Bundling and Mergers in Energy Markets

Laurent Granier, Marion Podesta

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Laurent Granier[†] and Marion Podesta[‡]

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Abstract

Does bundling trigger mergers in energy industries? We observe mergers between firms belonging to various energy markets, for instance between gas and electricity providers. These mergers enable firms to bundle. We consider two horizontally differentiated markets. In this framework, we show that bundling strategies in energy markets create incentives to form multi-market firms in order to supply bi-energy packages. Moreover, we find that this type of merger is detrimental to social welfare.

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[†]GATE, CNRS, University of Lyon 2.

[‡]Corresponding author: mpodesta@univ-tlse1.fr, LERNA, Toulouse School of Economics.

1 Introduction

A trend towards deregulation of utilities industries, such as energy or telecommunications, is observed worldwide. This has an impact on market structures and pricing strategies. In particular, market structures shift from monopolies[1] to oligopolies. Moreover, in energy industries, we observe multi-market mergers between firms belonging to various oligopolies. Such mergers enable firms to bundle several energies.[2] For instance, they provide packages of two different energies like gas and electricity. A significant example is the merger case between E.ON and Ruhrgas on the German market. Although the merger proposal is rejected in 2002 by the competition authority, the Federal Minister of Economics and Technology even so approves the merger in 2003 (Marsden et al., 2007). Before this acquisition, Ruhrgas was the first gas producer in Germany while E.ON, the first electricity one. E.ON only owned holdings in a few local subsidiaries of gas supply. Thus, the new leader of the German energy market now supplies bi-energy bundles. We also remark that other mergers become effective on this market straight after. Indeed, electricity supplier EWE merges with gas suppliers Cuxhaven and SWB in 2003. This substantiates the merger wave phenomenon. The following question therefore becomes important: do bundling strategies trigger mergers in energy markets? This type of incentive could better explain the convergence phenomenon in energy industries. In this paper, we study the emergence of these mergers. In order to carry out our analysis, we use a horizontally differentiated model derived from Reisinger (2006). It allows to study bundle competition. This analysis can be interpreted as a modelling of a competition between two electricity firms and two gas firms.[3] We build a merger game allowing to underline a merger wave phenomenon. This phenomenon is due to the ability to supply bi-energy bundles[4] once a merger is achieved. Bundling entails two effects. The first is a price discrimination one. The second is a competition one. The trade-off between these effects and merger choices causes an increase in profits.

The results which we have just evoked allow to better assess a relevant phenomenon in the energy markets: the convergence phenomenon. Usually, convergence refers to a process that reduces differences between activities. It corresponds to a gradual integration of formerly separate industries. To describe convergence in the energy industry, we analyze a specific trend: the convergence between gas and electricity.[5] This trend is widely observed during the 1990s in the US and is now described in Europe too (Verde, 2008). Multi-market mergers in energy industry participate in this convergence phenomenon. Indeed, downstream mergers allow the diversification of energy supplies and clearly participate in the convergence phenomenon. For instance, the inter-industry merger Dong/Elsam/EnergiE2 (European Commission, 2006a) refers to the integration between the Danish gas incumbent and Danish companies active in the electricity sec-

[1] Moreover, administrative "principle of specialization" that formerly assigned public monopoly operators to produce only a single specialized good, is removed.

[2] For instance in France, the dominant operators propose energy and service packages to professionals such as "Provalys" for Gaz de France and "Essentiel Pro" for Electricité de France.

[3] As illustration, we can lean on the competition which existed in the German energy market before the mergers which we have just quoted.

[4] We show that bundling creates an incentive to merge. Nevertheless, there exist other merger motives in energy markets.

[5] For more explanations about convergence between gas and electricity, see Toh (2003) and Bazart (2007).

tor. The firm could now exploit their complementarities and supply bi-energy bundles. Another example is Gaz de France/Suez merger proposition submitted to the European Commission in 2005. This corresponds to a national merger but concerning both mid-stream and downstream markets. Colette Lewiner (a senior vice president at Capgemini in Paris) says that this merger could have been "a plus for competition if Suez and GDF bundle their offerings to give customers like industry better offerings, perhaps in the form of a single bill for electricity, gas and water" (International Herald Tribune, 2006). As the proposition was declined by the authorities, Gaz de France has to purchase electricity to Electricité de France in order to supply bi-energy bundles. In 2008, the Gaz de France/Suez merger becomes effective because European Commission approves it. This example suggests that bundling strategies may incite to merge. Empirical studies show that a lot of consumers[6] use several types of energies (Bernard et al., 1996 and Nesbakken, 2001). So bundling strategies may be a fundamental reason for merger decisions.[7] Despite the prevalence of this particular type of merger, to our knowledge they are not analyzed by the theoretical literature. The aim of this paper is to fill this gap.

Before modelling the competition with bundles, we give more details about the bundling literature. Bundling refers to the practice of selling two or more goods at a unique price.[8] The economic literature on bundling isolates several effects. One of the main effects is price discrimination. Bundling allows to sort consumers according to their willingness to pay. This characteristic is analyzed by Adams and Yellen (1976) for a monopoly producing two goods. In analysis dealing with specific cases, they show that mixed bundling is generally the optimal strategy[9] since the correlation between the goods is negative. Whinston (1990), Nalebuff (2004) and Peitz (2008) underscore the fact that a two-market monopolistic firm can deter the entry of competitors by bundling[10] if the potential entrant can enter only one market. In this framework, Nalebuff shows that pure bundling is optimal. A second effect of bundling to consider is, in competitive environments, a competition effect. Anderson and Leruth (1993) analyze bundling in a complementary-goods duopoly. In their view, independent pricing is a dominant strategy in the commitment case. Economides (1993), in the same framework, shows that firms follow mixed bundling strategies in the Nash equilibrium. Firms, however, make lower profits than they do when adopting an independent pricing strategy. Armstrong and Vickers (2008) examine principally a unit-demand model where consumers may buy one product from one firm and another product from another firm under nonlinear pricing. They show that bundling generally acts to reduce profit and welfare and to boost consumer surplus.[11] However, they consider an intrinsic extra shopping cost when consumers purchase each good at different locations. Thanassoulis (2007) finds that if buyers incur firm specific costs or have shop specific tastes then competitive mixed bundling lowers consumer surplus overall and raises profits.

[6]Note that professionals also consume several energies at the same time.

[7]This reason is evoked by Jacobsen et al. (2006).

[8]When a firm sells its goods both separately and bundled in a package, this firm follows a mixed bundling strategy. When a firm commits to supply only the bundle, it follows a pure bundling strategy.

[9]Schmalensee (1984) shows their results are robust to a bivariate normal distribution. As for them, Mc Afee et al. (1989) generalize these results to almost all distributions.

[10]In Nalebuff (2004), bundling is optimal even without any commitment.

[11]By contrast, when consumers buy all their products from one firm (the one-stop shopping model), nonlinear pricing leads to higher profit and welfare but often lower consumers surplus, than linear pricing.

Reisinger (2006) also studies a duopoly that produces two types of horizontally differentiated goods. He analyzes a framework for which consumers buy one unit of each good with neither substitutability, nor complementarity effects created by variants choices for each type of goods. The correlation of the reservation prices is expressed by the correlation of consumers' location on each market. He shows that there are two effects created by bundling: the well-known "sorting effect" and the "business-stealing effect," which results from bundle competition. Reisinger shows that firms have an incentive to adopt a mixed bundling strategy. Nonetheless, the effect on profits is ambiguous. If the correlation of reservation prices is negative, then the competition effect dominates and the bundling strategy lowers profits. Such firms are in a prisoner's dilemma situation. On the other hand, if the correlation of reservation prices is positive, then the sorting effect allows firms to make higher profits.

We use the model of Reisinger (2006) in order to analyze the impact of bundling on merger incentives. We therefore consider two horizontally differentiated markets, that are electricity and natural gas markets. As Reisinger (2006), the link between these two markets is the correlation of consumers' locations. Nevertheless, four firms are present. Two firms produce electricity, and the two others supply natural gas. In their respective markets, firms compete in prices. We build an endogenous merger game and assume that monopolization was illegal. First, we exclude the post-merger bundling strategy. Second, we remove this assumption in order to analyze the effect of bundling strategy on merger incentives. In a basic model in which bundling is not considered, we find that there is no incentive to merge. Once a merger is achieved, however, as we show, there is an incentive to adopt a mixed bundling strategy. Otherwise, the bundling strategy triggers a merger wave. Moreover, we show that relative to the correlation of reservation prices, two types of mergers are achieved. Furthermore, while Reisinger (2006) shows that there is a prisoner's dilemma, we show that the different types of mergers allow this dilemma to be removed. Finally, from a welfare point of view, we show that bundling is less harmful than Reisinger suggests (2006).

In order not to neglect merger interactions in our model, we endogenize merger decisions. In this sense, our study is closely linked to the endogenous merger literature, some of which seeks to explain mechanisms preventing mergers as the "insider's dilemma[12]" previously evoked in the exogenous merger model of Stigler (1950). For instance, Kamien and Zang (1990, 1993) and Fridolfsson and Stennek (2005b) also consider the "insider's dilemma". Moreover, Kamien and Zang (1990, 1993) add auction mechanisms to take into account firms' acquisitions processes. We care about the "insider's dilemma" but without any auction mechanism. Indeed, we are not interested in surplus sharing rule. On the other hand, we did deal with other characteristics found in the endogenous merger literature, such as taking all firms' combinations into consideration. For instance, some endogenous merger models allow merger interactions to be revealed (Nilssen and Sorgard, 1998). More particularly, some models attempt to emphasize the phenomenon of preemp-

[12] "The insiders' dilemma means that a profitable merger does not occur, because it is even more profitable for each firm to unilaterally stands as an outsider" (Lindqvist and Stennek, 2005). Salant, Switzer and Reynolds (1983) validate the result of Stigler (1950) when firms compete in a Cournot fashion. Indeed, they show that if a takeover does not merge more than 80 per cent of an industry, such a takeover is not carried out because outsiders earn more than insiders. Going further, Inderst and Wey (2004) focus on probability of hold-up (respectively hold-out) in a merger game that includes cases for which outsiders benefit from mergers.

tive mergers (Fridolfsson and Stennek, 2005a, Brito 2003, Matsushima, 2001). Finally, other models, such as those of Fauli-Oller (2000) or Nilssen and Sorgard (1998), focus on merger waves phenomena. As the same type of merger interactions are possible in our framework, we build a merger game based upon Nilssen and Sorgard (1998). Contrary to Nilssen and Sorgard (1998), we do not restrict merger possibilities in an ad hoc fashion. Indeed, the only restriction concerning merger choices is due to the prohibition of the monopolization. Some merger choices are then mutually exclusive but this is not determined in an ad hoc way. This is due to the fact that a homogeneous merger is de facto incompatible with a heterogeneous merger.

The following section presents the basic model. The section 3 introduces the bundling strategy on energy markets. Section 4 gives the equilibrium of the game and the social welfare analysis. The final section presents some concluding remarks.

2 Basic model

Throughout this section, we exclude bundling strategies. We start with the assumptions of the competition game. Next, a merging game is defined. Finally, we solve this game in order to establish the benchmark, before introducing the bundling strategy in the next section.

2.1 Assumptions

We will consider a four-firm industry. Two firms produce the electricity A at the marginal cost c_A and two others produce the gas B at the marginal cost c_B. In order not to introduce bias[13] in our bundling analysis, we will assume that production costs are linear. Each type of energy is horizontally differentiated. For each energy, the product variants are the locations of the firms on a circle whose circumference is normalized to 1. According to the type and the location of their output, firms are named either A_i or B_j with $i, j = 1, 2$. The firm A_1 (respectively B_1) produces the good A, electricity (respectively B, gas) and is located at 0 on circle A (respectively B) while the firm A_2 (respectively B_2) produces the same energy[14] but is located at $\frac{1}{2}$. There is a continuum of consumers, and, without loss of generality, we normalize its total mass to 1. Consumers' locations on both circles are $x = (x_A, x_B)$. Each consumer wishes to buy one and only one unit of each type of energy.[15] This allows us to focus on the pure strategic effect of bundling. Firms compete in prices in each energy market. Their prices are denoted by p_A^i and p_B^i. Thus, consumers can choose between four product combinations. They can buy either the electricity from firm A_1 and the gas from firm B_1, *i.e.*, $(A1B1)$, or the electricity from firm A_2 and the gas from firm B_2, *i.e.*, $(A2B2)$, or the electricity from firm A_1 and the gas from firm B_2, *i.e.*, $(A1B2)$, or the electricity from firm A_2 and the gas from firm B_1, *i.e.*, $(A2B1)$.

For instance, a customer located at $0 \leq x_A, x_B \leq 1/2$, buying the electricity from firm

[13] In this model, bundling must not be incited by efficiency gains, for instance.

[14] Note that we deliberately choose to place firms at locations 0 and $\frac{1}{2}$, but without loss of generality. Indeed, if we placed firms more closely, results would be qualitatively the same. They would just be shifted relative to δ.

[15] Electricity and gas can be used for lighting and heating needs, for instance.

A_1 and the gas from firm B_2 has an indirect utility of:

$$V(x_A, x_B) = K_A - p_A^1 - t_A(x_A)^2 + K_B - p_B^2 - t_B(1/2 - x_B)^2. \tag{1}$$

Utilities from consumption (gross of prices and transportation costs) of electricity, A and gas, B are given by K_A and K_B. The two markets (or the two energies) are denoted by $k = A, B$, and we note t_k the transportation cost associated with circle k. Without loss of generality[16], we assume $t_A > t_B > 0$. The consumer reservation price R_k^i, for the variant i of the energy k, is given by $K_k - t_k(d_i)^2$, where d_i is the shortest arc length between the consumer's location and firm i on circle k. In order that all consumers buy both types of energies in each price equilibrium, we assume that K_k is sufficiently high. Reservation prices can be linked to the locations of consumers. Indeed, the joint distribution function of reservation values $G(R_A^i \mid R_B^i)$, and so, the correlation between reservation prices for the energy from location i on the two markets can be deduced from the joint distribution function of consumer location $F(x_A \mid x_B)$. Like Reisinger (2006), we give a structure to this distribution function. It is a simple function expressing all correlations of reservation prices. Thus, if a consumer is located at x_A on circle A, then this consumer is located at

$$x_B = \begin{cases} x_A + \delta & \text{if } x_A + \delta \leq 1 \\ x_A + \delta - 1 & \text{if } x_A + \delta > 1 \end{cases}$$

on circle B, where $0 \leq \delta \leq 1/2$. This means a δ-shift of all consumers on circle B. If $\delta = 0$, the reservation price correlation is one. Through adopting this simple structure, correlations of reservation values can be obtained easily by altering δ. The correlation coefficient $\rho[R_A, R_B](\delta) = \frac{Cov[R_A,R_B](\delta)}{\sigma(R_A)\sigma(R_B)}$ is given[17] by $1 - 30\delta^2 + 60\delta^3 - 30\delta^4$. By way of illustration, note that for small δ values, if a consumer has a high reservation price for the electricity of firm A_1, then s/he has a high reservation value for the gas of firm B_1. If a consumer has a high reservation price for the electricity of firm A_2, then s/he has a high reservation value for the gas of firm B_2. Conversely, a high value of δ implies that consumers have very different reservation prices for the two energies sold at the same location on each circle. Now, we define the merger game in which the four firms are involved.

2.2 Merger game

We assume that monopolization is illegal.[18] Thus, potential mergers necessarily involve firms from two different markets. We build a two-stage game. At the first stage, firms choose either to merge or not to merge. At the second stage, firms choose independently to follow either a bundling strategy or an independent pricing one. Then they compete in prices. The previous section already presents these stage assumptions. We now describe the first stage. Each electric firm A_i can choose to merge with the gas firm with the same location in the gas market. We call this type of merger a "homogeneous merger". Each electric firm A_i can also choose to merge with the gas firm located at the opposite in the

[16] The limit cases $t_B \to t_A$ and $t_B \to 0$ are studied in section 4.

[17] The proof is given by Reisinger (2006).

[18] There is always an incentive to monopolize the electricity market A or the gas market B as long as reservation prices of consumers are sufficiently high. But this is detrimental for consumers and generally, authorities forbid monopolization.

gas market. In this case, the merger is called a "heterogeneous merger".[19] Finally, each electric firm A_i can choose not to merge (see Figure 1 below).

Insert Figure 1

Firms take sequential and non-cooperative decisions. The sequential nature of the game is similar to Nilssen and Sorgard (1998). By this way, we focus on merger interactions. Moreover, we avoid coordination problems between firms. [20] Without loss of generality, we assume decisions are made by electric firms of the market A. Results are exactly the same if decisions are made by gas firms of market B. We also assume that electric firm A_1 makes its merger decision first, but the results are the same if electric firm A_2 chooses first. In this paper, we look for subgame perfect Nash equilibria (SPNE). Therefore, we solve the game backward. Thus, if we solve competition subgames, then we solve the merger game. Concerning mergers, we do not define any profit sharing rule. We focus exclusively on the following question: "Is the merger profit higher than the pre-merger profit sum of firms involving in the merger?" Indeed, if such is the case, there is necessarily a profit-sharing rule that gives an incentive to merge. On the other hand, in parallel with the "strategic motives" consideration (Nilssen and Sorgard, 1998), we take into account interactions between merger decisions. To illustrate, two-firm merger expectation can either incite or not incite another two-firm merger. Therefore, merger decisions are endogenous in this model. At the first stage, both electric firms A_1 and A_2 choose to merge or not to merge with gas firms of market B. Thus, we present this game in Figure 2 below.

Insert Figure 2

Now, we solve the game without considering bundling strategy. This constitutes the benchmark.

[19] To better illustrate these merger types, consider an example in energy. The homogeneous merger could be a merger between the firm A_1, which supplies electricity, and the firm B_1, which provides gas. The firm A_1 has the reputation of providing a vaster supply network than A_2, and the firm B_1 has the reputation of supplying a more performant technical aid than B_2 does. In the same way, the heterogeneous merger could be a merger between the firm A_2 and the firm B_1. The firm A_2 has a much wider range of services than A_1 does, and regarding the gas storage the firm B_2 has a better reputation than B_1 does.

[20] In a simultaneous game, a coordination problem can arise by two ways. First, the potential buyers bid for the same target. So we could use a method for selecting a buyer firm and the repetition of the simultaneous game would provide the same result. Second, firms coordinate on the wrong continuation equilibrium for intermediate values of delta. But whatever are the type of the first merger and the value of delta, there is an incentive to achieve a second merger by repeating the game because of mixed bundling (see proof of proposition 1 in Reisinger (2006) for the homogeneous case). If the simultaneous game is repeated, firms anticipate this and bid for the good continuous equilibrium since the wrong gives less profit.

2.3 Benchmark: mergers and independent pricing

By symmetry, we deduce from the game tree that there are five possible outcomes. There may be either two homogeneous mergers, two heterogeneous mergers, only one homogeneous merger, only one heterogeneous merger, or, finally, no merger. We determine prices and profits of the different game's outcomes in Appendix 6.1. We note that $\Pi^z_{A_iB_j}$ is the profit of the merged firm A_iB_j where $z = 1, 2$ is the number of mergers. Thus, we can establish the following equation:

$$\Pi^z_{A_iB_j} = \Pi_{A_i} + \Pi_{B_j}, \qquad \forall i, j, z = 1, 2. \tag{2}$$

We therefore deduce the following proposition:

Proposition 1 *If bundling strategy is not considered, then there is no incentive to merge.*

When they cannot provide bundles, the monoproduct firms are indifferent as to whether to merge or not to merge. Since markets are independent, there is no competition effect due to mergers. Therefore, there is no incentive to merge.[21] After a merger, prices are unchanged and the global profit of a merger is merely the profit sum of the merging firms. In this case of indifference, we assume that firms choose not to merge. After the benchmark analysis, the following section considers a case where merged firms are able to follow a mixed bundling strategy. Thus, we focus on pure effects of bundling in the competition game and on their impacts on incentives to merge.

3 Mergers and mixed bundling

In this section, we introduce mixed-bundling strategy.[22] Indeed, if two firms merge, they can supply a bundle composed of both electricity and gas. A merged firm A_iB_j $\forall i, j = 1, 2$ can offer a package composed of electricity A_i and gas B_j. This bundle is denoted by $(ABij)$ and its price is p^{ij}_{AB}. Mixed bundling may enable firms to attract marginal consumers by lowering the bundle price.[23] A consumer who buys the energies from different firms in the independent pricing case can then prefer to buy the two energies from the same firm. The desutility when purchasing its non-preferred variant of a energy is balanced by a lower price. We show that results depend on correlation of reservation prices. In this section, we analyze game outcomes. Here, a mixed bundling strategy is possible. Thus, we study competition in each outcome. We exclude, however, the non-merged outcome, because bundling is not possible in this case, and so, profits are already computed in the previous section. For simplicity, we analyze only the merger waves outcomes, *i.e.*, the two-merger cases. We will explain why it is sufficient to solve the game in section 4. First, we study the case of homogeneous two-firm merger. This corresponds to Reisinger's model (2006). Next, a sub-section is devoted to the case of heterogeneous two-firm mergers.

[21] Here, we model no other mechanism able to create a merger incentive. For instance, considering synergies could create an incentive to merge.

[22] We excluded the pure bundling strategy, because firms have no incentive to manage without an additional discrimination tool, given that firms are in competition.

[23] Firms supplying bi-energy packages offer discounts to consumers buying packages instead of independent energies. For instance, Gaz de France/Suez proposes the bi-energy package at the price of the two separate energies minus 36€ (respectively 66€) for one year (respectively for two years).

3.1 Bundling and homogeneous mergers

We assume electric firms A_i merged with gas firms B_j, $\forall i = j$, with $i, j = 1, 2$. In this configuration, customers choose between four product combinations. They can either buy the bundle of firm A_1B_1, *i.e.*, $(AB11)$, at price p_{AB}^{11}, or buy the bundle of firm A_2B_2, *i.e.*, $(AB22)$, at price p_{AB}^{22}. They can also purchase either the electricity A from firm A_1B_1 and the gas B from firm A_2B_2, *i.e.*, the product combination $(A1B2)$, at price $p_A^1 + p_B^2$, or the electricity A from firm A_2B_2 and the gas B from firm A_1B_1, *i.e.*, the consumption option $(A2B1)$, at price $p_A^2 + p_B^1$. We want to determine prices and profits when firms adopt a mixed bundling strategy, but this is interesting only if firms have an incentive to bundle. Thus, we use the lemma of Reisinger (2006):

Lemma 1 *If $\delta > 0$, i.e $\rho < 1$, then in equilibrium, homogeneously-merged firms follow a mixed-bundling strategy.*

Proof. See Reisinger (2006) ■

In the benchmark, there is no merger incentive. Merger incentives are only due to bundling strategies. Lemma 1 shows that if there are two mergers, each firm follows a mixed bundling strategy. In the same manner, every firm is incited to merge because merger incentives and bundling incentives are exactly the same here. In this case, two homogeneous mergers are achieved. The proof is exactly the same as the proof of Lemma 1 given by Reisinger (2006). For this reason, we only studied the two-homogeneous merger outcome.

Lemma 2 *Respectively for $\delta \leq \frac{3}{2}(\frac{t_A+t_B}{5t_A+t_B})$, $\frac{3}{2}(\frac{t_A+t_B}{5t_A+t_B}) < \delta \leq \frac{1}{3}\frac{t_B}{6t_A}$, and $\delta > \frac{1}{3}\frac{t_B}{6t_A}$, equilibrium profits are given by:*

$$\Pi_{A_iB_j}^{2*} = \frac{1}{8}(t_A + t_B) + \frac{2}{9}\delta^2 \frac{t_At_B}{t_A + t_B}, \tag{3}$$

$$\Pi_{A_iB_j}^{2*} = \frac{1}{8}(t_A + t_B) + \frac{t_At_B(4(t_A + t_B) - 2\delta(6t_A + t_B) - 4\delta^2 t_A)}{2(t_A - t_B)^2}, \tag{4}$$

$$\Pi_{A_iB_j}^{2*} = \frac{1}{8}t_A - \frac{7}{72}t_B. \tag{5}$$

Proof. See Reisinger (2006) ■

First, we assume that δ is small, *i.e* the correlation of reservation prices is positive. In this case, there are four consumption combinations: $(AB11)$, $(A1B2)$, $(AB22)$ and $(A2B1)$. Figure 3 below presents this demand configuration (i):

Insert Figure 3

Second, we assumed that δ is high. In this case, there are six consumption options: $(A1B2)$, $(AB11)$, $(AB22)$, $(A2B1)$, $(AB22)$ and $(AB11)$. Figure 4 below presents this demand configuration (ii):

Insert Figure 4

For the homogeneous mergers, the profit level explanation is similar to Reisinger (2006): in every case, firms compete, *à la* Bertrand, on each horizontally differentiated energy. But here, they can use bundling. Thus, bundle demands appear. When the correlation is high (δ small), firms compete with their own separate energies by lowering their bundle prices. Therefore, they have no incentive to decrease their bundle prices relative to the prices sum of the separate energies in the independent pricing strategy. Furthermore, bundling allows for consumers to be sorted and profits to be raised. Moreover, this effect increases when correlation decreases. Indeed, each firm can raise the prices of its separate energies. Thus, profits increase. On the other hand, the correlation decrease makes consumers more and more indifferent to the two bundles. Consequently, for a sufficiently weak correlation ($\delta > \delta_1^{HM}$), each bundle competes directly with the rival's bundle. Firms must lower their bundle prices in order to maintain their market shares. However, when this new competition for this level of correlation (δ_1^{HM}), is integrated, the profit maximization does not give an equilibrium. Hence the necessity of computing a touching equilibrium (Economides 1984) between this correlation threshold and the one for which the equilibrium becomes stable (δ_2^{HM}). This implies a linear drop in prices to keep the initial demand structure (i). This new effect dominates the positive sorting effect. The decrease in prices entails both a drop in profits and, for a sufficiently high correlation, a prisoner's dilemma concerning the bundling strategy decision. We compute the equilibrium of the competiton game following a homogeneous merger wave. Results, however, can differ when mergers are heterogeneous. Subsequently, we study this game outcome.

3.2 Bundling and heterogeneous mergers

We assume electric firms A_i merge with gas firms B_j, $\forall i \neq j$, with $i, j = 1, 2$. In this configuration, customers choose between four product combinations. They can either buy the bundle of firm A_1B_2, *i.e.*, $(AB12)$ at price p_{AB}^{12}, or buy the bundle of firm A_2B_1, *i.e.*, $(AB21)$ at price p_{AB}^{21}. They also can either purchase the electricity A from firm A_1B_2 and the gas B from firm A_2B_1, *i.e.*, the product combination $(A1B1)$ at price $p_A^1 + p_B^1$, or purchase the electricity A from firm A_2B_1 and the gas B from firm A_1B_2, *i.e.*, the product combination $(A2B2)$ at price $p_A^2 + p_B^2$. We want to determine prices and profits when firms follow a mixed-bundling strategy but this is interesting only if firms have an incentive to bundle. Thus, we establish this lemma:

Lemma 3 *If $\delta < \frac{1}{2}$, i.e $\rho > -1$, then, in equilibrium, heterogeneously-merged firms follow a mixed-bundling strategy.*

Proof. see Appendix 6.2 ■

In the benchmark, there is no merger incentive. Merger incentives are only due to bundling strategies. Lemma 3 shows that if there are two mergers, each firm adopts a mixed bundling strategy. In the same manner, every firm is incited to merge because merger incentives and bundling ones are exactly the same here. In this case, two heterogeneous mergers are achieved. The proof is exactly the same as the proof of Lemma 3. For this reason, we only study the two-heterogeneous merger outcome.

First, equilibrium demand configurations will be described.[24] These depend on δ. We assume δ is small, that is, ρ is high, *i.e* the correlation is positive. In this case, there

[24]See Appendix 6.2.

are six consumption options: $(A1B1)$, $(AB12)$, $(AB21)$, $(A2B2)$, $(AB21)$, and $(AB12)$. Below, Figure 5 presents this demand configuration (iii):

Insert Figure 5

Second, we assume δ is high. In this case, there are no longer four consumption options left: $(AB12)$, $(A2B2)$, $(AB21)$, and $(A1B1)$. Figure 6 below presents this demand configuration (iv):

Insert Figure 6

Equilibrium prices and profits are computed in Appendix 6.2. Thus, we just have to calculate for which value of δ the demand configuration is changing. If both firms set equilibrium prices as in Appendix 6.2.3, then there exists a δ threshold from which bundle $(AB12)$ is no longer followed by $(AB21)$ but by $(A2B2)$. Calculating this threshold leads to $\delta = \delta_1^{HT} = \frac{1}{6} - \frac{tb}{6ta}$. On the other hand, if firms set equilibrium prices as in Appendix 6.2.4, then we find the threshold δ_2^{HT} beyond which the second demand configuration arises. This threshold is given by $\delta = \delta_2^{HT} = \frac{ta-tb}{5ta+tb}$. For more details, refer to Appendix 6.2.5. For δ between $\frac{1}{6} - \frac{tb}{6ta}$ and $\frac{ta-tb}{5ta+tb}$, firms set prices in such a way that the last consumer purchasing $(AB12)$ is indifferent in the choice between $(AB12)$, $(AB21)$ and $(A2B2)$. Therefore, the first demand configuration still holds. The determination of the equilibrium prices in this region[25] is similar to the one in a standard Hotelling model when we move from local monopoly to competition (Economides, 1984, Gabszewicz and Thisse, 1986). We therefore establish the following lemma:

Lemma 4 *Respectively for* $\delta \leq \frac{1}{6} - \frac{tb}{6ta}$, $\frac{1}{6} - \frac{tb}{6ta} < \delta \leq \frac{ta-tb}{5ta+tb}$, *and* $\delta > \frac{ta-tb}{5ta+tb}$, *equilibrium profits are given by:*

$$\Pi^{2*}_{A_iB_j} = \frac{1}{8}t_A - \frac{7}{72}t_B, \tag{6}$$

$$\Pi^{2*}_{A_iB_j} = \frac{1}{8}(t_A + t_B) + \frac{t_A t_B}{2(t_A - t_B)^2}(3(t_B - t_A) + 2\delta(8t_A + t_B) - 4\delta^2 t_A), \tag{7}$$

$$\Pi^{2*}_{A_iB_j} = \frac{1}{8}(t_A + t_B) - (1 - 4(\delta^2 - \delta))\frac{t_A t_B}{18(t_A + t_B)}. \tag{8}$$

Proof. See Appendix 6.2 ■

Intuitions about profit levels are the same as in the case of homogeneous mergers, but reversed relative to the correlation. In the heterogeneous merger case, bundles are composed of goods with opposite locations. Subsequently, and contrary to the homogeneous merger case, the bundle competition effect appears for low correlation values. In the same way, the sorting effect is also reversed relative to the correlation. Indeed, by sorting consumers, firms can make more profits than they can in cases of independent pricing, when the correlation is weak. Furthermore, when the correlation is high ($\delta < \delta_2^{HT}$), the competition effect between bundles appears and dominates the sorting effect. This is due to the

[25] For more details, see appendix 6.2.6.

opposite locations of merged firms on each energy market. We find a prisoner's dilemma, but now for high correlation values. And now that competition outcomes corresponding to merger waves are studied, in the next section we compute and analyze the SPNE of the game.

4 Equilibrium of the game

In this section, we solve the whole game. Next, we analyze the welfare and competition policy implications.

4.1 Equilibrium computation

At the equilibrium of the merger game, we can write the following proposition:

Proposition 2 *In equilibrium, a merger wave occurs and firms choose a mixed bundling strategy.*

Proof. The merger game presented in Figure 2 establishes five possible outcomes. If there are two homogeneous mergers (respectively heterogeneous) and according to the Lemma 1 (respectively Lemma 3), then firms follow a mixed bundling strategy and profits are given in section 3.1 (respectively 3.2). If there is no merger, then profits are presented in section 2.3. At last, if there is one homogeneous merger (respectively heterogeneous), the proof of Lemma 1 (respectively Lemma 3) allows us to assert that the merged firm follows a mixed bundling strategy.[26] By comparing the different payoffs associated with the various outcomes, we find that in equilibrium, it occurs either a homogeneous merger wave or a heterogeneous one[27] (according to the correlation of reservation prices). ■

The case where the first firms merge with the wrong partner in order to prevent another merger is not feasible. Indeed, when a merger is already achieved, there always exists an incentive to achieve a second merger whatever is the value of delta (see proof of proposition 1 in Reisinger (2006) for the homogeneous case). As firms anticipate this, the first merger will be those for which the competition effect created by the second merger is minimized. Moreover, this first merger is achieved because, if is not the case, the second mover tries to benefit from the discrimination effect by merging and hurts the profit of the first mover. Thus, we are interested in outcomes which trigger a merger wave. As there can be only one type of merger at the same time, that is two homogeneous or two heterogeneous mergers, we compare the profits associated with these outcomes according to δ. Because the game is symmetric, it is sufficient to compare the profit of firm A_1B_1 further to a homogeneous merger wave and the profit of firm A_1B_2 further to a heterogeneous wave.

[26] For clarity reasons, we do not present all asymmetric cases because they are dominated. As an illustration, we present a case in Appendix 6.3. For more details, please contact the authors.

[27] Reisinger (2006) shows, in the extension of his model, that an independent pricing equilibrium appears when the game is sequential. This can occur if firms can commit not to practice bundling. Here, the merger game is sequential. But, as firms can choose in the first stage to merge either in a homogeneous way or in a heterogeneous one, it is never profitable for firms to commit to an independent pricing strategy or to commit not to merge. Indeed, it always exists one type of merger (homogeneous or heterogeneous) which allows firms to earn higher profits than in the separate sales configuration. This is valid when there is only one merger or two sequential mergers.

In order to rank these equilibria profits according to δ, we must order the thresholds for which profit functions are modified. These thresholds are given by δ_1^{HM}, δ_2^{HM}, δ_1^{HT} and δ_2^{HT}. We already know that $\delta_1^{HT} < \delta_2^{HT}$ and $\delta_1^{HM} < \delta_2^{HM}$. Moreover, $\delta_2^{HT} = \frac{t_A - t_B}{5t_A + t_B} < \delta_1^{HM} = \frac{3}{2}(\frac{t_A+t_B}{5t_A+t_B})$. We deduce the following ranking: $\delta_1^{HT} < \delta_2^{HT} < \delta_1^{HM} < \delta_2^{HM}$. There is a turnover between the two types of merger according to the correlation of consumers' reservation values for the two energies. This turnover occurs around three thresholds, *i.e.*, δ_1^*, δ_2^* and δ_3^*. The profits comparison according to δ allows the equilibrium and the associated profits to be computed. The following Proposition[28] presents this equilibrium and Figure 7, below, illustrates the turnover between homogeneous and heterogeneous merger profits:

Proposition 3 *In equilibrium, firms always make more profits than they do in the independent pricing case. Moreover, firms choose to merge either in a homogeneous way or in a heterogeneous one. This depends on the reservation prices correlation. They merge in a homogeneous way for* $0 \leq \delta \leq \delta_1^*$ *and* $\delta_2^* \leq \delta < \delta_3^*$ *and they merge in a heterogeneous one for* $\delta_1^* < \delta < \delta_2^*$ *and for* $\delta_3^* \leq \delta \leq \frac{1}{2}$.

Insert Figure 7

The intuitions behind the homogeneous merger wave and the heterogeneous merger wave have already been explained. There is a trade-off between a sorting effect due to bundling which is positive from the firms' point of view and a competition effect passing through energy bundles ("business-stealing effect", Reisinger 2006). In the homogeneous merger case, this competition effect exists only if the correlation is weak. In the heterogeneous merger case, this competition effect exists only if the correlation is strong. Thus, when the correlation is sufficiently high ($\delta \leq \delta_1^*$), firms avoid this competition effect by merging in a homogeneous way. Conversely, if the correlation is sufficiently weak ($\delta \geq \delta_3^*$), firms avoid this competition effect by merging in a heterogeneous way. The sorting effect is at a maximum for a weaker correlation with heterogeneous mergers than it is with homogeneous ones. Therefore, firms choose to alternate between these two types of mergers when the correlation is intermediate ($\delta_1^* < \delta < \delta_3^*$). This alternation is due to the following fact: according to the type of merger, the maximum profit values occur at different levels of correlation. These maximum values correspond to a strong sorting effect without triggering the business-stealing effect. Indeed, the sorting effect is even stronger than product bundles, since the two firms are similar from consumers' point of view. This lack of differentiation between bundles finally creates this new competition effect.

Concerning the heterogeneous merger, and therefore the bundles of energies with opposite locations, the maximum value of profit is reached at $\delta_2^{HT} \leq \frac{1}{4}$. Concerning the homogeneous merger, and therefore the bundles of goods with the same location, the maximum value of profit is reached at $\delta_1^{HM} \geq \frac{1}{4}$. In both cases, the different opportunities of merger allow firms to benefit better from the sorting effect by positioning their sales on the two energy markets according to the correlation. Because of these merger opportunities, firms avoid the competition effect between bundles. At the equilibrium, the competition effect exists only for the two following ranges of parameters corresponding to

[28] The proof is given in Appendix 6.4.

"touching" equilibria: $\delta_1^* < \delta < \delta_2^{HT}$ and $\delta_1^{HM} < \delta < \delta_3^*$. Moreover, these ranges are very restricted since, respectively, they correspond at the most to $\frac{1}{5} - \frac{16}{10000} \approx \frac{36-3\sqrt{114}}{20} < \delta < \frac{1}{5}$ and $\frac{3}{10} < \delta < \frac{3\sqrt{114}-26}{20} \approx \frac{3}{10} + \frac{16}{10000}$. Such is the case when $t_B \to 0$. Indeed, transportation costs vary the intensity of the two effects and the thresholds defining the different types of equilibria. Intuitively, the weaker the transportation cost t_B, the weaker the sorting and the competition effects. The two maximum profit values tend to get closer. Therefore, the minimum and maximum ranges of correlation become larger. To an extreme degree, when $t_B \to 0$, bundling has no effect and the price of the gas B is equal to its marginal cost of production. We find the Bertrand paradox, since there is no horizontal differentiation of the gas B and the sorting effect does not exist any more. Conversely, when $t_B \to t_A$, the effects are intensified, and for the two merger cases, the sorting effect is stronger and the competition effect between energy bundles (business-stealing effect) does not take place as easily. Indeed, the trade-off between the low price of the bundle and the additional distance to cover for the gas B tends to favor separate energies consumption. Figure 8, below, illustrates these two limit cases:

Insert Figure 8

The possibility of the four energy firms merging with firms, either at the same or at the opposite location, eliminates the prisoner's dilemma, which is already underlined in the two merger types. Indeed, as firms can choose their merger partner in relation to the correlation of reservation prices, firms can benefit better from the sorting effect without being affected by the competiton effect. In order to evaluate the scope of this study, we will focus on welfare implications in the following section.

4.2 Welfare analysis

First, we focus on social welfare. As a benchmark, we calculated the maximum welfare. The welfare is maximized when transportation costs are minimized. Indeed, price levels do not affect social welfare for the reason that the volume of consumption is unchanged in this model. Maximum welfare is achieved when consumers who are located at x_k with $0 \leq x_k \leq \frac{1}{4}$ and $\frac{3}{4} \leq x_k \leq 1$ for $k = A$ (respectively $k = B$) buy electricity A from firm A_1 (respectively gas B from firm B_1) and when consumers who are located at $\frac{1}{4} \leq x_k \leq \frac{3}{4}$ for $k = A$ (respectively $k = B$) buy electricity A from firm A_2 (respectively gas B from firm B_2). This situation corresponds to the independent pricing case for which covered distances are minimal. We note W^{IP} social welfare when energy firms follow an independent pricing strategy:

$$W^{IP} = W^0 - \frac{1}{48}(t_A + t_B), \tag{9}$$

with $W^0 = K_A + K_B - c_A - c_B$.

In this case, consumers always buy the energies that are near their locations. Therefore, welfare is maximal. Now, we will focus on social welfare in cases of merger waves. We describe social welfare at the game equilibrium in the following proposition[29] and in Figure 9:

[29] The proof of the Proposition 4 is given in Appendix 6.5.

Proposition 4 *In equilibrium, social welfare is always lower with bundling strategy than in the independent pricing case or than without merger. Moreover, by noting* Wr *the welfare obtained by Reisinger and* W *the welfare at the equilibrium of our model, we find that* $W = Wr$ *if* $0 \leq \delta \leq \delta_1^*$ *or if* $\delta_2^* < \delta \leq \delta_3^*$*, that* $W < Wr$ *if* $\delta_1^* < \delta \leq \delta_2^*$*, and that* $W > Wr$ *if* $\delta_3^* < \delta \leq 1/2$*.*

The fact that social welfare is always lower with bundling strategy is due to the sorting effect created by this strategy. Moreover, the social welfare differences with the model of Reisinger are explained by the opportunity given to energy firms to merge in different ways according to the correlation between the two energy markets. The main intuition is the following. Firms avoid the competition effect by selecting the right merger partners according to the correlation of consumers' reservation values for the two goods.

Insert Figure 9

When firms do not merge, or when firms sell their goods independently, social welfare is higer than in the equilibrium of our game. The first recommendation is as follows: European Commission should prevent mergers from being allowed to bundle on energy markets, if one relies on our model assumptions. For instance, one might assume efficiency gains which could make merger advantageous from a social welfare point of view. Another way for competition authorities might be to forbid bundling. It is interesting to note that the possibility for firms to choose a type of merger, homogeneous or heterogeneous, makes our results concerning welfare more balanced than those in Reisinger (2006). But, in accordance with Reisinger (2006), we note that bundling is harmful to social welfare. Indeed, the prisoner's dilemma disappears, which increases firms' profits when correlation is low. That increases social welfare. When the correlation is low ($\delta > \delta_3^*$), consumers choose packages with energies from faraway locations, thus there are lower transportation costs than in the model of Reisinger (2006). On the other hand, for the intermediate values of correlation, the possibility for firms to merge in homogeneous or heterogeneous ways can make profits higher but the transportation costs are also considerably higher. This accounts for social welfare jumps in δ_1^* and δ_3^*. Finally, for high correlation values ($\delta < \delta_1^*$), we find the same equilibrium as Reisinger (2006) and the same level of social welfare. Moreover, we observe that the competition authorities generally prefer to take consumers' surplus into account rather than social welfare. Thus, we establish the following corollary[30] to Proposition 4:

Corollary 1 *In equilibrium, the consumers' surplus is always lower than in the independent pricing case or without merger.*

In energy markets, several firms merge and some of these mergers are presented in Table 1 in the Appendix 6.7. We can think that energy firms merge in order to supply bundles. In Table 1, we make list of dowstream market mergers in energy markets. We leave out other types of mergers in energy markets in order to limit other effects than bundling in incentives to merge, as synergy effects due to a vertical integration

[30] The proof for Corollary 1 is given in Appendix 6.6.

for example. So, we can provide merger cases which appear mainly because of bundling strategies created by mergers. In Italy, the electric firm Enel merged in 2004 with the gas retailer Italgestioni in the downstream energy market. This example among others given in Table 1 can be analyzed through the homogeneous and heterogeneous mergers concepts. This depends on merged firms' characteristics with regard to each energy sold in packages.

Thus, we calculate the consumers' surplus. We note S^{IP}, the consumers' surplus for the independent pricing case, corresponding to the maximum surplus case. This value is easily given by social welfare minus two times the merged firm profit in the independent pricing strategy:

$$S^{IP} = W^0 - \frac{13}{48}(t_A + t_B), \tag{10}$$

with $W^0 = K_A + K_B - c_A - c_B$.

We can conclude that the analysis of consumers' surplus gives the same results as the social welfare analysis. The firms' gains from bundling are insignificant in comparison with the bundling's effect on social welfare. The graphical representation of equilibrium consumers' surplus is the same as it is with social welfare, with a lower level and the slopes more pronounced. The analysis of consumers' surplus as social welfare comes to the same conclusion.

5 Conclusion

We observe an increasing number of mergers in the energy markets. A lot of them concern firms from different markets such as gas and electricity. Whatever the merger, it allows firms to supply bi-energy bundles. Our paper studies the bundling effects on merger incentives in energy markets. We show that bundling strategies always create merger incentives for specialized firms (electricity or gas firms). The intuitive explanation is the following. Although competition effects of a merger involving firms from two independent markets are non-existent with an independent pricing, competition effects appear if the merger allows product bundling.

First, we show that there is always an incentive to follow a bundling strategy once the merger is achieved. When bundling is not possible, we find that there is no incentive to merge. From these two results, we deduce that bundling strategy generates not only a merger incentive but also a merger wave. This incentive comes from the sorting effect of the bundling strategy. However, a competition effect, which is negative for firms' profits, is also generated by the bundling strategy. We find that, in order to take better advantage of the sorting effect and to avoid the competition effect, energy firms choose between two merger types. This choice is function of the correlation of consumers' reservation prices for the two energies. An electric firm can merge with a gas firm at the same location on the other circle. An electric firm can also merge with a gas firm at opposite location on the other circle. We call homogeneous and heterogeneous mergers, respectively. These merger opportunities remove the prisoner's dilemma created by the dominance of the competition effect which is emphasized by Reisinger (2006).

Our model has important implications concerning competition policy. We show that bundling strategies have a negative effect on social welfare, but in our model this effect is weaker than in Reisinger (2006). Competition authorities should pay more attention to mergers in domestic markets, such mergers may be authorized by the governments in order to promote national champions. However, we must note that our analysis don't take into consideration potential efficiency gains following a merger. A direction for future research could be the introduction of these effects. The introduction of other effects like efficiency gains could affect the results.

References

Adams WA, Yellen JL. Commodity bundling and the burden of monopoly. Quarterly Journal of Economics 1976;91; 475-498

Anderson SP, Leruth L. Why firms prefer not to price discriminate via mixed bundling. International Journal of Industrial Organization 1993;11; 49-61

Armstrong M, Vickers J. Competitive nonlinear pricing and bundling. Review of Economic Studies 2008;77; 30-60

Barquin J, Bergman L, Crampes C, Glachant JM, Green R, Von Hirschhausen C, Lévêque F, Stoft S. The acquisition of Endesa by gas natural: why the antitrust authorities are right to be cautious. The Electricity Journal 2006;19(2); 62-68

Bazart C. Deregulation under environmental constraints: concentration, horizontal integration and renewable diversification in energy markets. INFER series 2008;Network Industries between Competition and Regulation; 99-121.

Bernard JT, Bolduc D, Belanger D. Quebec residential electricity demand: a microeconomic approach. Canadian Journal of Economics 1996;29(1); 92-113

Bradley M, Desai A, Kim EH. The rationale behind interfirm tender offers: information or synergy? Journal of Financial Economics 1983;11(1-4); 183-206.

Brito D. Preemptive mergers under spatial competition. International Journal of Industrial Organization 2003;10; 1601-1622

Economides N. The principle of minimum differentiation revisited. European Economic Review 1984;24; 345-368

Economides N. Mixed bundling in duopoly. Discussion Paper 1993. EC-93-29, Stern School of Business, N.Y.U

Eckbo BE Horizontal mergers, collusion and stockholder wealth. Journal of Financial Economics 1983;11; 241-273

European Commission, 2006a. Dong/Elsam/EnergiE2 COMP M. 3868, decision of 14 March 2006. Available at: http://ec.europa.eu/comm/competition/mergers/cases/index/m77.html#m_3868.

European Commission, 2006b. E.On/Endesa, COMP M. 4110, decision of 25 April 2006. Available at: http://ec.europa.eu/comm/competition/mergers/cases/decisions/m4110_20060425_20310_en.pdf

Fauli-Oller R. Takeover waves. Journal of Economics and Management Strategy 2000;9; 189-210

Fridolfsson SO, Stennek J. Why mergers reduce profits and raise share prices: a theory of preemptive mergers. Journal of the European Economic Association 2005a;3(5); 1083-1104

Fridolfsson SO et Stennek J. Hold-up of anti-competitive mergers. International Journal of Industrial Organization 2005b; 23 (9-10); 753-775

Gabszewicz JJ, Thisse JF. 1986. Spatial competition and the location of firms. In: R. Arnott (Ed), Location Theory, London: Harwood Academic Press; 1986

Inderst R, Wey C. The incentives for takeover in oligopoly. International Journal of Industrial Organization 2004;22; 1067-1089

Jacobson HK, Fristrup P, Munksgaard J. Integrated energy markets and varying degrees of liberalisation: price links, bundled sales and CHP production exemplified by norther european experiences. Energy Policy 2006;34; 3527-3537

Jensen M, Meckling W. Theory of the firm : Managerial behavior, agency costs and ownership structure. Journal of Financial Economics 1976;3(4); 305 - 360

Kamien M.I, Zang I. The limits of monopolization through acquisition. Quarterly Journal of Economics 1990;105; 465-499

Kamien M.I, Zang I. Monopolization by sequential acquisition. Journal of Law, Economics and Organization 1993;9; 205-229

Kander J. French merger bid creates EU paradox: national control of energy is at issue. International Herald Tribune 2006;march 5

Linqvist T, Stennek J. The insider's dilemma: an experiment on merger formation. Experimental Economics 2005;8 (3); 267-284

Marsden P, Schepens P, Whelan P. Competition Law and the Consumer: Results of the Legislative Survey on Fourteen European Competition Law Regimes. BIICL Report in conjunction with Consumers International 2007

Matsushima N. Horizontal mergers and merger waves in a location model. Australian Economic Papers, September 2001, 263-286

McAfee RP, McMillan J, Whinston MD. Multiproduct monopoly, commodity bundling, and correlation of values. Quarterly Journal of Economics 1989;104; 371-383

Molnar J. Preemptive horizontal mergers: theory and evidence. Research discussion papers 2007;17/2007;Bank of Finland

Nalebuff B. Bundling as an entry barrier. Quarterly Journal of Economics 2004;119; 159-187

Nesbakken R. Energy consumption for space heating: a discrete-continuous approach. Scandinavian Journal of Economics 2001;103(1); 165-184

Nilssen T, Sorgard L. Sequential horizontal mergers. European Economic Review 1998;42; 1683-1702

Peitz M. Bundling may blockade entry. International Journal of Industrial Organization 2008; 26; 41-58

Reisinger M. Product bundling and the correlation of valuations in duopoly. Mimeo 2006, Munich

Rodrigues V. Endogenous mergers and market structure. International Journal of Industrial Organization 2001;19(8); 1245-1261

Salant SW, Switzer S, Reynolds RJ. Losses from horizontal merger: the effects of an exogenous change in industry structure on Cournot-Nash equilibrium. Quartermy Journal of Economics 1983;93; 185-199

Schmalensee R. Gaussian demand and commodity bundling. Journal of Business 1984;57; 211 - 230

Stigler G. Monopoly and oligopoly by merger. American Economic Review 1950;40; 23-34

Thanassoulis J. Competitive mixed bundling and consumer surplus. Journal of Economics and Management Strategy 2007;16; 437-467

Toh K-H. The impact of convergence of the gas and electricity industries: Trends and policy implications. Working Paper 2003, IEA; http://www.iea.org/papers/2003/toh.pdf

Verde S. Everybody merges with somebody—The wave of M&As in the energy industry and the EU merger policy. Energy Policy 2008;36(3); 1125-1133

6 Appendices

6.1 Independent pricing case

In the independent pricing case, the computation of the equilibrium is the same as in the standard model of Salop (1979). We model two independent and horizontally differentiated markets. It should be noted that Π_{A_i} (respectively Π_{B_j}) is the profit of the single firm A_i (respectively B_j). In every case, equilibrium prices are given by:

$$\begin{aligned} p_A^* &= c_A + \frac{1}{4}t_A, \\ p_B^* &= c_B + \frac{1}{4}t_B. \end{aligned} \tag{11}$$

First, we consider the case where there is no merger. Thus, there are two monoproduct firms in each energy market, A and B, competing in prices. The equilibrium profits are given by:

$$\begin{aligned} \Pi_{A_i}^* &= \frac{1}{8}t_A, \\ \Pi_{B_j}^* &= \frac{1}{8}t_B. \end{aligned} \tag{12}$$

We note that $\Pi_{A_iB_j}^z$ is the profit of the merged firm A_iB_j where $z = 1, 2$ is the number of mergers. Whether there are one or two homogeneous mergers, the equilibrium profits are given by:

$$\begin{aligned} \forall i &= j, \qquad \Pi_{A_iB_j}^{2*} = \frac{1}{8}t_A + \frac{1}{8}t_B, \qquad \text{or} \\ \forall i &= j, \qquad \Pi_{A_iB_j}^{1*} = \frac{1}{8}t_A + \frac{1}{8}t_B, \qquad \Pi_{A_{-i}}^* = \frac{1}{8}t_A, \qquad \Pi_{B_{-j}}^* = \frac{1}{8}t_B. \end{aligned} \tag{13}$$

Whether there are one or two heterogeneous mergers, the equilibrium profits are given by:

$$\begin{aligned} \forall i &\neq j, \qquad \Pi_{A_iB_j}^{2*} = \frac{1}{8}t_A + \frac{1}{8}t_B, \qquad \text{or} \\ \forall i &\neq j, \qquad \Pi_{A_iB_j}^{1*} = \frac{1}{8}t_A + \frac{1}{8}t_B, \qquad \Pi_{A_{-i}}^* = \frac{1}{8}t_A, \qquad \Pi_{B_{-j}}^* = \frac{1}{8}t_B. \end{aligned} \tag{14}$$

6.2 Heterogeneous mergers

6.2.1 Proof of the Lemma 3

In the case of an heterogeneous merger wave, the firms A_i and B_j are merged $\forall i \neq j$ with $i, j = 1, 2$. Let us analyze if there is an incentive for the merged firm A_1B_2 to introduce a bundle. First, we consider the case where both firms do not bundle. Since the equilibrium is symmetric, both firms charge the same independent prices p_A^{IP} and p_B^{IP}, and earn profits of $\Pi_{A_iB_j}^* = \frac{1}{2}(p_A^{IP} - c_A + p_B^{IP} - c_B)$ $\forall i \neq j$ with $i, j = 1, 2$. Now, if firm A_1B_2 introduces a bundle, that means selling both goods together at a price $p_{AB}^{12} < p_A^1 + p_B^2$. We analyze the case where $p_{AB}^{12} = p_A^{IP} + p_B^{IP}$, but where $p_A^1 = p_A^{IP} + \varepsilon_1$ and $p_B^2 = p_B^{IP} + \varepsilon_1$, with $\varepsilon_1 > 0$ but small. So, the firm A_1B_2 increases its profits raising its independent prices by ε_1 and sets the bundle price equal to the sum of the independent prices.

We have to distinguish between two cases, either if δ is "near" $\frac{1}{2}$ or not, because this changes the demand structure on the circles. First, look at the case where δ is not near $\frac{1}{2}$. If firms do not bundle there are four demand regions on the circles, namely $(A1B1)$, $(A1B2)$, $(A2B2)$, and $(A2B1)$. The frontiers between these regions (or the marginal consumers) are given by $\frac{1}{4}-\delta$ for the frontier between $(A1B1)$ and $(A1B2)$, by $\frac{1}{4}$ for $(A1B2)$ and $(A2B2)$, by $\frac{3}{4}$ for the frontier between $(A2B2)$ and $(A1B2)$ and finally by $\frac{3}{4}-\delta$ for $(A1B2)$ and $(A1B1)$.

If the firm A_1B_2 introduces the bundle $(AB12)$, the frontiers are changed to $\frac{1}{4}-\delta-\frac{\varepsilon_1}{t_B}$ for the frontier between $(A1B1)$ and $(AB12)$, to $\frac{1}{4}+\frac{\varepsilon_1}{t_A}$ for $(AB12)$ and $(A2B2)$, to $\frac{3}{4}-\frac{\varepsilon_1}{t_A}$ for the frontier between $(A2B2)$ and $(AB12)$ and finally to $\frac{3}{4}-\delta-\frac{\varepsilon_1}{t_B}$ for $(AB12)$ and $(A1B1)$. The new profit function of firm A_1B_2 is given by:

$$\begin{aligned}\Pi^{**}_{A_1B_2} &= (p_A^1+p_B^2-c_A-c_B)\left(2\varepsilon_1(\frac{1}{t_A}+\frac{1}{t_B})\right)+(p_A^1-c_A+\varepsilon_1)\left(\frac{1}{2}-2\varepsilon_1\frac{1}{t_B}\right) \quad (15)\\ &\quad +(p_B^2-c_B+\varepsilon_1)\left(\frac{1}{2}-2\varepsilon_1\frac{1}{t_A}\right),\end{aligned}$$

or

$$\Pi^{**}_{A_1B_2}=\Pi^{*}_{A_1B_2}+2(p_A^1-c_A)\frac{\varepsilon_1}{t_A}+2(p_B^2-c_B)\frac{\varepsilon_1}{t_B}+\varepsilon_1-2\frac{(\varepsilon_1)^2}{t_A}-2\frac{(\varepsilon_1)^2}{t_B}.$$

This profit is always higher than the previous profit $\Pi^{*}_{A_1B_2}$ as long as $\delta>0$ because ε_1 can made arbitrary small and so $(\varepsilon_1)^2$ tends faster towards 0 than ε_1. We made the proof than the merged firm A_1B_2 has an incentive to introduce its bundle. Let us focus on firm A_2B_1 to introduce its bundle if the firm A_1B_2 is already bundling. The profit of firm A_2B_1 if firm A_1B_2 bundles while firm A_2B_1 not is given by:

$$\Pi^{*}_{A_2B_1}=(p_A^2-c_A)\left(\frac{1}{2}-2\varepsilon_1(\frac{1}{t_A})\right)+(p_B^1-c_B)\left(\frac{1}{2}-2\varepsilon_1(\frac{1}{t_B})\right).$$

If the firm A_2B_1 chooses to bundle $(AB21)$ and set $p_{AB}^{21}=p_A^{IP}+p_B^{IP}$, and sells their goods independently at the price $p_A^2=p_A^{IP}+\varepsilon_2$ and $p_B^1=p_B^{IP}+\varepsilon_2$, with $\varepsilon_2>0$ but small, the frontiers are given by $\frac{1}{4}-\delta-\frac{(\varepsilon_1+\varepsilon_2)}{t_B}$ for the frontier between $(A1B1)$ and $(AB12)$, by $\frac{1}{t_A-t_B}(\frac{1}{4}t_B-t_B\delta-\frac{1}{4}t_A)$ for $(AB12)$ and $(AB21)$, by $\frac{1}{4}-\delta+\frac{(\varepsilon_1+\varepsilon_2)}{t_B}$ for the frontier between $(AB21)$ and $(A2B2)$, by $\frac{3}{4}-\delta-\frac{(\varepsilon_1+\varepsilon_2)}{tB}$ for $(A2B2)$ and $(AB21)$, by $\frac{1}{t_A-t_B}(-\frac{3}{4}t_A+\frac{3}{4}t_B-t_B\delta)$ for the frontier between $(AB21)$ and $(AB12)$ and finally by $\frac{3}{4}-\delta+\frac{(\varepsilon_1+\varepsilon_2)}{t_B}$ for $(AB12)$ and $(A1B1)$. The new profit function of firm A_2B_1, when it proposes bundles, is then:

$$\begin{aligned}\Pi^{**}_{A_2B_1} &= (p_A^2+p_B^1-c_A-c_B)\left(2(\varepsilon_1+\varepsilon_2)(\frac{1}{t_B})-\frac{1}{2}+\frac{1}{t_A-t_B}(\frac{1}{2}t_B-\frac{1}{2}t_A\right) \quad (16)\\ &\quad +(p_A^2-c_A+\varepsilon_2)\left(\frac{1}{2}-2(\varepsilon_1+\varepsilon_2)(\frac{1}{t_B})\right)+(p_B^1-c_B+\varepsilon_2)\left(\frac{1}{2}-2(\varepsilon_1+\varepsilon_2)(\frac{1}{t_B})\right)\\ &= \Pi^{*}_{A_2B_1}+\varepsilon_2-4\left(\frac{(\varepsilon_2)^2+\varepsilon_1\varepsilon_2}{t_B}\right).\end{aligned}$$

Thus, for ε_1 and ε_2 small, bundling is profitable since $(\varepsilon_2)^2$ and $(\varepsilon_1\varepsilon_2)$ tend faster towards 0 than ε_2. We shown that bundling is always a profitable strategy for δ small.

Now let us turn the case where δ is near $\frac{1}{2}$. First, we analyze the incentive of firm A_1B_2 to introduce its bundle while the other firm practices independent pricing. If firm A_1B_2 does not bundle, product combinations are: $(A1B2)$, $(A2B2)$, $(A2B1)$ and $(A1B1)$. The frontiers are given by $\frac{1}{4}$ for the frontier between $(A1B2)$ and $(A2B2)$, by $\frac{3}{4}-\delta$ for $(A2B2)$ and $(A2B1)$, by $\frac{3}{4}$ for the frontier between $(A2B1)$ and $(A1B1)$and finally by $\frac{5}{4}-\delta$ for $(A1B1)$ and $(A1B2)$. If merged firm A_1B_2 bundles, then the frontiers are given by $\frac{1}{4}+\frac{\varepsilon_1}{t_A}$ for the frontier between $(AB12)$ and $(A2B2)$, by $\frac{3}{4}-\delta-\frac{\varepsilon_1}{t_B}$ for $(A2B2)$ and $(A2B1)$, by $\frac{3}{4}+\frac{\varepsilon_1}{t_A}$ for the frontier between $(A2B1)$ and $(A1B1)$ and finally by $\frac{5}{4}-\delta-\frac{\varepsilon_1}{t_B}$ for $(A1B1)$ and $(AB12)$. The profit of firm A_1B_2 if it bundles is:

$$\begin{aligned}\Pi^{**}_{A_1B_2} &= (p^1_A+p^2_B-c_A-c_B)\left(\varepsilon_1(\frac{1}{t_A}+\frac{1}{t_B})+\delta\right) \\ &\quad +(p^1_A-c_A+\varepsilon_1)\left(\frac{1}{2}-\varepsilon_1(\frac{1}{t_A}+\frac{1}{t_B})-\delta\right) \\ &\quad +(p^2_B-c_B+\varepsilon_1)\left(\frac{1}{2}-\varepsilon_1(\frac{1}{t_A}+\frac{1}{t_B})-\delta\right),\end{aligned} \tag{17}$$

or

$$\begin{aligned}\Pi^{**}_{A_1B_2} &= (p^1_A-c_A+p^2_B-c_B)\left(\frac{1}{2}-\varepsilon_1(\frac{1}{t_A}+\frac{1}{t_B})-\delta\right) \\ &= \Pi^{*}_{A_1B_2}+\varepsilon_1(1-2\delta)-2(\varepsilon_1)^2\left(\frac{1}{t_A}+\frac{1}{t_B}\right).\end{aligned} \tag{18}$$

$\Pi^{**}_{A_1B_2}$ is always higher than $\Pi^{*}_{A_1B_2}$ if $\delta<\frac{1}{2}$ since $(\varepsilon_1)^2$ tends faster towards 0 than ε_1. Therefore, A_1B_2 has an incentive to bundle. Now, let us analyze the profit of the firm A_2B_1 if the firm A_1B_2 is already bundling. If firm A_2B_1 chooses not to bundle, its profit is:

$$\begin{aligned}\Pi^{*}_{A_2B_1} &= (p^2_A+p^1_B-c_A-c_B)\left(\frac{1}{2}+\delta+\varepsilon_1(\frac{1}{t_A}+\frac{1}{t_B})\right) \\ &\quad +(p^2_A-c_A)\left(-\varepsilon_1(\frac{1}{t_A}+\frac{1}{t_B})-\delta\right)+(p^1_B-c_B)\left(-\varepsilon_1(\frac{1}{t_A}+\frac{1}{t_B})-\delta\right) \\ &= \frac{1}{2}(p^2_A+p^1_B-c_A-c_B).\end{aligned} \tag{19}$$

If firm A_2B_1 also bundles, it sets prices $p^{21}_{AB}=p^{IP}_A+p^{IP}_B$, sells its goods separately at $p^2_A=p^{IP}_A+\varepsilon_2$ and $p^1_B=p^{IP}_B+\varepsilon_2$, with $\varepsilon_2>0$ but small. Now, the frontiers are given by $\frac{1}{4}+\frac{(\varepsilon_1+\varepsilon_2)}{t_A}$ for the frontier between $(AB12)$ and $(A2B2)$, by $\frac{3}{4}-\delta-\frac{(\varepsilon_1+\varepsilon_2)}{t_B}$ for $(A2B2)$ and $(AB21)$, by $\frac{3}{4}+\frac{(\varepsilon_1+\varepsilon_2)}{t_A}$ for the frontier between $(AB21)$ and $(A1B1)$ and finally by $\frac{5}{4}-\delta-\frac{(\varepsilon_1+\varepsilon_2)}{t_B}$ for $(A1B1)$ and $(AB12)$. Profit of firm A_2B_1 if both firms bundle is then:

$$\begin{aligned}\Pi^{**}_{A_2B_1} &= (p^2_A+p^1_B-c_A-c_B)\left(\frac{1}{2}+\varepsilon_1(\frac{1}{t_A}+\frac{1}{t_B})+\varepsilon_2(\frac{1}{t_A}+\frac{1}{t_B})+\delta\right) \\ &\quad +(p^2_A-c_A+\varepsilon_1)\left(-\varepsilon_1(\frac{1}{t_A}+\frac{1}{t_B})-\varepsilon_2(\frac{1}{t_A}+\frac{1}{t_B})-\delta\right) \\ &\quad +(p^1_B-c_B+\varepsilon_1)\left(-\varepsilon_1(\frac{1}{t_A}+\frac{1}{t_B})-\varepsilon_2(\frac{1}{t_A}+\frac{1}{t_B})-\delta\right),\end{aligned} \tag{20}$$

or

$$\Pi^{**}_{A_2B_1} = \Pi^{*}_{A_2B_1} + \varepsilon_2(1-2\delta) - (2\varepsilon_1\varepsilon_2)\left(\frac{1}{t_A}+\frac{1}{t_B}\right) - (2\varepsilon_2)^2\left(\frac{1}{t_A}+\frac{1}{t_B}\right). \qquad (21)$$

If ε_1 and ε_2 are small, then $\Pi^{**}_{A_2B_1} > \Pi^{*}_{A_2B_1}$, provided that $\delta < \frac{1}{2}$. Thus, firm A_2B_1 also has an incentive to bundle.

6.2.2 Proof of the consumption combinations:

In order to study the different equilibria of heterogeneous merger waves, we have to establish several claims concerning consumption combinations:

Claim 1 *There cannot exist direct rivalry between product combination* $(A1B1)$ *and* $(A2B2)$.

Proof. The method of proof is the same than for claim 1 of Reisinger (2006) ■

Claim 2 .
($\star$) *Take* x_A *and* x'_A *with* $0 \le x_A, x'_A \le \frac{1}{2}$ *and* $x'_A < x_A$.
If $(AB12)$ *is optimal at* x_A*, then* $(AB21)$ *can never be optimal at* x'_A.
($\star\star$) *Take* x_A *and* x'_A *with* $\frac{1}{2} \le x_A, x'_A \le 1$ *and* $x'_A < x_A$.
If $(AB21)$ *is optimal at* x_A*, then* $(AB12)$ *can never be optimal at* x'_A.

Proof. The method of proof is the same than for claim 2 of Reisinger (2006) ■

Claim 3 .
($\star$) *Take* x_A *and* x'_A *with* $0 \le x_A, x'_A \le \frac{1}{2}$ *and* $x'_A < x_A$.
If $(A1B1)$ *is optimal at* x_A*, then* $(A2B2)$ *can never be optimal at* x'_A.
($\star\star$) *Take* x_A *and* x'_A *with* $\frac{1}{2} \le x_A, x'_A \le 1$ *and* $x'_A < x_A$.
If $(A2B2)$ *is optimal at* x_A*, then* $(A1B1)$ *can never be optimal at* x'_A.

Proof. The method of proof is the same than for claim 3 of Reisinger (2006) ■

Claim 4 .
($\star$) *Take* x_A *and* x'_A *with* $0 \le x_A, x'_A \le \frac{1}{2}$ *and* $x'_A < x_A$.
If $(AB12)$ *is optimal at* x_A*, then* $(A2B2)$ *can never be optimal at* x'_A.
($\star\star$) *Take* x_A *and* x'_A *with* $\frac{1}{2} \le x_A, x'_A \le 1$ *and* $x'_A < x_A$.
If $(A2B2)$ *is optimal at* x_A*, then* $(AB12)$ *can never be optimal at* x'_A.

Proof. The method of proof is the same than for claim 4 of Reisinger (2006) ■

Claim 5 .
($\star$) *Take* x_A *and* x'_A *with* $0 \le x_A, x'_A \le \frac{1}{2}$ *and* $x'_A < x_A$.
If $(A1B1)$ *is optimal at* x_A*, then* $(AB21)$ *can never be optimal at* x'_A.
($\star\star$) *Take* x_A *and* x'_A *with* $\frac{1}{2} \le x_A, x'_A \le 1$ *and* $x'_A < x_A$.
If $(AB21)$ *is optimal at* x_A*, then* $(A1B1)$ *can never be optimal at* x'_A.

Proof. The method of proof is the same than for claim 5 of Reisinger (2006) ■

6.2.3 Proof of the equilibrium: heterogeneous mergers and strong correlation

Assuming δ small, we consider a consumer at location $x_A = 0$. If we move clockwise on circle A, then the consumer who is indifferent between $(A1B1)$ and $(AB12)$ is located at:

$$x_A = \frac{1}{4} + \frac{p_{AB}^{12} - p_A^1 - p_B^1}{t_B} - \delta. \tag{22}$$

The product combination which is bought to the right of $(AB12)$ is $(AB21)$. The marginal consumer between to buy the bundle $(AB12)$ and the bundle $(AB21)$ is located at:

$$x_A = \frac{1}{t_A - t_B}(p_{AB}^{21} - p_{AB}^{12} + \frac{1}{4}(t_A - t_B) + t_B\delta). \tag{23}$$

Moving further to the right the next combination which is bought is $(A2B2)$ and the marginal consumer is located at:

$$x_A = \frac{1}{4} + \frac{p_A^2 + p_B^2 - p_{AB}^{21}}{t_B} - \delta. \tag{24}$$

If we pass the point $1/2$ and move upward on the left side of the circle, we get the same product structure as on the right side, because of symmetry, only with firm A_i and B_j reversed. The profit function of firm A_1B_2 is therefore:

$$\begin{aligned}\Pi_{A_1B_2} \quad = \quad & (p_A^1 - c_A)(\frac{1}{4} + \frac{p_{AB}^{12} - p_A^1 - p_B^1}{t_B} - \delta + \frac{1}{4} + \delta - \frac{p_{AB}^{12} - p_A^1 - p_B^1}{t_B}) \\ & + (p_{AB}^{12} - c_A - c_B)(\frac{p_{AB}^{21} - p_{AB}^{12} + \frac{1}{4}(t_A - t_B) + t_B\delta}{t_A - t_B} - \frac{1}{4} - \frac{p_A^1 + p_B^1 - p_{AB}^{12}}{t_B} + \delta \\ & + \frac{3}{4} + \frac{p_A^1 + p_B^1 - p_{AB}^{12}}{t_B} - \delta - \frac{p_{AB}^{12} - p_{AB}^{21} + \frac{3}{4}(t_A - t_B) + t_B\delta)}{t_A - t_B}) \\ & + (p_B^2 - c_B)(\frac{3}{4} + \frac{p_{AB}^{21} - p_A^2 - p_B^2}{t_B} - \delta - \frac{1}{4} - \frac{p_A^2 + p_B^2 - p_{AB}^{21}}{t_B} + \delta).\end{aligned} \tag{25}$$

Because of symmetry we get a similar function for firm A_2B_1. Calculating prices and profits, for both firms, we get:

$$\begin{aligned} p_A^* &= c_A + \frac{1}{4}t_A - \frac{1}{6}t_B, \\ p_B^* &= c_B + \frac{1}{12}t_B, \\ \forall i \neq j \qquad p_{AB}^{ij*} &= c_A + c_B + \frac{1}{4}(t_A - t_B), \\ \forall i \neq j \qquad \Pi_{A_iBj}^{z=2*} &= \frac{1}{8}t_A - \frac{7}{72}t_B. \end{aligned} \tag{26}$$

with $i, j = 1, 2$. When the value of δ increases, there is a disappearance of bundle options. It exist a value of δ where the bundle $(AB12)$ is not following by the bundle $(AB21)$. At this threshold demand structure changes and there is only one option of bundle consumption.

6.2.4 Proof of the equilibrium: heterogeneous mergers and weak correlation

Assuming δ high, we consider a consumer at location $x_A = 0$. If we move clockwise on circle A, there is a consumer who is indifferent between $(AB12)$ and $(A2B2)$ located at:

$$x_A = \frac{1}{4} + \frac{p_A^2 + p_B^2 - p_{AB}^{12}}{t_A}. \tag{27}$$

If we move clockwise on circle A, the next product combination is $(AB21)$. So, The marginal consumer between $(A2B2)$ and $(AB21)$ is located at:

$$x_A = \frac{3}{4} + \frac{p_{AB}^{21} - p_A^2 - p_B^2}{t_B} - \delta. \tag{28}$$

If we pass the point $1/2$ and move upward on the left side of the circle A, we get the same product structure as on the right side, because of symmetry, only with firm A_i and B_j reversed. Therefore, the profit function of firm A_1B_2 is:

$$\begin{aligned}
\Pi_{A_1B_2} = {} & (p_{AB}^{12} - c_A - c_B)(\frac{1}{4} + \frac{p_A^2 + p_B^2 - p_{AB}^{12}}{t_A} - \frac{1}{4} - \frac{p_{AB}^{12} - p_A^1 - p_B^1}{t_B} + \delta) \\
& + (p_A^1 - c_A)(\frac{5}{4} + \frac{p_{AB}^{12} - p_A^1 - p_B^1}{t_B} - \delta - \frac{3}{4} + \frac{p_A^1 + p_B^1 - p_{AB}^{21}}{t_A}) \\
& + (p_B^2 - c_B)(\frac{3}{4} + \frac{p_{AB}^{21} - p_A^2 - p_B^2}{t_B} - \delta - \frac{1}{4} - \frac{p_A^2 + p_B^2 - p_{AB}^{12}}{t_A}).
\end{aligned} \tag{29}$$

Because of symmetry we get a similar function for firm A_2B_1. Calculating prices and profits, for both firms, we get:

$$\begin{aligned}
& p_A^* = c_A + \frac{1}{4}t_A + (\frac{1}{2} - \delta)\frac{t_At_B}{3(t_A + t_B)}, \\
& p_B^* = c_B + \frac{1}{4}t_B + (\frac{1}{2} - \delta)\frac{t_At_B}{3(t_A + t_B)}, \\
& \forall i \neq j \qquad p_{AB}^{ij*} = c_A + c_B + \frac{1}{4}(t_A + t_B), \\
& \forall i \neq j \qquad \Pi_{A_iB_j}^{z=2*} = \frac{1}{8}(t_A + t_B) - (1 - 4(\delta^2 - \delta))\frac{t_At_B}{18(t_A + t_B)}.
\end{aligned} \tag{30}$$

6.2.5 Proof of the intermediate thresholds: heterogeneous mergers

For the profit function (26) arises, $(A1B1)$ must be followed by $(AB12)$ and not by $(AB21)$. The frontier between $(A1B1)$ and $(AB12)$ at the equilibrium prices is given by:

$$x_A = \frac{1}{12} - \delta. \tag{31}$$

The frontier between $(A1B1)$ and $(AB21)$ at the equilibrium prices is given by:

$$x_A = \frac{1}{4} + \frac{t_B\delta}{t_A - t_B}. \tag{32}$$

For the demand structure (*iii*) arises, then (31) must be smaller than (32). This gives the first threshold:

$$\delta_1^{HT} = \frac{1}{6} - \frac{t_B}{6t_A}. \tag{33}$$

For the profit profit function (29) to arise, the option consumption ($A1B1$) must be followed by ($AB21$) and not by ($AB12$). Calculating in the same way as before by inserting the equilibrium prices corresponding to the profit function (29) in (31) and (32) gives that demand structure (*iv*) arises only if:

$$\delta > \delta_2^{HT} = \frac{ta - tb}{5ta + tb}. \tag{34}$$

6.2.6 Proof of the intermediate equilibrium: heterogeneous mergers

In the region such as $\frac{1}{6} - \frac{t_B}{6t_A} < \delta \leq \frac{ta-tb}{5ta+tb}$, firms set their prices in such a way that demand structure (*iv*) arises. Prices are determined in order to satisfy the following constraint:

$$\frac{1}{4} + \frac{p_A^2 + p_B^2 - p_{AB}^{12}}{t_A} \leq \frac{3}{4} + \frac{p_{AB}^{21} - p_A^2 - p_B^2}{t_B} - \delta \tag{35}$$

This means that ($A2B2$) is followed by ($AB12$) and not by ($AB21$), and that thresholds δ_1^{HT} and δ_2^{HT} are given by (26) and (30) respectively. Because of the instability of the demands for these parameter values, we use a linear interpolation of the equilibrium prices given by (26) for δ_1^{HT} and by (30) for δ_2^{HT}. We check that prices and profits given below constitute an equilibrium in the competition game:

$$\begin{aligned}
p_A^* &= c_A + \frac{1}{4}t_A + \frac{t_A t_B}{2(t_A - t_B)^2}(3(t_B - t_A) + 2\delta(8t_A + t_B)), \qquad (36)\\
p_B^* &= c_B + \frac{1}{4}t_B + \frac{t_A t_B}{2(t_A - t_B)^2}(3(t_B - t_A) + 2\delta(8t_A + t_B)),\\
\forall i &\neq j \quad p_{AB}^{ij*} = c_A + c_B + \frac{1}{4}(t_A + t_B) + \frac{t_A t_B}{2(t_A - t_B)^2}(6(t_B - t_A) + 6\delta(5t_A + t_B),\\
\forall i &\neq j \quad \Pi_{A_iBj}^{z=2*} = \frac{1}{8}t_A + \frac{1}{8}t_B + \frac{t_A t_B}{2(t_A - t_B)^2}(3(t_B - t_A) + 2\delta(8t_A + t_B) - 4\delta^2 t_A).
\end{aligned}$$

6.3 Proof of the Proposition 2

Consider a homogeneous merger case, where A_1 and B_1 merge and the two other firms A_2 and B_2 are independent. This appendix is still valid if A_2 and B_2 merge but sell their products separately. The merger profit of A_2 and B_2 is merely the sum of Π_{A_2} and Π_{B2}. As an illustration, we focus on the case where correlation of reservation values is weak, that is for $0 < \delta < \frac{3(ta+tb)}{2(5ta+tb)}$. If the merged firm follows an independent pricing strategy, then profits are given by:

$$\begin{aligned}
\Pi_{A_1B1} &= \frac{1}{8}t_A + \frac{1}{8}t_B,\\
\Pi_{A_2} &= \frac{1}{8}t_A \qquad \text{and} \qquad \Pi_{B2} = \frac{1}{8}t_B.
\end{aligned}$$

Prices are given by: $p_A^1 = p_A^2 = \frac{1}{4}t_A$ and $p_B^1 = p_B^2 = \frac{1}{4}t_B$.

If the merged firm practices mixed bundling, profits are the following:

$$\Pi_{A_1B1} = \frac{t_B^2 + 2t_At_B + t_A^2 + 4\delta^2 t_At_B}{8(t_A + t_B)},$$
$$\Pi_{A_2} = \frac{1}{8}t_A \quad \text{and} \quad \Pi_{B2} = \frac{1}{8}t_B.$$

Prices are given by: $p_{AB}^{11} = \frac{1}{4}t_A + \frac{1}{4}t_B$, $p_A^1 = \frac{1}{4}\frac{t_A(2t_B\delta+t_B+t_A)}{t_A+t_B}$, $p_B^1 = \frac{1}{4}\frac{t_B(2t_A\delta+t_A+t_B)}{t_A+t_B}$, $p_A^2 = \frac{1}{4}t_A$ and $p_B^2 = \frac{1}{4}t_B$.

Comparing these two outcomes, since $\frac{t_B^2+2t_At_B+t_A^2+4\delta^2 t_At_B}{8(t_A+t_B)} > \frac{1}{8}t_A + \frac{1}{8}t_B$, the merged firm A_1B_1 has an incentive to practice mixed bundling. There is a trade-off between two effects. First, the bundle of the merged firm decreases the market shares of independent firms. Then, as prices of goods sold independently of merged firm are higher than those of independent firms (*e.g.* $p_A^1 > p_A^2$ and $p_B^1 > p_B^2$), there is a positive effect on the market shares of independent firms. In this configuration, these two effects perfectly offset, what explains that the profits of independent firms are not affected by the rival's bundle. By increasing its prices of separate sales, with unchanged market share, the competitor earns more profits by bundling its goods together.

6.4 Proof of the Proposition 3

Profits corresponding to homogeneous and heterogeneous merger waves are equal for three values of δ parameter.

Indeed, for $\delta_1^* = \frac{3(24t_A^2+27t_At_B+3t_B^2-\sqrt{21t_B^4+246t_B^3t_A+981t_B^2t_A^2+1212t_A^3t_B+456t_A^4})}{4(10t_A^2+7t_At_B+t_B^2)}$, with $\delta_1^{HT} < \delta_1^* < \delta_2^{HT}$, the heterogeneous merger profit corresponding to the equilibrium (7) is equal to the homogeneous merger profit corresponding to the equilibrium (3). After δ_1^*, the equilibrium profit (7) becomes greater than the equilibrium profit (3).

Next, for $\delta_2^* = \frac{1}{4}$, with $\delta_2^{HT} < \delta_2^* < \delta_1^{HM}$, the heterogeneous merger profit corresponding to the equilibrium (8) is equal to the homogeneous merger profit corresponding to the equilibrium (3). After δ_2^*, the equilibrium profit (3) becomes greater than to the equilibrium profit (8).

Finally, for $\delta_3^* = \frac{-(52t_A^2+67t_At_B+7t_B^2-\sqrt{21t_B^4+246t_B^3t_A+981t_B^2t_A^2+1212t_A^3t_B+456t_A^4})}{4(10t_A^2+7t_At_B+t_B^2)}$, with $\delta_1^{HM} < \delta_3^* < \delta_2^{HM}$, the heterogeneous merger profit corresponding to the equilibrium (8) is equal to the homogeneous merger profit corresponding to the equilibrium (4). After δ_3^*, the equilibrium profit (8) becomes greater than the equilibrium profit (4).

It is easy to prove these different profit functions are monotonic for considered parameter values. Thus, profit differences increase or decrease as specified here. It is also easy to prove that there is only for these three values of δ, that are δ_1^*, δ_2^*, and δ_3^*, that profits of heterogeneous and homogeneous merger wavesbecome level. Moreover, for $t_A \geq t_B \geq 0$, the following ranking is still valid: $0 \leq \delta_1^{HT} \leq \delta_1^* \leq \delta_2^{HT} \leq \delta_2^* = \frac{1}{4} \leq \delta_1^{HM} \leq \delta_3^* \leq \delta_2^{HM} \leq \frac{1}{2}$. We can deduce the following lemma:

Lemma 5 *If $0 \leq \delta \leq \delta_1^*$, in equilibrium, firms choose to merge in a homogeneous way. Prices and profits are given by (3).*

If $\delta_1^* < \delta < \delta_2^*$, in equilibrium, firms choose to merge in a heterogeneous way. Prices and profits are given by (36) for $\delta_1^* < \delta < \delta_2^{HT}$ and by (30) for $\delta_2^{HT} \leq \delta < \delta_2^*$.

If $\delta_2^* \le \delta < \delta_3^*$, in equilibrium, firms choose to merge in a homogeneous way. Prices and profits are given by (3) for $\delta_2^* \le \delta < \delta_1^{HM}$ and by (4) for $\delta_1^{HM} < \delta < \delta_3^*$.

If $\delta_3^* \le \delta \le \frac{1}{2}$, in equilibrium, firms choose to merge in a heterogeneous way. Prices and profits are given by (30).

6.5 Proof of the social welfare

6.5.1 Proof of the social welfare: homogeneous mergers

See Reisinger (2006).

6.5.2 Proof of the social welfare: heterogeneous mergers

As in the previous appendix, we compute the welfare by integrating equilibrium prices in every frontiers of consumption combinations and by calculating total transportation costs. It is not necessary to compute the welfare for $\delta < \frac{1}{6} - \frac{t_B}{6t_A}$ since it is never the equilibrium welfare. Here, we compute the welfare when $\frac{3}{2}(\frac{t_A+t_B}{5t_A+t_B}) < \delta \le \frac{1}{3} + \frac{t_B}{6t_A}$ and when $\delta > \frac{1}{3} + \frac{t_B}{6t_A}$. If $\frac{3}{2}(\frac{t_A+t_B}{5t_A+t_B}) < \delta \le \frac{1}{3} + \frac{t_B}{6t_A}$:

$$\begin{aligned}
W_2^{HT} &= K_A + K_B - c_A - c_B \qquad (37)\\
&-t_A\left(\int_0^{-\frac{1}{4}\frac{t_B-4t_B\delta-t_A}{t_A-t_B}} (x)^2dx + \int_{-\frac{1}{4}\frac{t_B-4t_B\delta-t_A}{t_A-t_B}}^{\frac{1}{2}} (\frac{1}{2}-x)^2dx\right)\\
&-t_A\left(\int_{\frac{1}{2}}^{-\frac{1}{4}\frac{3t_B-4t_B\delta-3t_A}{t_A-t_B}} (x-\frac{1}{2})^2dx + \int_{-\frac{1}{4}\frac{3(t_B-t_A)-4t_B\delta}{t_A-t_B}}^{1} (1-x)^2dx\right)\\
&-t_B\left(\int_0^{-\frac{1}{4}\frac{3(t_B-t_A)-4t_B\delta+8t_A\delta}{t_A-t_B}+\delta-1} (x)^2dx + \int_{-\frac{1}{4}\frac{5(t_B-t_A)-4t_B\delta+8t_A\delta}{t_A-t_B}+\delta-1}^{\frac{1}{2}} (\frac{1}{2}-x)^2dx\right)\\
&-t_B\left(\int_{\frac{1}{2}}^{-\frac{1}{4}\frac{3(t_B-t_A)-4t_B\delta+8t_A\delta}{t_A-t_B}+\delta} (x-\frac{1}{2})^2dx + \int_{-\frac{1}{4}\frac{3(t_B-t_A)-4t_B\delta+8t_A\delta}{t_A-t_B}+\delta}^{1} (1-x)^2dx\right).
\end{aligned}$$

After some manipulations, we get:

$$\begin{aligned}
W_2^{HT} &= K_A + K_B - c_A - c_B - \frac{1}{48}(t_A+t_B) \qquad (38)\\
&-\frac{t_At_B}{(t_A-t_B)}(\delta^2-\delta) - \frac{1}{24}\frac{(t_A^2-3t_At_B+2t_B^2)}{(t_A-t_B)}\\
&= W^{IP} - \frac{t_At_B}{(t_A-t_B)}(\delta^2-\delta) - \frac{1}{24}\frac{(t_A^2-3t_At_B+2t_B^2)}{(t_A-t_B)}.
\end{aligned}$$

Finally, for $\delta > \frac{1}{3} + \frac{t_B}{6t_A}$, the welfare is given by:

$$\begin{aligned} W_3^{HT} &= K_A + K_B - c_A - c_B \\ &-t_A \left(\int_0^{\frac{1}{12}\frac{3t_A+7t_B-8t_B\delta}{t_A+t_B}} (x)^2 dx + \int_{\frac{1}{12}\frac{3t_A+7t_B-8t_B\delta}{t_A+t_B}}^{\frac{1}{2}} (\frac{1}{2}-x)^2 dx \right) \\ &-t_A \left(\int_{\frac{1}{2}}^{\frac{1}{12}\frac{9t_A+13t_B-8t_B\delta}{t_A+t_B}} (x-\frac{1}{2})^2 dx + \int_{\frac{1}{12}\frac{9t_A+13t_B-8t_B\delta}{t_A+t_B}}^{1} (1-x)^2 dx \right) \\ &-t_B \left(\int_0^{-\frac{-11t_A+4t_A\delta-15t_B+12t_B\delta}{12(t_A+t_B)}+\delta-1} (x)^2 dx + \int_{-1\frac{-11t_A+4t_A\delta-15t_B+12t_B\delta}{12(t_A+t_B)}+\delta-1}^{\frac{1}{2}} (\frac{1}{2}-x)^2 dx \right) \\ &-t_B \left(\int_{\frac{1}{2}}^{-\frac{1}{12}\frac{-5t_A+4t_A\delta-9t_B+12t_B\delta}{t_A+t_B}+\delta} (x-\frac{1}{2})^2 dx + \int_{-\frac{1}{12}\frac{-5t_A+4t_A\delta-9t_B+12t_B\delta}{t_A+t_B}+\delta}^{1} (1-x)^2 dx \right). \end{aligned} \tag{39}$$

After some manipulations, we get :

$$\begin{aligned} W_3^{HT} &= K_A + K_B - c_A - c_B - \frac{1}{48}(t_A+t_B) \\ &-\frac{4}{9}\frac{(t_A t_B^2 \delta^2)}{(t_A+t_B)^2} + \frac{1}{144}\frac{(48t_A^2 t_B + 112 t_A t_B^2)\delta}{(t_A+t_B)^2} \\ &-\frac{1}{144}\frac{6t_A^3 + 33t_A^2 t_B + 40 t_A t_B^2 - 3t_B^3}{(t_A+t_B)^2} \\ &= W^{IP} \\ &-\frac{4}{9}\frac{(t_A t_B^2 \delta^2)}{(t_A+t_B)^2} + \frac{1}{144}\frac{(48t_A^2 t_B + 112 t_A t_B^2)\delta}{(t_A+t_B)^2} \\ &-\frac{1}{144}\frac{6t_A^3 + 33t_A^2 t_B + 40 t_A t_B^2 - 3t_B^3}{(t_A+t_B)^2}. \end{aligned} \tag{40}$$

6.5.3 Proof of the social welfare at game equilibrium with bundling

The appendices 6.5.1 and 6.5.2, as the Lemma 5 allow to determine the social welfare at equilibrium game.

Lemma 6 *In equilibrium, the social welfare is given by:*

$W_1^{HM} = W^{IP} - \frac{4}{9}\delta^2 \frac{t_A t_B}{t_A+t_B}$ if $0 \le \delta \le \delta_1^*$,
$W_2^{HT} = W^{IP} - \frac{t_A t_B}{(t_A-t_B)}(\delta^2-\delta) - \frac{1}{24}\frac{(t_A^2-3t_At_B+2t_B^2)}{(t_A-t_B)}$ if $\delta_1^* < \delta < \delta_2^{HT}$,
$W_3^{HT} = W^{IP} - \frac{4}{9}\frac{t_A t_B^2\delta^2}{(t_A+t_B)^2} + \frac{\delta}{144}\frac{48t_A^2t_B+112t_At_B^2}{(t_A+t_B)^2} - \frac{1}{144}\frac{6t_A^3+33t_A^2t_B+40t_At_B^2-3t_B^3}{(t_A+t_B)^2}$ if $\delta_2^{HT} \le \delta < \delta_2^*$,
$W_1^{HM} = W^{IP} - \frac{4}{9}\delta^2 \frac{t_A t_B}{t_A+t_B}$ if $\delta_2^* \le \delta < \delta_1^{HM}$,

$W_2^{HM} = W^{IP} - (\frac{1}{4} + \delta^2 - \delta)\frac{(t_A+t_B)t_At_B}{(t_A-t_B)^2}$ if $\delta_1^{HM} < \delta < \delta_3^*$,
$W_3^{HT} = W^{IP} - \frac{4}{9}\frac{(t_At_B^2\delta^2)}{(t_A+t_B)^2} + \frac{1}{144}\frac{(48t_A^2t_B+112t_At_B^2)\delta}{(t_A+t_B)^2} - \frac{1}{144}\frac{6t_A^3+33t_A^2t_B+40t_At_B^2-3t_B^3}{(t_A+t_B)^2}$ if $\delta_3^* \leq \delta \leq \frac{1}{2}$.

6.5.4 Proof of the welfare comparaison with that of Reisinger (2006)

For $0 \leq \delta \leq \delta_1^*$, $W_1^{HM} = W^{IP} - \frac{4}{9}\delta^2\frac{t_At_B}{t_A+t_B}$. We obtain, for these parameter values, that $W_1^{HM} = W_R$.

For $\delta_1^* < \delta \leq \delta_2^{HT}$, we obtain $W_2^{HT} = W^{IP} - \frac{t_At_B}{(t_A-t_B)}(\delta^2 - \delta) - \frac{1}{24}\frac{(t_A^2-3t_At_B+2t_B^2)}{(t_A-t_B)}$. But, for these parameter values, $W_R = W^{IP} - \frac{4}{9}\delta^2\frac{t_At_B}{t_A+t_B}$. By comparison, we find that $W_2^{HT} - W_R = -\frac{t_At_B}{(t_A-t_B)}(\delta^2 - \delta) - \frac{1}{24}\frac{(t_A^2-3t_At_B+2t_B^2)}{(t_A-t_B)} + \frac{4}{9}\delta^2\frac{t_At_B}{t_A+t_B} < 0$.

For $\delta_2^{HT} < \delta \leq \delta_2^*$, we obtain $W_3^{HT} = W^{IP} - \frac{4}{9}\frac{t_At_B^2\delta^2}{(t_A+t_B)^2} + \frac{\delta}{144}\frac{48t_A^2t_B+112t_At_B^2}{(t_A+t_B)^2} - \frac{1}{144}\frac{6t_A^3+33t_A^2t_B+40t_At_B^2-3t_B^3}{(t_A+t_B)^2}$. But, for these parameter values, $W_R = W^{IP} - \frac{4}{9}\delta^2\frac{t_At_B}{t_A+t_B}$. By comparison, we find that $W_3^{HT} - W_R = -\frac{4}{9}\frac{t_At_B^2\delta^2}{(t_A+t_B)^2} + \frac{\delta}{144}\frac{48t_A^2t_B+112t_At_B^2}{(t_A+t_B)^2} - \frac{1}{144}\frac{6t_A^3+33t_A^2t_B+40t_At_B^2-3t_B^3}{(t_A+t_B)^2} + \frac{4}{9}\delta^2\frac{t_At_B}{t_A+t_B} \leq 0$.

For $\delta_2^* < \delta \leq \delta_1^{HM}$, we obtain $W_1^{HM} = W^{IP} - \frac{4}{9}\delta^2\frac{t_At_B}{t_A+t_B}$. But for these parameter values, $W_R = W^{IP} - \frac{4}{9}\delta^2\frac{t_At_B}{t_A+t_B}$. Thus, we obtain that $W_3^{HT} = W_R$.

For $\delta_1^{HM} < \delta \leq \delta_3^*$, we obtain $W_2^{HM} = W^{IP} - (\frac{1}{4} + \delta^2 - \delta)\frac{(t_A+t_B)t_At_B}{(t_A-t_B)^2}$. But, for these parameter values, $W_2^{HM} = W_R$.

For $\delta_3^* < \delta \leq \delta_2^{HM}$, we obtain $W_3^{HT} = W^{IP} - \frac{4}{9}\frac{(t_At_B^2\delta^2)}{(t_A+t_B)^2} + \frac{1}{144}\frac{(48t_A^2t_B+112t_At_B^2)\delta}{(t_A+t_B)^2} - \frac{1}{144}\frac{6t_A^3+33t_A^2t_B+40t_At_B^2-3t_B^3}{(t_A+t_B)^2}$. But, for these parameter values, $W_R = W^{IP} - (\frac{1}{4}+\delta^2-\delta)\frac{(t_A+t_B)t_At_B}{(t_A-t_B)^2}$. Thus, we obtain that $W_3^{HT} - W_R = -\frac{4}{9}\frac{(t_At_B^2\delta^2)}{(t_A+t_B)^2} + \frac{1}{144}\frac{(48t_A^2t_B+112t_At_B^2)\delta}{(t_A+t_B)^2} - \frac{1}{144}\frac{6t_A^3+33t_A^2t_B+40t_At_B^2-3t_B^3}{(t_A+t_B)^2} + (\frac{1}{4} + \delta^2 - \delta)\frac{(t_A+t_B)t_At_B}{(t_A-t_B)^2} > 0$.

At last, for $\delta_2^{HM} < \delta \leq \frac{1}{2}$, we obtain $W_3^{HT} = W^{IP} - \frac{4}{9}\frac{(t_At_B^2\delta^2)}{(t_A+t_B)^2} + \frac{1}{144}\frac{(48t_A^2t_B+112t_At_B^2)\delta}{(t_A+t_B)^2} - \frac{1}{144}\frac{6t_A^3+33t_A^2t_B+40t_At_B^2-3t_B^3}{(t_A+t_B)^2}$. But, for these parameter values, $W_R = W^{IP} - \frac{1}{36}(t_A+t_B)\frac{t_B}{t_A}$. Thus, we obtain that $W_3^{HT} - W_R = -\frac{4}{9}\frac{(t_At_B^2\delta^2)}{(t_A+t_B)^2} + \frac{1}{144}\frac{(48t_A^2t_B+112t_At_B^2)\delta}{(t_A+t_B)^2} - \frac{1}{144}\frac{6t_A^3+33t_A^2t_B+40t_At_B^2-3t_B^3}{(t_A+t_B)^2} + \frac{1}{36}(t_A + t_B)\frac{t_B}{t_A} > 0$.

6.6 Proof of the consumers' surplus

6.6.1 Proof of the consumers' surplus: homogeneous mergers

We just subtract two equilibrium profits from equilibrium welfare to find the consumers' surplus. For a homogeneous merger wave and for $\delta < \frac{3}{2}(\frac{t_A+t_B}{5t_A+t_B})$, the consumers' surplus is given by:

$$\begin{aligned} S_1^{HM} &= K_A + K_B - c_A - c_B - \frac{13}{48}(t_A + t_B) \\ &\quad -\frac{39}{72}(t_A + t_B) - \frac{8}{9}\delta^2\frac{t_At_B}{t_A + t_B} \\ &= S^{IP} - \frac{39}{72}(t_A + t_B) - \frac{8}{9}\delta^2\frac{t_At_B}{t_A + t_B}. \end{aligned} \quad (41)$$

For a homogeneous merger wave and for $\frac{3}{2}(\frac{t_A+t_B}{5t_A+t_B}) < \delta < \frac{1}{3} + \frac{t_B}{6t_A}$, the consumers' surplus is given by:

$$\begin{aligned}
S_1^{HM} &= K_A + K_B - c_A - c_B - \frac{13}{48}(t_A + t_B) \\
&\quad -\frac{2}{48}\frac{(13t_A^3 + 89t_B t_A^2 + 89t_A t_B^2 + 13t_B^3)}{(t_A - t_B)^2} - \frac{2}{48}\delta\frac{312t_B t_A^2 + 72t_A t_B^2}{(t_A - t_B)^2} \\
&\quad -\frac{2}{48}\delta^2\frac{24t_A t_B^2 - 72t_B t_A^2}{(t_A - t_B)^2} \\
&= S^{IP} \\
&\quad -\frac{2}{48}\frac{(13t_A^3 + 89t_B t_A^2 + 89t_A t_B^2 + 13t_B^3)}{(t_A - t_B)^2} - \frac{2}{48}\delta\frac{312t_B t_A^2 + 72t_A t_B^2}{(t_A - t_B)^2} \\
&\quad -\frac{2}{48}\delta^2\frac{24t_A t_B^2 - 72t_B t_A^2}{(t_A - t_B)^2}.
\end{aligned} \tag{42}$$

6.6.2 Proof of the consumers' surplus: heterogeneous mergers

We just subtract two equilibrium profits from equilibrium welfare to find the consumers' surplus. For a heterogeneous merger wave and for $\frac{1}{6} - \frac{t_B}{6t_A} < \delta < \frac{ta-tb}{5ta+tb}$, the consumers' surplus is given by:

$$\begin{aligned}
S_2^{HT} &= K_A + K_B - c_A - c_B - \frac{13}{48}(t_A + t_B) \\
&\quad -\frac{2}{48}\frac{(13t_A^3 - 85t_B t_A^2 + 59t_A t_B^2 + 13t_B^3)}{(t_A - t_B)^2} - \frac{2}{48}\delta\frac{384t_B t_A^2 + 48t_A t_B^2}{(t_A - t_B)^2} \\
&\quad -\frac{2}{48}\delta^2\frac{24t_A t_B^2 - 72t_B t_A^2}{(t_A - t_B)^2} \\
&= S^{IP} \\
&\quad -\frac{2}{48}\frac{(13t_A^3 - 85t_B t_A^2 + 59t_A t_B^2 + 13t_B^3)}{(t_A - t_B)^2} - \frac{2}{48}\delta\frac{384t_B t_A^2 + 48t_A t_B^2}{(t_A - t_B)^2} \\
&\quad -\frac{2}{48}\delta^2\frac{24t_A t_B^2 - 72t_B t_A^2}{(t_A - t_B)^2}.
\end{aligned} \tag{43}$$

For a heterogeneous merger wave and for $\delta > \frac{ta-tb}{5ta+tb}$ the consumers' surplus is given by:

$$\begin{aligned}
S_3^{HT} &= K_A + K_B - c_A - c_B - \frac{13}{48}(t_A + t_B) \\
&\quad -\frac{1}{72}\frac{(39t_A^2 + 94t_A t_B + 39t_B^2)}{(t_A + t_B)} - \frac{8}{9}(\delta + \delta^2)\frac{t_A t_B}{(t_A + t_B)} \\
&= S^{IP} \\
&\quad -\frac{1}{72}\frac{(39t_A^2 + 94t_A t_B + 39t_B^2)}{(t_A + t_B)} - \frac{8}{9}(\delta + \delta^2)\frac{t_A t_B}{(t_A + t_B)}.
\end{aligned} \tag{44}$$

6.6.3 Proof of the consumers' surplus at equilibrium game with bundling

The Appendices 6.6.1 and 6.6.2, as the Lemma 5, allow to determine the consumers' surplus at the equilibrium.

Lemma 7 *In equilibrium, the consumers' surplus is given by:*

$$S_1^{HM} = S^{IP} - \frac{39}{72}(t_A + t_B) - \frac{8}{9}\delta^2 \frac{t_A t_B}{t_A + t_B} \text{ if } 0 \leq \delta \leq \delta_1^*,$$
$$S_2^{HT} = S^{IP} - \frac{13t_A^3 - 85t_B t_A^2 + 59t_A t_B^2 + 13t_B^3}{24(t_A - t_B)^2} - \delta \frac{384t_B t_A^2 + 48t_A t_B^2}{24(t_A - t_B)^2} - \delta^2 \frac{24t_A t_B^2 - 72t_B t_A^2}{24(t_A - t_B)^2} \text{ if } \delta_1^* < \delta < \delta_2^{HT},$$
$$S_3^{HT} = S^{IP} - \frac{1}{72}\frac{(39t_A^2 + 94t_A t_B + 39t_B^2)}{(t_A + t_B)} - \frac{8}{9}(\delta + \delta^2)\frac{t_A t_B}{(t_A + t_B)} \text{ if } \delta_2^{HT} \leq \delta < \delta_2^*,$$
$$S_1^{HM} = S^{IP} - \frac{39}{72}(t_A + t_B) - \frac{8}{9}\delta^2 \frac{t_A t_B}{t_A + t_B} \text{ if } \delta_2^* \leq \delta < \delta_1^{HM},$$
$$S_2^{HM} = S^{IP} - \frac{13t_A^3 + 89t_B t_A^2 + 89t_A t_B^2 + 13t_B^3}{24(t_A - t_B)^2} - \delta \frac{312t_B t_A^2 + 72t_A t_B^2}{24(t_A - t_B)^2} - \delta^2 \frac{24t_A t_B^2 - 72t_B t_A^2}{24(t_A - t_B)^2} \text{ if } \delta_1^{HM} < \delta < \delta_3^*,$$
$$S_3^{HT} = S^{IP} - \frac{1}{72}\frac{39t_A^2 + 94t_A t_B + 39t_B^2}{(t_A + t_B)} - \frac{8}{9}(\delta + \delta^2)\frac{t_A t_B}{(t_A + t_B)} \text{ if } \delta_3^* \leq \delta \leq \frac{1}{2}.$$

6.7 Domestic and downstream mergers examples

Companies	Countries	Industries	Date
E.ON - Hein Gas (10%)	Germany	Electricity/Gas	2002
E.ON - EAM (27%)	Germany	Electricity/Gas	2002
Enel - Sicilmetano	Italy	Electricity/Gas	2003
Enel - Marcotti	Italy	Electricity/Gas	2003
EWE - SWB (32.4%)	Germany	Electricity/Gas	2003
EWE - Cuxhaven (74.9%)	Germany	Electricity/Gas	2003
Hidrocantabrico - Naturcorp (62%)	Spain	Electricity/Gas	2003
E.ON - Distributors of Westphalia	Germany	Electricity/Gas	2003
Enel - Ottogas, Vendita	Italy	Electricity/Gas	2004
Enel - Italgestioni gas	Italy	Electricity/Gas	2004

Table 1: Recent pure downstream mergers between European electricity and gas firms