymbol{\eta}} \end{aligned} \tag{14}$$

where $(\mathcal{T}^m * D^j)^\dagger$ represents the Moore-Penrose inverse matrix of $(\mathcal{T}^m * D^j)$.

Proof. Notice that equation (4) can be expressed as follows:

$$\begin{aligned} \hat{\mathbf{\Gamma}} - (\mathcal{T}^m * D^j)^\dagger \left[\hat{\tilde{\boldsymbol{\lambda}}} * (\mathcal{T}^r * D^j)\boldsymbol{\gamma}\right] = {} & (\mathcal{T}^m * D^j)^\dagger \left[\hat{\tilde{\boldsymbol{\delta}}} * \left[(\mathcal{T}^m * (S^{Z^{mr}} - S^j))\hat{\mathbf{\Gamma}}\right]\right] \\ & - (\mathcal{T}^m * D^j)^\dagger \left[\hat{\tilde{\boldsymbol{\lambda}}} * \hat{\tilde{\boldsymbol{\theta}}} * ((\mathcal{T}^r * (S^{Z^{mr}} - S^j))\boldsymbol{\gamma})\right] \end{aligned}$$

and by applying the distribution of the marginal costs and recalling that $\hat{\mathbf{\Gamma}} = \boldsymbol{p} - \boldsymbol{\gamma} - (\hat{\boldsymbol{c}}^m + \hat{\boldsymbol{c}}^r)$, then equation (14) will be resulted. □

By solving the second term of the right-hand side of equation (14), that term can be rephrased as $\check{E}\tilde{\boldsymbol{\delta}}$, where $\check{E} = \mathcal{E}\mathcal{I}_N$ being $\mathcal{E}$ an square matrix of dimension Z which general element is $\mathcal{E}[t, z] = (\mathcal{T}^m * D^j)^\dagger[t, z] \left(\sum_{k=1}^{Z} ts^m_{zk}(p_k - \gamma^r_k)\right)$ in which ts^m_{zk} is the element in position $[z, k]$ of matrix $(\mathcal{T}^m * (S^{Z^{mr}} - S^j)$.

Proof. Denoting the general element of matrix $(\mathcal{T}^m * (S^{Z^{mr}} - S^j))[t, z] = ts^m_{tz}$; and for the purpose of this proof, the element of matrix $(\mathcal{T}^m * D^j)^\dagger$ in position $[t, z]$ is defined as a_{tz}, while the element in position t of vector $(\boldsymbol{p} - \boldsymbol{\gamma})$ as p^γ_t. In this way, the second term of the right-hand side of equation (14) can be simplified as follows:

$$
\begin{aligned}
&(\mathfrak{T}^m * D^j)^\dagger \left[\hat{\tilde{\boldsymbol{\delta}}} * ((\mathfrak{T}^m * (S^{Z^{mr}} - S^j))(\boldsymbol{p} - \boldsymbol{\gamma}))\right] = \\
= &\begin{pmatrix} a_{11} & \dots & a_{1Z} \\ \vdots & \ddots & \vdots \\ a_{Z1} & \dots & a_{ZZ} \end{pmatrix} \left[\begin{pmatrix} \hat{\tilde{\delta}}_1 \\ \vdots \\ \hat{\tilde{\delta}}_Z \end{pmatrix} * \left(\begin{pmatrix} ts^m_{11} & \dots & ts^m_{1Z} \\ \vdots & \ddots & \vdots \\ ts^m_{Z1} & \dots & ts^m_{ZZ} \end{pmatrix} \begin{pmatrix} p^\gamma_1 \\ \vdots \\ p^\gamma_Z \end{pmatrix} \right) \right] \\
= &\begin{pmatrix} a_{11}\hat{\tilde{\delta}}_1(ts^m_{11}(p^\gamma_1) + \dots + ts^m_{1Z}(p^\gamma_Z)) + \dots + a_{1Z}\hat{\tilde{\delta}}_Z(ts^m_{Z1}(p^\gamma_1) + \dots + ts^m_{ZZ}(p^\gamma_Z)) \\ \vdots \\ a_{Z1}\hat{\tilde{\delta}}_1(ts^m_{11}(p^\gamma_1) + \dots + ts^m_{1Z}(p^\gamma_Z)) + \dots + a_{ZZ}\hat{\tilde{\delta}}_Z(ts^m_{Z1}(p^\gamma_1) + \dots + ts^m_{ZZ}(p^\gamma_Z)) \end{pmatrix} \\
= &\begin{pmatrix} a_{11}(ts^m_{11}(p^\gamma_1) + \dots + ts^m_{1Z}(p^\gamma_J)) & \cdots & a_{1Z}(ts^m_{Z1}(p^\gamma_1) + \dots + ts^m_{ZZ}(p^\gamma_Z)) \\ \vdots & \ddots & \vdots \\ a_{Z1}(ts^m_{11}(p^\gamma_1) + \dots + ts^m_{1Z}(p^\gamma_Z)) & \cdots & a_{ZZ}(ts^m_{Z1}(p^\gamma_1) + \dots + ts^m_{ZZ}(p^\gamma_Z)) \end{pmatrix} \begin{pmatrix} \hat{\tilde{\delta}}_1 \\ \vdots \\ \hat{\tilde{\delta}}_Z \end{pmatrix} \\
= &\begin{pmatrix} a_{11}\sum_{k=1}^Z ts^m_{1k}(p^\gamma_k) & \cdots & a_{1Z}\sum_{k=1}^Z ts^m_{Zk}(p^\gamma_k) \\ \vdots & \ddots & \vdots \\ a_{Z1}\sum_{k=1}^Z ts^m_{1k}(p^\gamma_k) & \cdots & a_{ZZ}\sum_{k=1}^Z ts^m_{Zk}(p^\gamma_k) \end{pmatrix} \begin{pmatrix} \hat{\tilde{\delta}}_1 \\ \vdots \\ \hat{\tilde{\delta}}_Z \end{pmatrix} \\
= &\,\mathcal{E}\hat{\tilde{\boldsymbol{\delta}}} \\
= &\,\mathcal{E}\mathfrak{I}_N\tilde{\boldsymbol{\delta}} \\
= &\,\check{\mathcal{E}}\tilde{\boldsymbol{\delta}}
\end{aligned}
$$

□

Simplifying the third term of the right-hand side of equation (14) in a similar way as the second, then this term $-(\mathfrak{T}^m * D^j)^\dagger \left[\hat{\tilde{\boldsymbol{\delta}}} * ((\mathfrak{T}^m * (S^{Z^{mr}} - S^j))\hat{P}\boldsymbol{\kappa})\right]$ can be expressed as $\sum_h \kappa_h \check{\mathcal{F}}_h \tilde{\boldsymbol{\delta}}$, where κ_h is the element in position h of vector $\boldsymbol{\kappa}$, while $\check{\mathcal{F}}_h = \mathcal{F}_h \mathfrak{I}_N$ where $\mathcal{F}_h$ is an square matrix of dimension Z which general element is $\mathcal{F}_h[t,z] = -(\mathfrak{T}^m * D^j)^\dagger[t,z](\sum_{k=1}^Z ts^m_{zk}\hat{P}[k,h])$, being ts^m_{zk} the element in position $[z,k]$ of matrix $(\mathfrak{T}^m * (S^{Z^{mr}} - S^j))$.

Proof. Denoting again as a_{tz} the element in position $[t,z]$ of matrix $(\mathfrak{T}^m * D^j)^\dagger$, likewise the element in position $[t,h]$ of matrix $\hat{P}[t,h] = \hat{p}_{th}$. Then, the third term of equation (14) can be reformulated as:

$$
\begin{aligned}
&-(\mathcal{T}^m * D^j)^\dagger \left[\hat{\tilde{\boldsymbol{\delta}}} * ((\mathcal{T}^m * (S^{Z^{mr}} - S^j))\hat{P}\boldsymbol{\kappa})\right] = \\
= \;& -\begin{pmatrix} a_{11} & \cdots & a_{1Z} \\ \vdots & \ddots & \vdots \\ a_{Z1} & \cdots & a_{ZZ} \end{pmatrix} \left[\begin{pmatrix} \hat{\tilde{\delta}}_1 \\ \vdots \\ \hat{\tilde{\delta}}_Z \end{pmatrix} * \begin{pmatrix} ts^m_{11} & \cdots & ts^m_{1Z} \\ \vdots & \ddots & \vdots \\ ts^m_{Z1} & \cdots & ts^m_{ZZ} \end{pmatrix} \begin{pmatrix} \hat{p}_{11} & \cdots & \hat{p}_{1H} \\ \vdots & \ddots & \vdots \\ \hat{p}_{Z1} & \cdots & \hat{p}_{ZH} \end{pmatrix} \begin{pmatrix} \kappa_1 \\ \vdots \\ \kappa_H \end{pmatrix} \right] \\
= \;& \begin{pmatrix} -a_{11} & \cdots & -a_{1Z} \\ \vdots & \ddots & \vdots \\ -a_{Z1} & \cdots & -a_{ZZ} \end{pmatrix} \left[\begin{pmatrix} \hat{\tilde{\delta}}_1 \\ \vdots \\ \hat{\tilde{\delta}}_Z \end{pmatrix} * \begin{pmatrix} \kappa_1 \sum_{k=1}^Z ts^m_{1k}\hat{p}_{k1} + \cdots + \kappa_H \sum_{k=1}^Z ts^m_{1k}\hat{p}_{kH} \\ \vdots \\ \kappa_1 \sum_{k=1}^Z ts^m_{Zk}\hat{p}_{k1} + \cdots + \kappa_H \sum_{k=1}^Z ts^m_{Zk}\hat{p}_{kH} \end{pmatrix} \right] \\
= \;& \begin{pmatrix} -a_{11} & \cdots & -a_{1Z} \\ \vdots & \ddots & \vdots \\ -a_{Z1} & \cdots & -a_{ZZ} \end{pmatrix} \left[\begin{pmatrix} \hat{\tilde{\delta}}_1 \\ \vdots \\ \hat{\tilde{\delta}}_Z \end{pmatrix} * \left(\begin{pmatrix} \kappa_1 \sum_{k=1}^Z ts^m_{1k}\hat{p}_{k1} \\ \vdots \\ \kappa_1 \sum_{k=1}^Z ts^m_{Zk}\hat{p}_{k1} \end{pmatrix} + \cdots + \begin{pmatrix} \kappa_H \sum_{k=1}^Z ts^m_{1k}\hat{p}_{kH} \\ \vdots \\ \kappa_H \sum_{k=1}^Z ts^m_{Zk}\hat{p}_{kH} \end{pmatrix} \right) \right] \\
= \;& \begin{pmatrix} -a_{11} & \cdots & -a_{1Z} \\ \vdots & \ddots & \vdots \\ -a_{Z1} & \cdots & -a_{ZZ} \end{pmatrix} \left[\begin{pmatrix} \hat{\tilde{\delta}}_1 \\ \vdots \\ \hat{\tilde{\delta}}_Z \end{pmatrix} * \begin{pmatrix} \kappa_1 \sum_{k=1}^Z ts^m_{1k}\hat{p}_{k1} \\ \vdots \\ \kappa_1 \sum_{k=1}^Z ts^m_{Zk}\hat{p}_{k1} \end{pmatrix} \right] + \cdots \\
& + \begin{pmatrix} -a_{11} & \cdots & -a_{1Z} \\ \vdots & \ddots & \vdots \\ -a_{Z1} & \cdots & -a_{ZZ} \end{pmatrix} \left[\begin{pmatrix} \hat{\tilde{\delta}}_1 \\ \vdots \\ \hat{\tilde{\delta}}_Z \end{pmatrix} * \begin{pmatrix} \kappa_H \sum_{k=1}^Z ts^m_{1k}\hat{p}_{kH} \\ \vdots \\ \kappa_H \sum_{k=1}^Z ts^m_{Zk}\hat{p}_{kH} \end{pmatrix} \right] \\
= \;& \begin{pmatrix} -a_{11}\hat{\tilde{\delta}}_1\kappa_1 \sum_{k=1}^Z ts^m_{1k}\hat{p}_{k1} - \cdots - a_{1Z}\hat{\tilde{\delta}}_Z\kappa_1 \sum_{k=1}^Z ts^m_{Zk}\hat{p}_{k1} \\ \vdots \\ -a_{Z1}\hat{\tilde{\delta}}_1\kappa_1 \sum_{k=1}^Z ts^m_{1k}\hat{p}_{k1} - \cdots - a_{ZZ}\hat{\tilde{\delta}}_Z\kappa_1 \sum_{k=1}^Z ts^m_{Zk}\hat{p}_{k1} \end{pmatrix} + \cdots \\
& + \begin{pmatrix} -a_{11}\tilde{\delta}_1\kappa_H \sum_{k=1}^Z ts^m_{1k}\hat{p}_{kZ} - \cdots - a_{1Z}\tilde{\delta}_Z\kappa_H \sum_{k=1}^Z ts^m_{Zk}\hat{p}_{kH} \\ \vdots \\ -a_{Z1}\hat{\tilde{\delta}}_1\kappa_H \sum_{k=1}^Z ts^m_{1k}\hat{p}_{kH} - \cdots - a_{ZZ}\hat{\tilde{\delta}}_Z\kappa_H \sum_{k=1}^Z ts^m_{Zk}\hat{p}_{kH} \end{pmatrix} \\
= \;& \begin{pmatrix} -a_{11}\sum_{k=1}^Z ts^m_{1k}\hat{p}_{k1} & \ldots & -a_{1Z}\sum_{k=1}^Z ts^m_{Zk}\hat{p}_{k1} \\ \vdots & \ddots & \vdots \\ -a_{Z1}\sum_{k=1}^Z ts^m_{1k}\hat{p}_{k1} & \ldots & -a_{ZZ}\sum_{k=1}^Z ts^m_{Zk}\hat{p}_{k1} \end{pmatrix} \begin{pmatrix} \hat{\tilde{\delta}}_1\kappa_1 \\ \vdots \\ \hat{\tilde{\delta}}_Z\kappa_1 \end{pmatrix} + \cdots \\
& + \begin{pmatrix} -a_{11}\sum_{k=1}^Z ts^m_{1k}\hat{p}_{kH} & \ldots & -a_{1Z}\sum_{k=1}^Z ts^m_{Zk}\hat{p}_{kH} \\ \vdots & \ddots & \vdots \\ -a_{Z1}\sum_{k=1}^Z ts^m_{1k}\hat{p}_{kH} & \ldots & -a_{ZZ}\sum_{k=1}^Z ts^m_{Zk}\hat{p}_{kH} \end{pmatrix} \begin{pmatrix} \hat{\tilde{\delta}}_1\kappa_H \\ \vdots \\ \hat{\tilde{\delta}}_Z\kappa_H \end{pmatrix} \\
= \;& \sum_h \mathcal{F}_h \hat{\tilde{\boldsymbol{\delta}}}\kappa_h \\
= \;& \sum_h \mathcal{F}_h \mathcal{I}_N \tilde{\boldsymbol{\delta}}\kappa_h \\
= \;& \sum_h \kappa_h \check{F}_h \tilde{\boldsymbol{\delta}}
\end{aligned}
$$

□

The fourth term of equation (14) can be expressed as $\check{\mathcal{H}}\tilde{\boldsymbol{\theta}}$, where $\check{\mathcal{H}} = \mathcal{H}\mathcal{I}_N$ in which $\mathcal{H}$ is an square matrix of dimension Z being its general element $\mathcal{H}[t,z] = -(\mathcal{T}^m * D^j)^{\dagger}[t,z]y_z$ and y_z is the element in position z of vector $[(\mathcal{T}^r * (S^{Z^{mr}} - S^j))\boldsymbol{\gamma}]$.

Proof. Denoting as d_t the element in position t of vector $\hat{\tilde{\boldsymbol{\lambda}}} * ((\mathcal{T}^r * (S^{Z^{mr}} - S^j))\boldsymbol{\gamma})$; and as before the element in position $[t,z]$ of matrix $(\mathcal{T}^m * D^j)^{\dagger}$ as a_{tz}. Then the fourth term of equation (14) can be simplified as:

$$
\begin{aligned}
&-(\mathcal{T}^m * D^j)^{\dagger}\left[\hat{\tilde{\boldsymbol{\theta}}} * \hat{\tilde{\boldsymbol{\lambda}}} * ((\mathcal{T}^r * (S^{Z^{mr}} - S^j))\boldsymbol{\gamma})\right] = \\
&= -\begin{pmatrix} a_{11} & \cdots & a_{1Z} \\ \vdots & \ddots & \vdots \\ a_{Z1} & \cdots & a_{ZZ} \end{pmatrix} \left[\begin{pmatrix} \hat{\tilde{\theta}}_1 \\ \vdots \\ \hat{\tilde{\theta}}_Z \end{pmatrix} * \begin{pmatrix} d_1 \\ \vdots \\ d_J \end{pmatrix}\right] \\
&= \begin{pmatrix} -a_{11}\tilde{\theta}_1 d_1 - \cdots - a_{1Z}\hat{\tilde{\theta}}_Z d_Z \\ \vdots \\ -a_{Z1}\hat{\tilde{\theta}}_1 d_1 - \cdots - a_{ZZ}\hat{\tilde{\theta}}_Z d_Z \end{pmatrix} \\
&= \begin{pmatrix} -a_{11}d_1 & \cdots & -a_{1Z}d_Z \\ \vdots & \ddots & \vdots \\ -a_{Z1}d_1 & \cdots & -a_{ZZ}d_Z \end{pmatrix} \begin{pmatrix} \tilde{\theta}_1 \\ \vdots \\ \tilde{\theta}_Z \end{pmatrix} \\
&= \mathcal{H}\hat{\tilde{\boldsymbol{\theta}}} \\
&= \mathcal{H}\mathcal{I}_N\tilde{\boldsymbol{\theta}} \\
&= \check{\mathcal{H}}\tilde{\boldsymbol{\theta}}
\end{aligned}
$$

□

Finally, the last two terms of equation (14) can be expressed as $(\mathcal{G} + I)\hat{\boldsymbol{\eta}}$ where $\mathcal{G}$ is an square matrix of dimension Z which general element is $\mathcal{G}[t,z] = -\sum_{k=1}^{Z}(\mathcal{T}^m * D^j)^{\dagger}[z,k]\hat{\tilde{\delta}}_k ts_{kz}^m$ in which ts_{kz}^m is the element in position $[k,z]$ of matrix $(\mathcal{T}^m * (S^{Z^{mr}} - S^j))$.

Proof. Denoting the element of matrix $(\mathcal{T}^m * D^j)^{\dagger}$ in position $[t,z]$ as a_{tz}, then we have:

$$
\begin{aligned}
&-(\mathcal{T}^m * D^j)^\dagger \left[\hat{\hat{\boldsymbol{\delta}}} * ((\mathcal{T}^m * (S^{Z^{mr}} - S^j))\hat{\boldsymbol{\eta}})\right] + \hat{\boldsymbol{\eta}} = \\
&= -\begin{pmatrix} a_{11} & \cdots & a_{1Z} \\ \vdots & \ddots & \vdots \\ a_{Z1} & \cdots & a_{ZZ} \end{pmatrix} \left[\begin{pmatrix} \hat{\hat{\delta}}_1 \\ \vdots \\ \hat{\hat{\delta}}_Z \end{pmatrix} * \begin{pmatrix} ts^m_{11} & \cdots & ts^m_{1Z} \\ \vdots & \ddots & \vdots \\ ts^m_{1Z} & \cdots & ts^m_{ZZ} \end{pmatrix} \begin{pmatrix} \hat{\eta}_1 \\ \vdots \\ \hat{\eta}_Z \end{pmatrix} \right] + \begin{pmatrix} \hat{\eta}_1 \\ \vdots \\ \hat{\eta}_Z \end{pmatrix} \\
&= \begin{pmatrix} -a_{11}\hat{\hat{\delta}}_1(ts^m_{11}\hat{\eta}_1 + \cdots + ts^m_{1Z}\hat{\eta}_Z) - \cdots - a_{1Z}\hat{\hat{\delta}}_Z(ts^m_{1Z}\hat{\eta}_1 + \cdots + ts^m_{ZZ}\hat{\eta}_Z) \\ \vdots \\ -a_{Z1}\hat{\hat{\delta}}_1(ts^m_{11}\hat{\eta}_1 + \cdots + ts^m_{1Z}\hat{\eta}_Z) - \cdots - a_{ZZ}\hat{\hat{\delta}}_Z(ts^m_{1Z}\hat{\eta}_1 + \cdots + ts^m_{ZZ}\hat{\eta}_Z) \end{pmatrix} + \begin{pmatrix} \hat{\eta}_1 \\ \vdots \\ \hat{\eta}_Z \end{pmatrix} \\
&= \begin{pmatrix} -\hat{\eta}_1(a_{11}\hat{\hat{\delta}}_1 ts^m_{11} + \cdots + a_{1Z}\hat{\hat{\delta}}_Z ts^m_{Z1}) - \cdots - \hat{\eta}_Z(a_{11}\hat{\hat{\delta}}_1 ts^m_{1Z} + \cdots + a_{1Z}\hat{\hat{\delta}}_Z ts^m_{ZZ}) \\ \vdots \\ -\hat{\eta}_1(a_{Z1}\hat{\hat{\delta}}_1 ts^m_{11} + \cdots + a_{ZZ}\hat{\hat{\delta}}_Z ts^m_{Z1}) - \cdots - \hat{\eta}_Z(a_{Z1}\hat{\hat{\delta}}_1 ts^m_{1Z} + \cdots + a_{ZZ}\hat{\hat{\delta}}_Z ts^m_{ZZ}) \end{pmatrix} + \begin{pmatrix} \hat{\eta}_1 \\ \vdots \\ \hat{\eta}_Z \end{pmatrix} \\
&= \begin{pmatrix} -(a_{11}\hat{\hat{\delta}}_1 ts^m_{11} + \cdots + a_{1Z}\hat{\hat{\delta}}_Z ts^m_{Z1}) & \ldots & -(a_{11}\hat{\hat{\delta}}_1 ts^m_{1Z} + \cdots + a_{1Z}\hat{\hat{\delta}}_Z ts^m_{ZZ}) \\ \vdots & \ddots & \vdots \\ -(a_{Z1}\hat{\hat{\delta}}_1 ts^m_{11} + \cdots + a_{ZZ}\hat{\hat{\delta}}_Z ts^m_{Z1}) & \ldots & -(a_{Z1}\hat{\hat{\delta}}_1 ts^m_{1Z} + \cdots + a_{ZZ}\hat{\hat{\delta}}_Z ts^m_{ZZ}) \end{pmatrix} \begin{pmatrix} \hat{\eta}_1 \\ \vdots \\ \hat{\eta}_Z \end{pmatrix} + \begin{pmatrix} \hat{\eta}_1 \\ \vdots \\ \hat{\eta}_Z \end{pmatrix} \\
&= \begin{pmatrix} -\sum_{k=1}^Z a_{1k}\hat{\hat{\delta}}_k ts^m_{k1} & \ldots & -\sum_{k=1}^Z a_{1k}\hat{\hat{\delta}}_k ts^m_{kZ} \\ \vdots & \ddots & \vdots \\ -\sum_{k=1}^Z a_{Zk}\hat{\hat{\delta}}_k ts^m_{k1} & \ldots & -\sum_{k=1}^Z a_{Zk}\hat{\hat{\delta}}_k ts^m_{kZ} \end{pmatrix} \begin{pmatrix} \hat{\eta}_1 \\ \vdots \\ \hat{\eta}_Z \end{pmatrix} + \begin{pmatrix} \hat{\eta}_1 \\ \vdots \\ \hat{\eta}_Z \end{pmatrix} \\
&= \mathcal{G}\hat{\boldsymbol{\eta}} + \hat{\boldsymbol{\eta}} \\
&= (\mathcal{G} + I)\hat{\boldsymbol{\eta}}
\end{aligned}
$$

□

In this way, equation (14) can be expressed as in equation (11).

D Matrix Y in section 3.3.2

As presented in section 2, the matrix notation of the system of equations from the Nash-in-Nash product maximization of a bargaining under uncertainty is the following (equation (4)):

$$(\mathfrak{T}^m * D^j)\hat{\mathbf{\Gamma}} - \hat{\hat{\boldsymbol{\delta}}} * \left[\left(\mathfrak{T}^m * (S^{Z^{mr}} - S^j)\right)\hat{\mathbf{\Gamma}}\right] = \hat{\hat{\boldsymbol{\lambda}}} * \left[(\mathfrak{T}^r * D^j)\gamma - \hat{\hat{\boldsymbol{\theta}}} * \left[\left(\mathfrak{T}^r * (S^{Z^{mr}} - S^j)\right)\gamma\right]\right]$$

Notice that in the after period the bargainers would use the beliefs they already assessed in the former period, i.e. vectors $\hat{\hat{\boldsymbol{\delta}}}$ and $\hat{\hat{\boldsymbol{\theta}}}$ were retrieved, then the manufacturers margin can be expressed as follows:

$$\hat{\mathbf{\Gamma}} = \left[(\mathfrak{T}^m * D^j) - \mathfrak{X}\right]^{\dagger}\left[\hat{\hat{\boldsymbol{\lambda}}} * \left[(\mathfrak{T}^r * D^j)\gamma - \hat{\hat{\boldsymbol{\theta}}} * \left[\left(\mathfrak{T}^r * (S^{Z^{mr}} - S^j)\right)\gamma\right]\right]\right]$$

where $\left[(\mathfrak{T}^m * D^j) - \mathfrak{X}\right]^{\dagger}$ represents the Moore-Penrose inverse of matrix $\left[(\mathfrak{T}^m * D^j) - \mathfrak{X}\right]$, in which $\mathfrak{X}$ is an square matrix of dimension Z which general element is $\mathfrak{X}[t,z] = \hat{\hat{\delta}}_t\left(\mathfrak{T}^m * (S^{Z^{mr}} - S^j)\right)[t,z]$, in which $\hat{\hat{\delta}}_t$ is the element in position t of vector $\hat{\hat{\boldsymbol{\delta}}}$. And therefore, the manufacturers margin can be expressed as follows:

$$\hat{\mathbf{\Gamma}} = Y\hat{\hat{\boldsymbol{\lambda}}}$$

where Y is an squared matrix of dimension Z which general element is $Y[t,z] = q_z\left((\mathfrak{T}^m * D^j) - \mathfrak{X}\right)^{\dagger}[t,z]$, in which q_z is the element in position z of vector $\left((\mathfrak{T}^r * D^j)\gamma - \hat{\hat{\boldsymbol{\theta}}} * \left(\left(\mathfrak{T}^r * (S^{Z^{mr}} - S^j)\right)\gamma\right)\right)$.

Proof. Focusing on the second term of the right-hand side of the equation (4) and just for the purpose of this proof denote as a_{tz} the general element of matrix $\left(\mathfrak{T}^m * (S^{Z^{mr}} - S^j)\right)$, then we have:

$$
\begin{aligned}
\hat{\hat{\boldsymbol{\delta}}} * \left[\left(\mathcal{T}^m * (S^{Z^{mr}} - S^j)\right)\hat{\boldsymbol{\Gamma}}\right] &= \begin{pmatrix} \hat{\hat{\delta}}_1 \\ \vdots \\ \hat{\hat{\delta}}_Z \end{pmatrix} * \left[\begin{pmatrix} a_{11} & \dots & a_{1Z} \\ \vdots & \ddots & \vdots \\ a_{Z1} & \dots & a_{ZZ} \end{pmatrix}\begin{pmatrix} \hat{\Gamma}_1 \\ \vdots \\ \hat{\Gamma}_Z \end{pmatrix}\right] \\
&= \begin{pmatrix} \hat{\hat{\delta}}_1 a_{11}\hat{\Gamma}_1 + \dots + \hat{\hat{\delta}}_1 a_{1Z}\hat{\Gamma}_Z \\ \vdots \\ \hat{\hat{\delta}}_Z a_{Z1}\hat{\Gamma}_1 + \dots + \hat{\hat{\delta}}_Z a_{ZZ}\hat{\Gamma}_Z \end{pmatrix} \\
&= \begin{pmatrix} \hat{\hat{\delta}}_1 a_{11} & \dots & \hat{\hat{\delta}}_1 a_{1Z} \\ \vdots & \ddots & \vdots \\ \hat{\hat{\delta}}_Z a_{Z1} & \dots & \hat{\hat{\delta}}_Z a_{ZZ} \end{pmatrix}\begin{pmatrix} \hat{\Gamma}_1 \\ \vdots \\ \hat{\Gamma}_Z \end{pmatrix} \\
&= \mathcal{X}\hat{\boldsymbol{\Gamma}}
\end{aligned}
$$

Hence, from equation (4) the following expression for the manufacturers margins is unfolded:

$$
\hat{\boldsymbol{\Gamma}} = \left[(\mathcal{T}^m * D^j) - \mathcal{X}\right]^\dagger \left[\hat{\hat{\boldsymbol{\lambda}}} * \left[(\mathcal{T}^r * D^j)\boldsymbol{\gamma} - \hat{\hat{\boldsymbol{\theta}}} * \left[\left(\mathcal{T}^r * (S^{Z^{mr}} - S^j)\right)\boldsymbol{\gamma}\right]\right]\right]
$$

In this way, by denoting as q_z the element in position z of vector $\left((\mathcal{T}^r * D^j)\boldsymbol{\gamma} - \hat{\hat{\boldsymbol{\theta}}} * \left(\left(\mathcal{T}^r * (S^{Z^{mr}} - S^j)\right)\boldsymbol{\gamma}\right)\right)$ in the right-hand side of expression above, while the general element of matrix $\left[(\mathcal{T}^m * D^j) - \mathcal{X}\right]^\dagger [t, z] = x_{tz}$, then we have:

$$
\begin{aligned}
\hat{\boldsymbol{\Gamma}} = {} & \left[(\mathcal{T}^m * D^j) - \mathcal{X}\right]^\dagger \left[\hat{\hat{\boldsymbol{\lambda}}} * \left[(\mathcal{T}^r * D^j)\boldsymbol{\gamma} - \hat{\hat{\boldsymbol{\theta}}} * \left[\left(\mathcal{T}^r * (S^{Z^{mr}} - S^j)\right)\boldsymbol{\gamma}\right]\right]\right] \\
= {} & \begin{pmatrix} x_{11} & \dots & x_{1Z} \\ \vdots & \ddots & \vdots \\ x_{Z1} & \dots & x_{ZZ} \end{pmatrix} \left[\begin{pmatrix} \hat{\hat{\lambda}}_1 \\ \vdots \\ \hat{\hat{\lambda}}_Z \end{pmatrix} * \begin{pmatrix} q_1 \\ \vdots \\ q_Z \end{pmatrix}\right] \\
= {} & \begin{pmatrix} x_{11}\hat{\hat{\lambda}}_1 q_1 + \dots + x_{1Z}\hat{\hat{\lambda}}_Z q_Z \\ \vdots \\ x_{Z1}\hat{\hat{\lambda}}_1 q_1 + \dots + x_{ZZ}\hat{\hat{\lambda}}_Z q_Z \end{pmatrix} \\
= {} & \begin{pmatrix} x_{11}q_1 & \dots & x_{1Z}q_Z \\ \vdots & \ddots & \vdots \\ x_{Z1}q_1 & \dots & x_{ZZ}q_Z \end{pmatrix} \begin{pmatrix} \hat{\hat{\lambda}}_1 \\ \vdots \\ \hat{\hat{\lambda}}_Z \end{pmatrix} \\
= {} & Y\hat{\hat{\boldsymbol{\lambda}}}
\end{aligned}
$$

□

E Data Description and Descriptive Statistics

Table 4: Variable Description and Sources

Variable	Description	Source
Price	$Price = \frac{TPM}{TPQ}$, (ct/g) TPM = Total paid amount, TPQ = Total purchased quantity.	GFK Panelservice SE
Promotion (Prom)	Indicator variable being 1 if the purchase was done under a promotion (not at its normal price), and 0 otherwise.	GFK Panelservice SE
Fat Level (FL)	Variable that measures the percentage of fat. This information was available by intervals in the database in the estimations it was used the mid-value from the interval.	GFK Panelservice SE
Organic (Bio)	Indicator variable being 1 if the purchased product is organic and 0 otherwise.	GFK Panelservice SE
Probiotic (PB)	Indicator variable being 1 if the purchased product is probiotic and 0 otherwise.	GFK Panelservice SE
Size Variables	The size (g.) of the purchased product was computed as follows: $Size = \frac{TPQ}{TPU}$ TPU = Total purchased untis. Afterwards, products were classified in groups by size: size $\leq 200g.$, $200g. <$ size $\leq 400g.$, $400g. <$ size $\leq 600g$, size $> 600g$.	GFK Panelservice SE
Household Income (HHI)	The net monthly household income provided in the dataset were categories by ranges, the employed variable considered the middle value of the range.	GFK Panelservice SE
Raw-Milk	Monthly prices for whole milk delivered from the farm with 4.0% fat and 3.4% protein (Preise für angelieferte Vollmilch ab Hof bei 4.0% Fettgehalt und 3.4% Eiweissgehalt)	German Federal Ministry of Food and Agriculture: Statistical monthly reports 03-2008, 03-2009 and 03-2010: Table MBT-0301431-0000
Type of month (TM)	Indicator variables that distinguished *cold* and *hot months*, considering *cold months* from October to March, and the rest as *hot months*.	

Table 5: Descriptive Statistics by Period

Period	Type of brand	Variable	Mean	Std. Dev.	Min	Max
Before M&A	Conventional	Price (ct/g)	0.22	0.08	0	0.77
		Promotion	0.26	0.44	0	1
		Bio	0.02	0.14	0	1
		Probiotic	0.07	0.26	0	1
		Fat level	0.04	0.03	0.00	0.13
		Size (g)	235.18	166.00	50	3000
	Private Labels	Price (ct/g)	0.13	0.05	0.00	0.60
		Promotion	0.02	0.16	0	1
		Bio	0.05	0.21	0	1
		Probiotic	0.14	0.35	0	1
		Fat Level	0.03	0.03	0.00	0.13
		Size (g)	355.29	229.43	100	5000
After M& A	Conventional	Price (ct/g)	0.25	0.08	0.04	0.99
		Promotion	0.33	0.47	0	1
		Bio	0.02	0.13	0	1
		Probiotic	0.11	0.31	0	1
		Fat Level	0.04	0.02	0.00	0.13
		Size (g)	249.44	169.23	37.5	3000
	Private Labels	Price (ct/g)	0.15	0.05	0.03	0.46
		Promotion	0.06	0.23	0	1
		Bio	0.06	0.23	0	1
		Probiotic	0.10	0.30	0	1
		Fat Level	0.03	0.03	0.00	0.13
		Size (g)	355.73	235.53	125	1200

F Control Function and Demand Results

Table 6: Control Functions by Period

Variables	Before M&A		After M&A	
	Coeff.	Std. Error	Coeff.	Std. Error
$Milk_{t-3}$	0.004^{***}	0.00	0.001^{***}	0.00
PL	-0.10^{***}	0.00	-0.08^{***}	0.00
Discounter	0.10^{***}	0.01	0.17^{***}	0.01
FL	0.28^{*}	0.15	0.24^{***}	0.09
Prom	-0.04^{***}	0.00	-0.07^{***}	0.00
Bio	0.04^{***}	0.02	0.05^{***}	0.02
PB	-0.02^{**}	0.01	0.01	0.01
Brands	X		X	
Outlets	X		X	
Size	X		X	
TM	X		X	
$R^2 - Adj.$	0.998		0.998	
$F - Test$	369.38		37.14	
$Obs.$	864		864	

***, **, * denote 1%, 5% and 10% level of significance respectively

CF = Residuals from control function, **PL** = Private Label, **FL** = Fat Level,

Prom = Promotion, **PB** = Probiotic, **TM** = Type of month

Values were rounded to two decimals for display reasons.

Table 7: Demand Results by Periods

Variables	Before M& A		After M& A	
	Coeff.	Std. Error	Coeff.	Std. Error
Price (β^p)	-40.05^{***}	0.61	-51.17^{***}	0.50
Price (σ_{β^p})†	8.32^{***}	0.10	-6.50^{***}	0.08
CF	15.94^{***}	0.73	30.78^{***}	0.66
PL	10.72^{***}	0.09	8.02^{***}	0.09
Discounter	-0.39^{***}	0.05	1.24^{***}	0.05
FL	26.75^{***}	1.02	65.69^{***}	0.98
Prom	0.15^{*}	0.09	0.12	0.08
Bio	-0.34^{**}	0.14	-0.74^{***}	0.13
PB	2.09^{***}	0.08	3.80^{***}	0.09
Price x HHI	0.00^{***}	0.00	0.00^{***}	0.00
Price x HHI^2	0.00^{***}	0.00	0.00^{***}	0.00
PL x HHI	0.00^{***}	0.00	0.00^{***}	0.00
FL x HHI	0.00^{***}	0.00	0.00^{***}	0.00
Prom x HHI	0.00^{***}	0.00	0.00^{***}	0.00
Bio x HHI	0.00^{***}	0.00	0.00^{***}	0.00
PB x HHI	0.00	0.00	0.00^{***}	0.00
Discounter x HHI	0.00^{***}	0.00	0.00^{***}	0.00
Brands	X		X	
Outlets	X		X	
Size	X		X	
TM	X		X	
$Log - Likelihood$	-234035.04		-236440.46	
$Obs.$	7 300 000		7 300 000	

† The sign of the estimated standard deviation should be interpreted as being positive.

G Own-Price Elasticity, Retailers Margins, Manufacturers Margins, Retailer bargaining power and Beliefs

Table 8: Mean Results by Manufacturer and Retailer: Before and After M&A

	Before						After					
Manufacturer	OPE	RM	MM	λ	$(1-\delta)$	$(1-\theta)$	OPE	RM	MM	λ	MMc	λ_c
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
M1(PL)	-8.50	0.05	0	1	0.10	0	-12.27	0.05	0	1	0	1
M2	-8.42	0.04	0.08	0.30	0.15	0.02	-13.04	0.03	0.09	0.19	0.09	0.19
M3	-10.62	0.05	0.31	0.15	0	0	-17.36	0.03	0.31	0.09	0.32	0.09
M4(PL)	-10.21	0.04	0.02	0.38	0.20	0.13	-15.16	0.03	0.03	0.34	0.04	0.34
M5	-9.39	0.04	0.07	0.35	0.00	0.00	-13.69	0.03	0.08	0.21	0.09	0.20
M6	-10.61	0.05	0.09	0.37	0.00	0.00	-15.23	0.04	0.09	0.31	0.10	0.30
M7	-8.42	0.04	0.05	0.38	0	0	-13.16	0.05	0.04	0.55	0.05	0.50
M8(PL)	-4.29	0.03	0.02	0.74	0.04	0	-12.22	0.03	0.03	0.45	0.03	0.46
M9(PL)	-9.01	0.04	0.00	1	0.05	0	-12.00	0.03	0.00	1	0.00	1
M10	-11.38	0.04	0.10	0.26	0.20	0.07	-17.13	0.03	0.13	0.22	0.16	0.14
M11(PL)	-7.24	0.06	0.02	0.73	0.03	0.00	-10.58	0.04	0.03	0.55	0.04	0.52
M12(PL)	-7.40	0.04	0.03	0.53	0.49	0.13	-11.34	0.03	0.04	0.34	0.04	0.39
M13(PL)	-9.45	0.05	0.03	0.52	0.25	0.00	-12.49	0.07	0.01	0.79	0.01	0.83
M14	-7.01	0.03	0.04	0.43	0	0	-10.76	0.03	0.07	0.26	0.07	0.25
M15	-5.83	0.06	0.01	0.87	0.50	0	-14.50	0.03	0.04	0.58	0.06	0.36
M16(PL)	-12.24	0.07	0.03	0.74	0.22	0	-15.91	0.05	0.02	0.58	0.03	0.58
M17	-11.47	0.04	0.04	0.79	0.07	0.00	-16.29	0.03	0.04	0.78	0.05	0.65
Retailer	OPE	RM	MM	λ	$(1-\delta)$	$(1-\theta)$	OPE	RM	MM	λ	MMc	λ_c
R1	-8.50	0.05	0	1	0.10	0	-12.27	0.05	0	1	0	1
R2	-10.07	0.04	0.06	0.35	0.08	0.04	-15.19	0.03	0.07	0.30	0.08	0.28
R3	-10.60	0.04	0.12	0.26	0	0	-14.71	0.02	0.19	0.13	0.19	0.13
R4	-9.31	0.05	0.07	0.51	0.13	0.01	-14.68	0.03	0.09	0.37	0.09	0.34
R5	-9.06	0.04	0.08	0.63	0.17	0.10	-14.10	0.03	0.08	0.59	0.10	0.57
R6	-7.24	0.06	0.02	0.73	0.03	0.00	-10.58	0.04	0.03	0.55	0.04	0.52
R7	-9.48	0.04	0.10	0.41	0.22	0.03	-14.38	0.03	0.09	0.39	0.12	0.30
R8	-10.04	0.05	0.09	0.37	0.10	0.00	-14.37	0.05	0.10	0.42	0.10	0.43
R9	-12.24	0.07	0.03	0.74								
Mean	-9.58	0.04	0.07	0.49	0.12	0.03	-14.40	0.04	0.08	0.43	0.09	0.40
$R^2 - Adj.$				0.95	0.86					0.91		0.92

OPE: Own-Price Elasticity, **RM:** Retailer Margin, **MM:** Manufacturer Margin, $\boldsymbol{\lambda}$**:** Retailer Bargaining power, $\boldsymbol{(1-\delta)}$**:** Manufacturer Belief of facing a "strong" bargaining strategy approach, $\boldsymbol{(1-\theta)}$**:** Retailer Belief of facing a "strong" bargaining strategy approach, **MMc:** Manufacturer Margin assuming certainty, $\boldsymbol{\lambda_C}$**:** Retailer Bargaining power assuming certainty.

Values were rounded to two decimals for display reasons.

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