Mergers as Auctions[*]

Marc IVALDI

Toulouse School of Economics, France, and CEPR

ivaldi@cict.fr

Jrissy MOTIS

Toulouse School of Economics, France

jrissy.motis@univ-tlse1.fr

April 2007

Abstract

Most empirical studies that evaluate motives and gains in M&A conclude that acquirers at best do not lose from the deal while targets obtain positive gains. With a database containing merging firms' characteristics and final bids, we propose a structural approach to infer acquirers' gains from merging by interpreting a merger as an auction. Using nonparametric methods, we estimate bidders' private values for targets and informational rents. We provide evidence of significant and positive merging gains. Moreover, investigating for the source of bidders' private valuation and informational rents, our empirical analysis supports the synergy hypothesis as a motive in horizontal mergers.

Keywords: mergers, auctions, event studies, corporate finance.

JEL codes: L10, L20, G14, G34, C14.

_____

1. Introduction

Every day mergers and acquisitions are arranged bringing together separate companies to make larger ones. They may worth billions of dollars and dictate the gains and/or losses of the involved companies' shareholders, managers, competitors and consumers for years to come. Paradoxically, most empirical studies investigating for the gains in mergers and acquisitions conclude that mergers are unprofitable for acquirers since they lose from the deal on average. We conjecture that this puzzling inference might be the result of measurement pitfalls of methods that produce them, namely the so-called event studies and operating performance studies. Indeed, because these methods rely on reduced form analyses that do not take into account the merger mechanism, they may fail to adequately measure, i.e., to well identify, the effects from merging. Here, we propose to interpret a merger as an auction in order to provide a proper analytical tool for evaluating the gains to merge.

Interpreting a merger as an auction has two main advantages. First, it allows introducing a theoretical mechanism to the merger course in the context of a large group of mergers occurring in the market. In other words, the auction approach in mergers proposes a mechanism by which the price of targets and the gains of acquirers are revealed in mergers. Second, it allows applying a structural econometric approach to the computation of such merging gains. In particular, with a database reporting bidders' and targets' characteristics, bids proposals as well as the final bid paid for the deal, acquirers' merging gains can be inferred from their estimated private values for targets. That is, bidding gains accrued to the acquiring firms can be recovered by means of the informational rents by subtracting the actual bid paid for the target to the estimated private valuation of the winning bidder. Furthermore, by recovering these informational rents, we are able to investigate for the existence of synergy gains in horizontal mergers as defined by Farrell and Shapiro (2001), i.e., mergers-specific gains that could have not been reached by other means than merging like internal growth, joint ventures or any other bilateral agreement.

That a merger or an acquisition can be interpreted as an auction has received little attention in the literature. There are however some important theoretical contributions. Klemperer and Bulow (1996) explain a takeover as an auction and show that targets' managers get higher profits by auctioning the firm than by negotiating with fewer bidders. The authors show that an auction with $N+1$ bidders dominates any negotiation mechanism

with *N* bidders because the rent extraction of an extra bidder is more valuable that any amount of bargaining power. Jehiel and Moldovanu (1996 and 2000) propose to interpret mergers through an auction model with externalities. According to them, the externality in mergers arrives because a merger affects the profits of agents not directly involved in the transaction (non-merging rivals). Molnar (2000) applies Jehiel and Moldovanu's idea and derives the takeover premium through an auction setting where each firm is negatively affected if the target is acquired by another competitor. In the empirical field, Crooke, Froeb and Tschantz (1999) use an auction model to predict merger price effects within structural merger analysis when analyzing gains in bidding mergers.[1] We share with these studies the general idea that mergers could be analyzed as auctions. However, we are not aware of any empirical study that estimates the gains of merger takeovers on the basis of a structural model of auctions when data about bids is available.[2]

In this study, we analyze a merger as the result of an independent private values auction and apply the methodology proposed by Guerre, Perrigne and Vuong (2000), to estimate bidders' gains. The procedure consists in estimating the bid probability distribution nonparametrically and using it along with the differential equations of the auction model in order to recover bidders' private values and subsequently informational rents left to the acquirers. The method has the advantage of being easily implemented since it does not require either computing or inversing the Bayesian Nash equilibrium strategies of the auction model.

For purposes of comparison, we also performed an event study to estimate abnormal returns to the merger announcement since such returns have been largely proposed as the merging gains in the financial literature.

Our analysis shows that we cannot reject the assumption that merging is a profitable activity for bidders. That is, we find that bidders' merging gains, measured by means of informational rents, are significantly positive. We also provide evidence that private valuations of bidders for targets in horizontal mergers are not only determined by the composition of assets of the target but also by the complementarity of both firms' non-tradable intangibles assets. From our empirical results, we conjecture that, when merging gains or losses are estimated by means of informational rents, they are well explained by the merger-specific combination of assets, while, when they are estimated by the event study

---

[1] The authors stated that "estimating the bidders' joint value distributions is just as important for evaluating mergers in auction markets as estimating demand is for evaluating mergers in differentiated products industries". See pp.13 in Crooke, P., Froeb, L, and Tschantz, S., (1999): "Mergers among Asymmetric Bidders: A Logit Second-Price Auction Model", Working Paper of Vanderbilt University.
[2] Crooke and al.'s alternative has been applied by Brannman and Froeb (2000) within a forest service timber auction.

technique, they are mostly explained by external (to the merger) factors. We claim that, whereas financial techniques may not be adequate for evaluating the *true* gains and motivations in mergers, our proposed structural approach of auctions is.

Section 2 provides a review of the most employed empirical techniques that measure merging gains and that conclude that bidders do not gain from merging, as well as the different proposals to justify such a paradox. In Section 3 we explain why interpreting mergers as auctions is a natural step and we describe the auction model for interpreting mergers as auctions. Section 4 is devoted to the implementation method of our proposal: Here we describe our data and we summarize the empirical results of the merging gains by means of informational rents and abnormal returns. Then, Section 5 provides an analytical framework for investigating the determinants of private values and informational rents. Section 6 enlightens a preliminary test of robustness for our proposal using a bigger sample that cannot be compared with the abnormal returns due to lack of data. Finally section 7 concludes.

2. Related literature

2.1. *Empirical studies on mergers and acquisitions' gains*

Most empirical studies that evaluate the gains of mergers and acquisitions conclude that, while targets obtain significantly positive gains, acquirers, at best, do not lose from such a deal.[3]

A major proportion of these studies employ the so-called event study technique, which consists in computing the *abnormal returns* due to the merger announcement. Based on the market model, abnormal returns are computed by subtracting the predicted merging firms' returns, obtained from a period prior to the merger (the estimation window), to the ones estimated for a period after the merger announcement (the event window).[4] These studies rely

---

[3]Exceptions to empirical studies finding non-profitable outcomes from merging are *case by case* studies based on structural approaches on the product market. In such studies structural econometric models are applied to evaluate the impact of a particular merger. Data required are composed of detailed information about sales and prices of products in the industry where the merger is taken place allowing for a measure of "unilateral merger effects" or market power effects via the prediction of price increases. See Pinkse and Slade (2004) and Ivaldi and Verboven (2005) among others.

[4] The market model, $R_{it} = \alpha_i + \beta R_{mt} + e_{it}$, is first calculated for a period prior to the merger announcement called the "estimation window". Here R_{it} are the actual returns to firm i at time t, R_{mt} are the actual returns to a market portfolio for firm i at time t. Secondly, another period after merger announcement called the "event window" is

on the assumption that stock prices reflect the present value of the expected gains created by the merging firms, assumption sustained in turn by the efficiency of the stock markets. Their objective is to determine whether the announcement of the merger causes the bidder's and target's stock returns to perform differently. In other words, the abnormal returns are the returns that are observed in excess of what they would have been if no merger announcement had been made. These studies attempt to investigate the effects of mergers on the merging firms, and sometimes on the non-merging firms as well, by testing for the market power and efficiency hypotheses. The former hypothesis predicts that a merger of competing (substitute) products allows both merging and non-merging firms, to increase prices and profits due to a lessening in competition. The latter hypothesis predicts that, if merging parties can substantially reduce their marginal costs, they become a tougher competitor so that non-merging firms result hurt.[5]

In this context, event studies affirm that, if merging and non-merging firms register positive abnormal returns, an increase in market power is the motive/effect of the merger. On the one hand, when the merging (non-merging) firms register positive (negative, respectively) abnormal returns, then efficiencies should account for the merger. On the other hand, if merging firms obtain negative abnormal returns while outsiders gain, no suitable explanation is readily available and event studies evoke managerial hypotheses such "empire-building" or "hubris." Finally, when all players register negative abnormal returns, event studies fall back on the theory of preemptive mergers. We return on this point below.

In one of the most known reviews of these studies, Tichy (2002) concludes that most published event studies show that, while targets obtain positive and significant gains, acquirers at best break even. Jensen and Ruback (1983) conclude that targets obtain a twenty percent excess return in successful mergers and a thirty percent excess return in successful tender offers. On the opposite, acquirers obtain no excess return in mergers and four percent in tender offers. Andrade, Mitchell and Stafford (2001) reveal that the value-weighted average of the two merging firms' returns is positive, with most of the gains accruing to the target company. However, when their sample is clustered by decades, from the 1970s to the 1990s,

---

selected to compute the abnormal returns. These lasts are obtained by subtracting the predicted returns to the actual returns: $AR_{it} = R_{it} - \left(\hat{\alpha}_i + \hat{\beta} R_{mt} \right)$. Thirdly, the presumed merging gains are obtained by summing up the abnormal returns over the length of the event window, T, and are called the cumulative abnormal returns: $CAR_i = \sum_t R_{it}$. Finally their significance is tested by a t-statistic, constructed as: $t(CAR_i) = CAR_i / \hat{\sigma}_{CAR_i} \sqrt{T}$.

[5] When merging firms produce complement products, oligopoly theory predicts a decrease in prices since merging firms will increase profits by selling more of their two merging products than by increasing prices of one of them and consequently decreasing both goods' demands. A similar prediction results in the case of quantity competition.

the acquirer abnormal returns are never positive nor are significant. Bradley, Desai and Kim (1988) introduce the auction effect to their analysis of 236 successful tender offers by comparing the abnormal returns when there are multiple bidders with those when there is a single bidder. They find that, in the former case, targets' excess returns increase in time while in the latter case they do not change. Contrarily, acquires' return is negative when a single bidder arrives and the loss is greater in the case of multiple bidders. These lasts results are consistent with the predictions of auction theory, namely, the higher the number of bidders that participate in the auction, the more aggressively bidders bid and the higher the rents for the auctioneer (the target). Concerning the event studies that analyze the competitive effects of mergers, Eckbo (1985) finds an excess return of almost 20 percent for target firms, 1.26 percent for non-merging firms, and 1.64 percent for bidders. For a shorter event window, all excess returns decreased. While targets' and rivals abnormal returns are significant at the one percent level, acquirers' abnormal returns are only slightly significant. As it can be noticed from this review, event studies converge to the result, that targets gain and bidders do not.

However, we believe important pitfalls decrease the reliability of this technique to analyze merging gains. On one side, a strong assumption is needed to affirm that merging gains arrive by this mean, namely that economic profits of the merging (and non-merging) firms are perfectly reflected in the firms' stock prices. That is, the whole procedure is based on the assumption that financial markets are efficient and that insiders and outsiders (with respect to the merger process) have symmetric information. Nevertheless, variations in stock prices may be caused by a broad list of events that could have simultaneously happened in the stock market which could turn difficult to isolate the merger effect. Moreover, it might be that the gains of mergers are not necessarily immediately reflected in the change of stock prices because stock market reactors may not have the same information, or the same long-run perspective than the merging firms do when joining their sets of assets. Insiders might have better information to anticipate when/how their particular bundle of assets, operated separately, can be combined in new ways to generate additional value. Consequently, outsiders could underestimate synergy gains simply because they do not observe the assets composition of the merging firms and therefore cannot observe their potential combination and exploitation. In other words, as market reactors may not have access to the same information to estimate the *true gains* of the game as insiders do; outsiders' computations

may differ from those of insiders'. This might be the reason why financial empirical studies incorrectly conclude that acquirers do not gain from merging.[6]

Another worry -not very often evoked in the event study literature- is the large variation (among studies) of the length of the estimation and event windows. That is, there is no consensus in the number of days one should consider the market requires to reveal information that translates into gains for the merging firms. Estimation windows are chosen somewhat arbitrarily and they vary from [-250, -30] to [-1, 0], where 0 is the announcement date. Short periods before the announcement are said to miss relevant information and larger periods are said to be too noisy to isolate the merger announcement effect.[7] The latter issue arrives because stock returns are correlated with other pre-merger trading operations causing two important problems to abnormal returns, a higher variance and a lack of identification of the source of such returns. Indeed, some research has already pointed out these problems. For instance, Aktas, Bodt and Roll (2004) show that ignoring firm-specific events inflates the variance of abnormal returns biasing downwards their significance test.[8] Schwert (1996) proposes to separate the pre and post bid-announcement abnormal returns in what he called the run-up and the mark-up respectively. The author shows that the run-up reflects information held by other potential bidders rather than insider trading leakage and it is unrelated with the mark-up return. From this result, Schwert affirms that the information from capital markets (the run-up) is irrelevant for merging firms. If the author's interpretation is correct, the gains of event studies may even be upward biased since they normally include the run-up as part of the merging gain.

In general, these critics focus on the noise of external factors around the announcement of the merger that can affect the abnormal returns. They tackle the event induced variance but they do not critic the methodology of the market model itself. Indeed, they employ the same technique with some corrections, but still the same idea based on stock price variations revealing merger gains.

In our view, the most important pitfall of the event study technique is that it is not able to investigate for the merger mechanism and the sources that generate the merging gains. This results in identification difficulties. In other words, since the event study generated gains are not based on a structural true model, there is no way to precisely determine the mechanism

---

[6] Recall that financial studies compute precisely reactors' appreciation of the merger.
[7] Some event studies collect stock prices for even five years after announcement, but they converge in general results with short run studies, namely, targets gain while acquirers do not.
[8] Firm-specific events can be the announcement of competing bids and antitrust interventions but also earnings and other announcements which are specific to the firm and that have nothing to be with the merger.

and sources of such gains. To illustrate this issue, consider a merger that produces strong efficiencies that are passed through competitors due to innovation spillovers for example. In this case, merging and non-merging firms should gain from the merger and should obtain positive abnormal returns (provided these lasts reflect economic profits). An event study could wrongly conclude that the market power enhancement due to a merger is found because it obtains positive abnormal returns for insiders and outsiders, while the real effect is a cost efficiency gain that benefits all players in the market. With this technique even the worst case may arrive, namely, that the claimed effect of mergers on stock prices just reflects a spurious correlation of prices and market indices.[9] Recall, that this is a common statistical problem encountered in time series regressions including models of expected returns. That is, with the abnormal return approach, we might end up by finding that a significant correlation exists just because of a statistical coincidence. For example, if the firms involved in the mergers, i.e., bidder, target and outsider, obtained positive abnormal returns because the market index, with which the event study was run, performed relatively bad (e.g., because of demand shock), could lead to wrongly conclude that the involved firms performed better due to the merger enhancement of market power.

Bearing in mind that stock price studies may be unable to provide evidence of the gains of merging and on the source of any merger-related gains; a second method to evaluate the gains in mergers, the so-called operating performance study or outcome study, has also been largely performed. An operating performance study is based on an accounting approach. It analyzes merger performance by measuring and comparing the accounting profits of the merging parties before and after their integration with those of a control group. That is, changes in profitability of the merging firms are compared to similar measures for the control groups. Periods post merger vary from 24 to 60 months. These studies are less homogeneous between them because different measures of profitability are adopted, for example: cash flows, gross profits, profits net of interest and taxes, profit ratios (on equity, total assets, or on sales). Different alternatives are also used to control for external shocks, for instance, they compare the merging firms with their base industry or with a group of matching firms (i.e., firms similar to the merged ones in industry and size). One of the most accepted outcome studies by Ravenscraft and Scherer (1987) uses the ratio of annual operating income to total end-of-period assets as the measure of profitability for targets and the value of the acquired

---

[9] Fama (1998, pp. 291) affirmed that "all models for expected returns are incomplete descriptions of the systematic pattern in average returns" and this is what may lead to spurious indications of abnormal returns in an event study.

assets to total assets of the branch of the firm that made the acquisition as the performance for acquirers. Healy, Palepu and Ruback (1992) use pre-tax operating cash flow returns on assets. Mueller (1980) makes a collection of studies (from various countries) that use three distinct measures of profitability, the rate of profit on equity, the rate of profit on total assets and the rate of profit on total sales. While the first and the second group of authors use the firms in the industry where the merger took place as the control group, Mueller's collection of studies employs a pair of firms that are similar to the merged ones and the industry average as the control group. The variation in the employment of this methodology, i.e., the differences of sample compositions with respect to length of time, control groups and measures of profitability, seems higher than the variance of general results. Indeed, the findings of these studies do not differ very much from those of event studies. In most cases, post-merger profits of the acquiring or (joint) merging firms are weaker than the ones of the merging-control group. For instance, Ravenscraft and Scherer (1987) find that, while targets perform better than the control group (except for a sample of tender-offers), acquiring firms' impact in profitability is negative. Healy, Palepu and Ruback (1992) find that merging firms' profitability declined after merger. The main conclusion of Mueller's findings is that acquirers report worse returns than the non acquiring firms of the control group in the years after acquisition. Roller, Stennek and Verboven (2000) qualify Mueller's collection of evidence from such studies as "mixed" because, whereas for some countries profitability improves on average, for some other countries profitability decreases. Moreover, often the changes in profitability are small and statistically insignificant.

These studies are also criticized on the grounds that accounting data are imperfect measures of economic profits and can be affected by managerial decisions. Moreover, accounting profits only refer to current profits which in turn depend on the precise methods that have been used to classify revenues and costs inside the firms. As the event approach, the accounting approach limits the analysis to reduced form regressions and it does not perform any structural analysis behind the decision to merge. That is, in these methods there is not an underlying structural model from which one could identify the parameters of the reduced form employed to infer about merging gains.

2.2. Explaining acquirers' losses

Fridolfsson and Stennek (2005) propose a rational that they call the preemptive merger motive (or defensive merger motive) to explain why unprofitable mergers occur. Their

framework is related to the Jehiel and Moldovanu's (1996) model of auctions of assets causing externalities on other potential buyers. In their setting a strong positive externality on the outsider's profit makes its gain larger than the gain of the insiders relative to the status quo situation.[10] Molnar (2000) uses auction theory to model the pre-emption hypothesis as well and shows that merging is a rational strategy even when acquirers lose from merging. He states that it can be optimal to overpay for a target firm and decrease bidder's value if such a loss is lower than the one the bidder will incur in if staying an outsider.

Managerial hypotheses like the hubris hypothesis proposed by Roll (1986), the empire-building hypothesis proposed by Shleifer and Vishny (1988), the cash-flow hypothesis proposed by Jensen (1986) and the market for the corporate control hypothesis proposed by Manne (1965) state that the owners of firms lack the instruments to discipline their managers who might have objectives other than profits and firm's value maximization. For instance, the hubris hypothesis states that managers overestimate their abilities or use irrational judgment when undertaking firms. In fact, the hubris consequence on acquirers' value is equivalent to the winner's curse of bidders in common value auctions, namely, bidders overpay for the auctioned item. The empire-building hypothesis states that managers have other than value maximization motives such as the size of the organization they want to lead. Their goal is to grow and the fastest way to do it is by acquiring. The cash flow hypothesis states that managers believe in the superior quality of their investments decisions relative to those of shareholders and that they invest corporate earnings even when this is not in the interest of the latter. Finally, the market for corporate control hypothesis proposes that a market for targets is an alternative to use as a disciplinary device to managers. That is, it states that takeovers play a substitute instrument in insuring that managers' actions do not deviate too far from those that would maximize shareholders' value. It asserts that, if a firm (target) is undervalued due to inefficient management, any other firm (bidder) can detect this inefficiency and buy the target to replace the manager. Thus, as there is competition between bidders to acquire that target, the target's share price increases, implying zero gains to the bidder from acquisition.

The common feature among these four hypotheses is that acquiring firms' managers overpay for the target and, as a result, shareholders lose from merging. The thorny feature is that such hypotheses cannot be distinguished from one another by simply regarding at

---

[10] The reason is that the outsiders gain from the increase in the price due to the decrease in competition, without having to reduce their own production.

abnormal returns because these lasts lack a structural model of merging decision and raise therefore an identifications problem.[11]

In an attempt for disentangling such identification problem, Mueller and Sirower (1998) test for the different financial hypotheses that claim justifying acquirers negative gains from merging. The authors use the distribution of the abnormal returns across targets and acquirers and their relationship to one another to identify the motive to merge. Consistent with the stylized facts, they find evidence of value decreasing mergers. In addition, they find support for the hubris, empire building and market for corporate control hypotheses but not for the market power or efficiency hypotheses. That is, they find that while targets gain, acquirers lose from merging.

The previous review drive us to conclude that limiting the analysis to financial and/or accounting techniques not only raises an identification problem due to the lack of a structural model, but also limits the analysis to a misleading exploration of the economic rational behind bidders' decisions to merge and the source of merging gains. Employing a structural framework of the rational strategy in such a decision might be useful to understand the motives and hence to compute the *true gains* from merging. We propose then to interpret a merger as an auction in order to provide a powerful analytical tool for evaluating the gains from merging. We propose to infer the merging gains accrued to the acquirer on the basis of the informational rents accrued to the winning bidder of the auction process. Thus, our study concentrates on the acquirer gains and not on the distribution of the gains among the acquired and acquiring firms. That is, we do not look at the sum of the target and acquirer gains, but instead we compute the buyer gains from acquiring the target as the gains of a bidder acquiring an auctioned firm.

3. Mergers and Auctions

3.1. Motivations

Applying auction theory to analyze mergers is a natural step because a public bid places a target into the game of an auction. It is not rare to read in newspapers that, after the announcement of a bid for acquiring a firm, another competitor announces that it bids for the

---

[11] The identification problem is present when more than one merger driver predicts the same effect on merging firms' profits. For example, and as mentioned before, the market power hypothesis and the efficiency hypothesis both predict an increase in profits of the merging firms.

same target. Indeed, mergers involve the same strategic interaction and asymmetric information than auctions do. As in auctions, the strategic interaction in mergers is reflected when an acquirer publicly proposes to buy a firm in an open market knowing that other potential acquirers could compete in the acquisition game. As in auctions, the information structure in mergers is one in which the target (seller) has only incomplete information about the buyers' valuations for the former. In turn, the acquirer (bidder) only knows his own private valuation but not the valuation of his competitors. In mergers as in auctions, the objective of bidders and sellers is to maximize their gain from merging. Acquirers maximize profits by bidding for the particular target that could add the highest value to the new merging firm, while targets maximize revenue by incurring in an auction process rather than by negotiating the acquisition price. The reason is that the target knows that the competition pressure of the auction should push the acquirer to reveal its true valuation while the negotiation process facilitates *hiding* the true valuation.

The auction aspect of corporate takeovers is even explicitly recognized by regulators. For instance, under Delaware law, the predominant corporate law in the US, when a potential acquirer proposes a bid for a target, the latter's board of directors is required to act as would "auctioneers charged with getting the best price for the stockholders at sake of the company".[12] Under the Williams Act, the federal legislation that regards the rules of acquisitions in the US, it is required that a takeover bid remains open for at least 20 business days to facilitate the auction process.[13] That is, bids in mergers and acquisitions are subject to delay and disclosure provisions that facilitate the entry of competitors. While chairman of the FTC in 2003, Timothy Muris, pointed out that, "auction theory and empirical research based on it probably have made the greatest contribution to merger enforcement." (See Muris, 2003.) All this suggests that corporate regulators have a preference for auctions because they know that auctions maximize shareholders returns and promote efficiency by shifting corporate assets into the hands of those that value them most highly.[14] In this perspective,

---

[12] Cramton, P. (1998): "Auctions and Takeovers" in the New Palgrave Dictionary of Law and Economics, pages 122-125.

[13] The Williams Act was passed in 1968 in order to protect investors from difficulties due to takeovers that occurred unannounced. Effectively, in the 1960s, a large number of takeovers occurred unannounced. This created difficulties for managers and stockholders who were forced to make crucial decisions with very little preparation. This federal act defines the rules in regards to acquisitions and tender offers as follows. The bidders must include all details of their tender offer in their filing to the SEC (Securities and Exchange Commission) and the target company. Their file must include the terms, cash source, and their plans for the company after takeover, etc. This is in fact the Securities and Exchange Commission Rule 14e-1.

[14] This is of course the case under efficient auctions. In turn, efficiency in auctions is attained under certain conditions, for instance, under symmetry of bidders. If bidders in the auction are not symmetric the efficiency property is lost. However, in this study we do not intend to defend the efficiency property of auctions. We

matching theory of auctions with practice of takeover auctions, as mergers and acquisitions, is indeed a natural step.

At this point we consider important to differentiate between two mechanisms of takeovers, the ones taking the form of mergers, and the ones starting as tender offers, i.e., partial acquisitions. This distinction is important since, while the tender offer is a public - either friendly or hostile- invitation to targets' shareholders to sell part of their stock; the merger is a twofold negotiation between the winning bidder and the target.[15] In mergers, after shareholders vote to make a collective decision, the two firms agree going forward as a new single company and new stock replaces the separated pre-merging stock. Rather in acquisitions, shareholders make independent decisions about their own shares and firms remain separately owned and operated. That is, there is no exchange of stock or consolidation as a new company in acquisitions but instead a partial purchase of stock.

A merger should be equivalent to an acquisition when the acquisition bears on more than fifty percent of the target's stock, in order to be sure that the acquisition results in a true integration and not only on a diversification of the acquirer's portfolio. For instance, at the FTC and the Antitrust Division of the DOJ, thresholds requiring pre-merger notification are stated in terms of the post merger total amount of the voting securities and assets of the target held by the acquirer in addition to their size category. In fact, some empirical studies find evidence of differences in gains between mergers and acquisitions. For example, Bradley, Desai and Kim (1988) find that bidders reach positive abnormal returns in tender offers, but not in mergers.

To further illustrate the difference between mergers and acquisitions, we could conjecture that the difference in the information setting of mergers and acquisitions is equivalent to the difference in the information setting of private and common values auctions. In private values auctions, bidders' private information includes only their idiosyncratic factors, i.e., they know their own valuation but do not have private information about the valuations of their opponents. In common values auctions, each bidder's private information includes factors that affect all bidders' valuations. Bidders have in this case different private information about the value of the target and each bidder updates his beliefs when he learns his competitors' bids in addition to his own bid. Thus, in common value auctions, knowledge

---

merely intend to give an alternative to measure merging gains and we start by analyzing the simplest implementable case of auctions, namely the symmetric independent private values auction. Further extensions of the auction models like asymmetry of bidders, risk aversion, affiliation (which might break the efficiency property) are not yet included in our analysis.

[15] In the empirical literature of procurement auctions, it is even considered that, in some cases, the winning bidder has indeed won the right of "negotiation" of the contract rather than the contract itself.

of opponents' bids, say bidder j for all $j \neq i$, would alter the expectation of the own valuation of bidder i, while in private values auctions observing competitors' bids does not change the own valuation of bidder i. In other words, the bid of bidder j is not informative to bidder i in private value auctions.

Mergers could also entail some common factors to all potential bidders. Nonetheless, in order to avoid this interpretation problem between mergers and acquisitions, we focus on "full" mergers, i.e., deals in which the bidder is buying 100 percent of the target. We believe that these horizontal mergers are well approximated by independent private values auction mechanisms. Using common or affiliated values auction mechanisms for analyzing acquisitions or "partial" mergers is let for further research. Here we conjecture that, in horizontal mergers, a bidder has perfect information of its internal composition of assets and can accurately compute the expected value added of joining his assets with those of the target However, the bidder has only imperfect information about his competitors' composition of assets and therefore about the latter's potential gains of merging.

Thus, in our analytical framework, the object that is auctioned is the target. For the target to represent an auctioned object it must be that it is indivisible. In mergers, a firm is actually indivisible since the acquirer is bidding for the entire bundle of assets the target is composed of. In an auction, the process starts when the auctioneer dictates it. In a takeover, the auction starts when the first bidder has arrived. That is, in a takeover, the starting time depends on the first potential bidder. Once the bidder has made public his interest to acquire the target, other bidders come along and participate in the auction. Neither in auctions nor in takeovers there is a rule that limits the number of bids an acquirer can propose for a target.

Here we assume that horizontal mergers follow a first-price sealed-bid auction rule. Given that, on the stock market, bid proposals are made publicly, it might be argued that, in practice, a merger is closer in mechanism to an ascending first-price auction than to a sealed-bid first-price auction. Nevertheless, we consider that assuming the first-price sealed-bid rule for mergers is not very thorny because, in equilibrium, the winner pays the expected second highest valuation for the target, say $E[v_2]$, while, in a first-price ascending auction, the winning bidder pays the second highest valuation, that is, v_2. This difference should not substantially change the expected pattern of the estimated gains (informational rents) in mergers. Moreover, since in horizontal mergers the two firms agree going together, it is unlikely that the acquirer bids several times to win the target as it would be the case in the ascending auction. The revenue equivalence theorem could also be a useful argument to

sustain our assumption since it proves that any auction format would lead the same expected revenue to the auctioneer and the same expected profit to the winning bidder under conditions of symmetry, risk neutrality and independency of private valuations of bidders. However, we do not test here for the equivalence revenue theorem in merger auctions; we instead focus on the computation of merging gains and the first-price sealed-bid auction mechanism simplifies our purposes.[16]

3.2. Modelling a merger as a private-values auction

We assume that bidders are symmetric and that available data consist on winning bids from independent auctions of identical and indivisible targets. Symmetry of bidders in this context means that the characteristics of bidders are drawn by nature from the same probability distribution which is common knowledge to all bidders. This in turn means that each bidder believes that all the other acquirers' values are equally likely. That is, each bidder is assumed to know his own valuation as well as the number of participants in the auction, but he does not have private information about the valuation of his opponents. Note that this last assumption fits well horizontal mergers searching for synergies (merger-specific gains) because a bidder has perfect information of its internal composition of assets and can accurately compute the expected value added by joining his assets with those of the target. But bidders have only imperfect information about their competitors' composition of assets and therefore about their potential gains from the combination of their assets with the target.

In addition, we assume that there is no reservation price in our takeover auctions; so that the number of potential bidders is equal to the number of actual bidders. Introducing a random reserve price in the analysis would imply that the unobserved number of bidders is an additional parameter to be estimated. We do not consider this question here because we perfectly observe the number of bidders. Moreover, relaxing this assumption would not significantly change our analysis because excluding a reserve price in our takeover auctions would imply an underestimation of bidders' informational rents.[17] The reason is that such a reservation price would introduce an extra random element that increases private valuations and hence informational rents. (See Appendix A.1. for an illustration of this issue.) Then, if even when excluding the random reservation price, we obtain positive and significant gains

---

[16] As we will see, for the first-price sealed-bid auction we only require data on winning bids to estimate private valuations. Whereas with the first-price ascending auction, and the same data it would be impossible to recover private valuations, only their underlying distribution could be recovered by employing order statistics.
[17] Our main concern is to investigate for significant informational rents for bidders when merging.

from merging, we would only reinforce our findings by introducing it. We base our assertion on Elakime, Laffont, Loisel and Vuong (2004) who show that introducing a random reserve price is not optimal for the seller who may lose some profit compared to an announced optimal reserve price.[18]

Formally, in a merger viewed as an independent private-values auction, a target is in sale to N symmetric bidders.[19] Following conventional notation, we denote bidder i's private value for the target as v_i. Assuming that there is independence across auctions and that bidders are risk neutral, bidder i's utility for acquiring the target is expressed as his own valuation for the target i.e., $U(v_i) = v_i$.[20] In the private values auction, each bidder knows his/her own valuation and has beliefs about his competitors valuations' up to their distribution which is denoted by $F(\cdot)$.[21] Then, private valuations are independent and identically distributed draws from the common distribution $F(\cdot)$ with positive density $f(\cdot)$. The distribution $F(\cdot)$ in turn, is assumed to be absolutely continuous with support $\left[\underline{v}, \overline{v}\right] \subset R^+$, where $\underline{v}$ is the lowest private value of all bidders and $\overline{v}$ is the highest one. Because $U(v_i)$ and $F(\cdot)$ determine the structure of the independent private values auction model, they define the structural elements of our mergers. In the first-price sealed-bid auction, bidders submit bids simultaneously, and the commodity is awarded to the highest bid at a price equal to his/her bid, b_i.[22] Then, bidder i's expected gain, π_i, conditional on his/her own signal and on his/her bid being the highest competing bid, is expressed as:

$$E(\pi_i) = (v_i - b_i) \Pr\left[b_i \geq b_j, j \neq i\right], \qquad (1)$$

---

[18] It is worth noting that a natural candidate for a nonbinding reserve price is the pre-merger stand alone market value of the target since, and as it is exposed in Table 1 of Section 4.4, in our merger-auctions, winning bidders always bid a higher amount than the market value of the target.

[19] Symmetry implies that the distribution of private valuations is exchangeable in its arguments. In turn, a sequence of identically distributed random variables is exchangeable if the common distribution function does not depend on the order of the random variables.

[20] Assuming risk neutrality of bidders is not problematic in our merger cases because adding bidders' risk aversion would result in the ascending auction being dominated by the sealed-bid auction which is already our proposal to estimate informational rents in mergers.

[21] Indeed, bidder i faces three major uncertainties, the characteristics of the target, the characteristics of other bidders and the strategies of other bidders. In the simplest auction model we focused on the third uncertainty.

[22] Here, the bid b_i is the normalized bidder's signal, say, x_i, then $x_i(b_i) = b_i$.

where $(v_i - b_i)$ is the gain or the informational rent accrued to the bidder, and $\Pr(b_i \geq b_j, j \neq i)$ is his probability of winning the auction. Given his/her beliefs about competitors' valuations, $F(\cdot)$, and their strategies, b_j for $j \neq i$, bidder i maximizes his/her expected gain with respect to his/her own bid and bids independently of the private values of his/her competitors. Thus, in the Bayesian Nash equilibrium the bid is only in function of its own private value, that is, $b_i = s_i(v_i)$, where $s_i(v_i)$ is the equilibrium strategy. The symmetry property allows to express the inverse function of the equilibrium strategy as identical for all bidders $s_i^{-1}(\cdot) = s^{-1}(\cdot)$ and the probability of b_i being the maximum bid, $\Pr(b_i \geq b_j, j \neq i)$, as $F^{N-1}(v_i)$. Then, the expected gain of the bidder i from acquiring the target can be expressed as:

$$E(\pi_i) = (v_i - b_i) F^{N-1}\left(s^{-1}(b_i)\right). \tag{2}$$

Requiring that $b_i = s(v_i)$ solves the first order condition for $s(\cdot)$; the symmetric Bayesian Nash Equilibrium strategy gives the following differential equation for $N \geq 2$:

$$1 = (v_i - b_i)(N-1)\frac{f(v_i)}{F(v_i)s'(v_i)}, \tag{3}$$

where $s'(\cdot)$ is the derivative of the equilibrium strategy, $s(\cdot)$, which is subject to the boundary condition of $s(\underline{v}) = \underline{v}$. Solving for $s(\cdot)$ one obtains

$$b_i = s(v_i) \equiv v_i - \frac{1}{\left[F(v_i)\right]^{N-1}}\int_{\underline{v}}^{v_i}\left[F(z)\right]^{N-1}dz. \tag{4}$$

The private valuation of the winning bidder i for the target can be recovered from Equation (4) and so the gains from merging. That is, the gains of the winning bidder in mergers are interpreted as the difference between his/her private value for the target, v_i, and the actual price he/she pays to obtain it, b_i. In other words, the acquirers' merging gains are computed by means of the informational rents derived from the auction process, namely:

$$IR_i = \left(v_i - b_i \right). \tag{5}$$

4. Estimating Informational Rents

To estimate informational rents in mergers we employ the Guerre-Perrigne-Vuong (GPV) estimator that allows recovering the private valuations, v_i, of the winning acquirers according to Equation (4). We then infer the merging gains of the auction according to Equation (5). Furthermore, we perform a one-sided test of significance in our estimated informational rents by computing their variance.

4.1. Data

Our sample of mergers has been composed by joining two sources of information. The first one is the SDC (Securities Data Company) database collected by Thompson that contains the winning bids to estimate the auction model. This dataset also contains the characteristics of the merging firms that we require to further investigate for the determinants of estimated private values and informational rents. These are the balance sheets' elements of the merging firms that include tangible and intangible assets, liabilities and equity among others. This dataset also displays information about the merger environment. In particular, we can observe if the merger has being challenged by competition authorities, the attitude of the target towards the merger; and more interestingly for our purposes, if the bidder has faced more than two competitors.

To estimate the private valuations of acquirers for targets within the model of independent private values auction following the rules of a sealed bid first-price auction, we have selected a sample that accomplishes the following criteria. All horizontal mergers display a non-zero bid, the effective year of the deal (to ensure that the merger has been completed), and the presence at least two bidders competing for the target. We have also verified that, in our sample, winning bidders have bid only once for the target in order to ensure that we are in the first-price sealed-bid auction case.[23] Moreover, since we have assumed that bidders are symmetric and that available data consist on winning bids from independent auctions of identical and indivisible goods, in our sample, all mergers occur in the same industry, at the same period and with acquirers having similar size in terms of

---

[23] Recall that in the ascending first-price auction; in contrast, bidders may bid several times. In this case private values cannot be recovered but only their distribution (by using order statistics).

relative market value to total assets.[24] Given that our study also investigates for merger-specific gains in horizontal mergers, we focus on deals in which the bidder is buying 100 percent of the target and in which both firms belong to the same industry. By this mean we avoid having "virtual mergers" in which an acquisition of 51 percent risks entering into the category of preemptive mergers described by Fridolfsson and Stennek (2005). Also, we have verified that bidders have acquired only once within the six months after and before the merger in question in order to isolate as much as possible this particular merger event.

The second source of information comes from Datastream and it includes the necessary financial data for the event study estimation, namely, stock prices and indices of the merging firms prior and after the merger announcement. We preferred to collect the firms' industry indices instead of the general market index in order to further get rid of general non merger specific events influencing the merger.

Matching SDC and DataStream databases was not an easy task because the identified codes of the firms listed by SDC were not the same as the ones listed in DataStream, so we had to use the exact names of the firms as their identification code. Because of this last issue our sample shrinks to 152 horizontal mergers occurring from February 2000 to February 2003 in the manufacturing industry of the US.

4.2. Econometric specification and estimation

For the translation of the economic auction model into the econometric model we apply the GPV method based on the following. Note that the equilibrium strategy of bidder i in Equation (4) is expressed as a function of his/her own private value, the distribution of private valuations and the number of bidders, that is, $s\left[v, F(v), N\right]$. Because we have assumed that the reservation price is non-binding (implying that N does not have to be estimated), the only unknown structural element of Equation (4) is the latent distribution $F(\cdot)$. Then, the identification of v_i reduces to whether this distribution is uniquely determined from the observed bids. Since the equilibrium relation that links the observed bid, b_i, to the underlying private value , v_i over $\left[\underline{v}, \overline{v}\right]$, is strictly monotonic, the identification problem can be solved. It is based on the fact that winning bids are a function of private values, which in

---

[24] Recall that symmetry of bidders in our context means that the characteristics of bidders are drawn by nature from the same probability distribution.

turn are random and distributed as $F(\cdot)$. This implies that winning bids are also randomly distributed by a function denoted herein $G(\cdot)$. Then, in equilibrium, the joint distribution of private values is related to the joint distribution of winning bids through $F(v) = G\big[b \mid s(\cdot)\big]$ and $f(v) = g\big[b \mid s(\cdot)\big] s'(\cdot)$. Finally, if each private value v_i can be expressed as a function of the corresponding winning bid b_i, the distribution of bids $G(\cdot)$ and its corresponding density function $g(\cdot)$, Equation (4) can be estimated non-parametrically by:[25]

$$v_i = \varphi(b_i, G, N) \equiv b_i + \frac{1}{N-1} \frac{G(b_i)}{g(b_i)}, \tag{6}$$

where $G(b_i)$ is the distribution of observed winning bids and $g(b_i)$ is a kernel density estimator of the observed bids. Assuming that the number of bidders, N, is fixed in L independent auctions, and denoting b_{nl} for n=1,...,N, and l=1,...,L, the winning bid of auction L, the GPV two-step estimation procedure can be employed as follows. Letting v_{nl} denote the private value of the winner bidder n of auction l, the first step consists in estimating $G(b_{nl})$ and $g(b_{nl})$ by

$$\tilde{G}(b) = \frac{1}{NL} \sum_{l=1}^{L} \sum_{n=1}^{N} 1(b_{nl} < b), \tag{7}$$

where $\tilde{G}(b)$ is the empirical distribution of the observed winning bids; and

$$\tilde{g}(b) = \frac{1}{NLh_g} \sum_{l=1}^{L} \sum_{n=1}^{N_l} K\left(\frac{b - b_{nl}}{h_g}\right), \tag{8}$$

---

[25] See details in the Appendix A.1 in which we further explain how Equation (4) translates in the estimating Equation (6).

is the kernel density estimator of observed winning bids. K is a triweight kernel of the form

$$K(u) = (35/32)(1-u^2)^3 \frac{1}{n} \| (|u| \le 1),$$ and h_g is the bandwidth or the smoothing parameter of

the kernel. Our optimal bandwidth is the one that minimizes the integrated sum of squared

errors of the estimated density, $\tilde{g}(b)$, and it is defined as $h_g = c_g (NL)^{-1/(2R+3)}$ where

$c_g = a * 1.06\sigma_b$, a is the factor of the kernel (which in the triweight case is 2.978) and σ_b is

the empirical standard deviation of observed winning bids. R is the number of derivatives of

the density, in our case is $R=1$. Finally, by substituting (7) and (8) in (6) a sample of pseudo

private values of (4) is estimated by

$$\hat{v}_{nl} = b_{nl} + \frac{1}{N-1} \frac{\tilde{G}(b_{nl})}{\tilde{g}(b_{nl})}. \tag{9}$$

Giving that the density estimator is asymptotically biased at the boundaries of the support, the

following trimming rule must also be applied:

$$\hat{v}_{nl} = \begin{cases} b_{bl} + \dfrac{1}{N-1} \dfrac{\tilde{G}(b_{nl})}{\tilde{g}(b_{nl})} & \text{if} \quad b_{\min} + h_g \le b_{nl} \le b_{\max} - h_g \\ \infty & \text{otherwise} \end{cases} \tag{10}$$

where b_{min} and b_{max} are the minimum and maximum bids, respectively. Once having

obtained (10), we are able to compute the informational rents by:

$$\hat{IR}_i = (\hat{v}_i - b_i). \tag{11}$$

4.3. Significance test

We next perform a significance test of the informational rents by constructing a t-

Student value for each observation. For this, we estimate the standard error of the

informational rents for each bidder by first calculating their variance, $Var[(\hat{v}-b)]$, as:[26]

$$Var(I\hat{R}_i) = \frac{1}{L^{(R+1/2R+d+3)}} \frac{\left[\tilde{G}(b)\right]^2}{(N-1)^2 \, \tilde{g}(b)} \int K_g^{\,2}(b) db. \tag{12}$$

Then, the standard error of each $I\hat{R}_i$ is obtained by taking the square root of $Var(I\hat{R}_i)$ which is in turn computed by replacing $\tilde{G}(b)$ and $\tilde{g}(b)$ with their respective values in the corresponding observations of the winning bids.

The one-sided significance test for each acquirer is then obtained by forming the ratio of each estimated informational rent to its standard error. That is, if the square root of $Var(I\hat{R}_i)$ is $SE_{I\hat{R}_i} = \sqrt{Var(I\hat{R}_i)}$, the Student value of each $I\hat{R}_i$ is

$$t_{IR_i} = I\hat{R}_i \big/ SE_{I\hat{R}_i}. \tag{13}$$

4.4. Estimation results

We estimate the auction model with three different measures of bid. The reason is that, to further explore for the determinants of estimated private values and informational rents, we consider pertinent to have measures that have a natural interpretation and that can be comparable with the event study. The first and most natural measure for the auction model is of course the actual bid proposed for the target, denoted herein by b_i. A second measure is obtained by dividing b_i by the number of outstanding shares of the target, we call it the *bid per share* and denote bps_i. The purpose of using this second measure is to obtain informational rents per share that are comparable to the abnormal returns obtained from the event study (since they are both gains per share). Finally, we also use the natural logarithm of bids because their distribution tends to be highly skewed in the case of horizontal mergers. Once transformed in logs we observe that the distribution is close to the shape of a normal distribution. Another reason to consider the log transformation of bids is that this measure

provides higher goodness of fit for the models that are used to investigate the determinants of estimated private valuations and informational rents.[27]

Table 1 shows the summary statistics of our estimated private values $\hat{v}_i$ ($\hat{v}ps_i$ for the per share case). Note that the variance of the estimated private values is very large. This might be due to the real heterogeneity of targets in these horizontal mergers. Table 1 also exposes the actual winning bid b_i, the bid per share, bps_i as well as the market value of the target one day prior to the merger announcement, denoted by MV_T^{t-1}, and the stock price of the target one day prior to the merger announcement, p_T^{t-1}. Note that the winner has always proposed a bid higher than the actual market value of the target at the time of announcement and this is consistent with our guess that MV_T^{t-1} is a natural nonbinding reserve price. This is also the case when comparing the bid per share, bps_i, with the corresponding share price of the target one day prior to announcement, p_T^{t-1}. This is in addition consistent with the fact that, for a statutory merger to be approved, at least a certain fraction must vote for accepting the offer if the proposed bid, b_i, is higher than the stand alone present value of the target, MV_T^{t-1}.

TABLE 1

SUMMARY STATISTICS

		Mean	St. dev.	Min	Max
Targets' market values	MV_T^{t-1}	145.804	174.429	2.144	863.737
Wining bids	b_i	212.399	227.177	2.200	890.400
Estimated private valuations	$\hat{v}_i$	216.397	229.054	5.501	905.492
Targets' share prices	p_{t-1}^T	11.086	8.740	0.290	40.580
Wining bids per share	bps_i	15.923	13.433	0.077	59.705
Est. private valuations per share	$\hat{v}ps_i$	16.151	13.577	0.185	61.324

i.   *Number of observations for estimated private valuations (per share) is 146 (143).*
ii.   *Units are in millions of dollars.*

---

[27] Depending on the measure of informational rents, the sample must be adjusted due to the trimming rule of the kernel estimator. The final sample of pseudo true private values decreased from 152 to 146 in the case of actual bids and to 143 in the case of bids per share, signifying that 6 (and 9 respectively) estimated private values are removed from the tails of their distribution.

Using bidders' estimated private valuations, $\hat{v}_i$ and $\hat{v}ps_i$ we compute the informational rents and proportional informational rents accrue to the acquirer from the auction game. These are denoted by $I\hat{R}_i$ and $I\hat{R}p_i$ where, $I\hat{R}_i = (\hat{v}_i - b_i)$ and $I\hat{R}p_i = (\hat{v}_i - b_i)/\hat{v}_i$ respectively. Similarly, we denote $i\hat{r}_i$ the informational rents per share and $i\hat{r}p_i$ the proportional informational rents per share, that is, $i\hat{r}_i = (\hat{v}ps_i - bps_i)$ and $i\hat{r}p_i = (\hat{v}ps_i - bps_i)/\hat{v}ps_i$. Finally estimated informational rents in logs are denoted by $\ln I\hat{R}_i$.

For the purpose of comparing the auction gains and the financial returns, we also perform an event study with the data obtained from Datastream. In order to avoid discussions about the size of the event windows that event studies awake, we have chosen the windows' size proposed by Johnson (1998), namely 30 days for the estimation window and ten days for the event window (seven days prior and two days after announcement).[28] Table 2 below displays the merging gains computed by means of the auction model, i.e., the informational rents, $I\hat{R}_i$, $I\hat{R}p_i$, $i\hat{r}_i$, $i\hat{r}p_i$ and $\ln I\hat{R}_i$, as well as the merging gains computed with the event study methodology. These lasts are denoted by *CAAR* for *cumulative average abnormal returns* accrue to acquirers. They are the average of the *cumulative abnormal returns* (CAR_i) over the sample of the *N* bidders, that is: $CAAR = \sum_i^N CAR_i = \sum_t^T \sum_i^N AR_{it}$, where T is the length of the event window.

On one side, our results, gathered in Table 2, show that the gains to bidders as indicated by the informational rents, estimated with the auction model, are positive and significantly greater than zero according to our constructed one-sided test ($I\hat{R}_i > 0$). The last column of Table 2 exposes the percentage of the sample that shows significantly positive informational rents, i.e., the proportions of observation for which the one-sided test has concluded to positively significant informational rents. As it can be noticed, informational rents are always significantly positive when they are computed with the measures based on actual bids and on bids per share. When they are computed with the log of bids, they are significantly positive in eighty percent of the cases, that is, in 116 out of the 146 cases. Note

---

[28] Johnson proposes a graphical analysis to determine the sizes of the event and estimation windows (as well as the number of securities in the benchmark portfolio) that maximize the leakage of the merger announcement and minimizes the external (to the event announcement) shocks' noise.

that, on the other side, cumulative abnormal returns are negative in average and significant only in two of the 146 cases. This last result is consistent with the stylized findings in this kind of literature.

TABLE 2

INFORMATIONAL RENTS AND CUMULATIVE ABNORMAL RETURNS ON MERGERS

		N	Mean	Min	Max	St.Err	%IR>0[a]
Informational rents (log)	$\ln I\hat{R}_i$	146	0.021	0.011	0.032	0.003	80
Informational rents[b]	$I\hat{R}_i$	146	3.712	3.053	11.014	0.021	100
Informational rents per share[b]	$i\hat{r}_i$	143	0.228	0.101	1.619	0.083	100
Prop. Informational rents	$I\hat{R}p_i$	146	0.060	0.009	0.600	0.087	N/A
Prop. Informational rents/share	$i\hat{r}p_i$	143	0.037	0.008	0.587	0.065	N/A
Cumulative abnormal returns	$CAAR$	146	-0.003	-0.129	0.088	0.020	2

[a] *%IR>0 is the percent of the total observations that show significant informational rents or abnormal returns.*
[b] *Units are in millions of dollars.*

In Table 2 we can see that according to estimated proportional informational rents, on average, bidders gain a 6 percent of their valuation for the target when it is estimated with the actual bid of the deal and nearly 4 percent when it is estimated with the bid per share. We can also see in this table that the loss revealed by the *CAAR* is around 0.3 percent. From these findings, we conjecture that the gains revealed by means of informational rents are not revealed by the stock market because they reside on bidder's private information. In other words, we conjecture that merging gains are not revealed by the stock market - and so by the event study - because they are derived from the bidder's private information about the target firm. [29]

---

[29] Even when we have chosen the size of the windows proposed by Kenneth Johnson (1998) we have computed abnormal returns for different windows. However results did not qualitatively change. For instance the most common event windows such as ± 1, ± 5 and ± 21 showed all negative abnormal returns.

5. Explaining Informational Rents

With purposes of testing for the robustness of informational rents in horizontal mergers, we further explore for their possible sources. For this, we assume that the bidder's valuation for the target is a function of the internal bundle of assets of the latter, i.e., the book value. In fact, the book value of a firm is considered as the ultimate value of securities in liquidation. That is, it shows how much the company would have left over in assets if it were out of business (as it is the case in mergers). Given that in horizontal mergers, the target is indeed selling its complete set of assets to the bidder, we expect private valuations to be determined by the book value of the firm. We then decompose the book value of the target into its formal definition, that is, into tangible assets, intangible assets, and debt as reported in their balance sheets. We denote these assets by the variables T^T, T^T and D^T respectively.

Tangible assets include cash flows and property plant and equipment whereas intangible assets include the remaining value of the firm that cannot be easily traded or contracted. Among others, know-how, patents, brand names and reputation are grouped into the intangible assets. Here, we conjecture that if the motive of the bidder is to joint its assets with those of the target to create synergies, we should have an effect on private valuations and informational rents from the combination of both firms' assets. To take this combination into account we construct interaction terms of the target assets with their respective counterpart of the acquirer, that is, we create interaction variables of bidder's and target's tangible and intangible assets as well as for debt. We denote these terms $T_i^{T,i}$, $I_i^{T,i}$ and $D_i^{T,i}$ respectively where T represents the acquired firm and i the winning bidder.

In addition, in our context or mergers as auctions, we expect that factors related with the auction-merger environment also affect bidders' private valuations for targets and informational rents. Such factors are for instance, the existence of more than two competitors per auction, the intervention of competition authorities to challenge the merger and the attitude of the bidder towards the auction merger (hostile or friendly). Indeed, since bids are increasing in competition in the independent private values auctions model we expect to have a negative effect on informational rents due to higher competition. The reason is that bidders anticipate that the higher the number of competitors the lower the probability of winning the auction unless they bid more aggressively.

The intervention of competition authorities challenging the merger may have two opposite effects on private valuations and informational rents. On the one side, the probability

of blocking the merger may reduce the private value for the target (and so informational rents), but on the other side it may well confirm that the merger is profitable due to the possible enhancement of market power. Since we cannot directly control for such a possibility in our sample (essentially because we do not observe the product market), we conjecture that a positive effect of authorities challenging the merger may indirectly indicate that bidders expect to obtain net gains at the outcome of the merger process.

Finally, a hostile attitude of the target towards the mergers may of course decrease the expected gains of the acquirer from joining its assets with a non participative partner.

Then, we introduced a set of three dummy variables denoted by COM if more than two bidders compete for the target, CHA if competition authorities challenge the merger and ATT if the target had a hostile (instead of friendly) attitude towards the merger.

Summarizing the previous statement, we conjecture that bidders' private valuations for targets can be expressed in function of the latter's assets, the expected complementarity of both firm's assets and the auction-merger environment that includes more competition in the auction, challenge of competition authorities and hostile attitude of the target. Thus, we express private valuations as:[30]

$$\hat{v}_i = f\left(T^T, I^T, D^T, T_i^{T,i}, I_i^{T,i}, D_i^{T,i}, CHA, COM, ATT\right) \tag{14}$$

Estimation results for a linear version of Equation (14) estimated with GLS are exposed in Table 3.[31] The first column of this table indicates that the private value the acquirer estimates for its target, when this is obtained from the actual bid, is positively determined by the target's tangible and intangible assets T^T, and I^T as well as by the complementarity of intangibles assets, $I_i^{T,i}$. In turn, it is negatively determined by the combination of both firms' tangible assets, $T_i^{T,i}$. These results suggest that tangible assets, like property plant and equipment, are substitutes for the acquirer while, intangibles assets like know-how, patents, and reputation are complements in generating additional value to the new merged entity. Note that the negative coefficient of the competition variable, COM, in the first column reveals that the bidder's private valuation decreases as the number of

---

[30] Even when a specification test has been performed, favouring the model specification of expression (14) we have also estimated a semi-log transformation of $\hat{v}_i$ with purposes of easiness of interpretation of coefficients and of relaxing linearity assumption.

[31] OLS with transformed variables to correct for heteroscedasticity to satisfy the OLS assumptions.

competitors increases. This is a result consistent with the auction model. The presence of competition authorities challenging the merger has a positive but not significant effect over the private valuations. A non surprising result is that taking a hostile attitude towards the merger decreases the valuation the bidder grants to the target.

The semi-log version of Equation (14) exposed in the second column of the table follows the almost same pattern than the previous expression. It indicates that there is a percent increase in the valuation for the target due to additional intangible and tangibles assets. In addition, debt plays a positive role in the private valuation in both, its stand alone value and its interacted term with the acquirer's debt. This suggests that merging firms' debt is complementary. However, the interaction term of both firms' intangible assets is no longer significant whereas the substitability of the firms' tangible assets is indicated by the negative and significant coefficient of this variable. Another finding in this expression is that the presence of antitrust authorities challenging the merger positively contributes in the valuation for the target. As we conjecture, it might be that authorities feared an adverse competition effect, by confirming to the acquirer that additional value would be generated from the merger. On the other side, whereas competition decreases private valuation in a certain percent, the hostile attitude of the target does not have any influence.

As exposed in column three and four of Table 3, we also run version of Equation (14) with the private value per share $\hat{v}ps_i$ and the target's stock price one day prior to announcement p_{t-1}^T, respectively. The reason is that these are comparable measures since they are both values per share. The first one reflects the target firm's valuation to bidders and the second one, the target firm's valuation to the rest of the market. The interesting insight of these specifications, as columns three and four show, is that while the internal elements of the target and their combination with those of the acquirer explain a 62 percent of the variation of the private valuation per share, they only explain a 17 percent of the stock price variation (as indicated by the Adjusted R-squares).

In summary, our estimations lead us to conclude that, when an acquirer is bidding for a target in a first-price sealed-bid auction, he/she is basing his/her private valuation on the internal assets of the target and on the combination of both firms' assets. Moreover, while tangible assets seem to be substitutes, intangible assets show being complements in the generation of private valuations.

TABLE 3

DETERMINANTS OF BIDDERS' PRIVATE VALUATIONS

		Private valuation	Private valuation in logs	Private valuation per share	Share price
		$\hat{v}_i$	$\ln \hat{v}_i$	$\hat{vps}_i$	p_{t-1}^T
Target's tangible assets	T_i^T	1.131*** (0.152)	0.006*** (0.001)	0.032*** (0.011)	0.026*** (0.007)
Target's intangible assets	I_i^T	1.081*** (0.371)	0.005*** (0.002)	-0.010 (0.036)	-0.032** (0.019)
Target's debt	D_i^T	0.020 (0.041)	4.122E-04*** (1.881E-04)	0.006** (0.004)	0.007*** (0.002)
Interaction of both firms tangible assets	$T_i^{T,i}$	-1.864E-05* (1.348E-05)	-7.552E-08* (5.915E-08)	-3.978E-07 (3.914E-06)	-8.353E-07 (8.121E-07)
Interaction of both firms intangible assets	$I_i^{T,i}$	7.753E-04*** (3.202E-04)	2.400E-06 (1.942E-06)	3.875E-05* (2.877E-05)	3.033E-05*** (1.381E-05)
Interaction of both firms debt	$D_i^{T,i}$	-1.037E-03 (1.525E-03)	3.984E-06*** (1.337E-06)	5.998E-05 (1.300E-04)	-1.578E-05 (1.086E-04)
More competition	COM	-2.319*** (1.116)	-3.071*** (1.099)	-3.450*** (1.458)	-0.323 (3.171)
Competition Authorities Challenge	CHA	0.268 (1.241)	3.467*** (1.081)	3.533*** (1.364)	N/A N/A
Attitude, hostile or friendly	ATT	-1.615*** (0.211)	-0.278 (0.314)	-0.550 (0.539)	-5.806** (3.388)
Constant		273.056*** (26.336)	4.235*** (0.300)	17.601*** (6.637)	13.557*** (3.449)
Observations		139	139	139	122
F-statistis		102.428	774.608	23.980	4.074
P-value		0.000	0.000	0.000	0.000
R-squared		0.890	0.984	0.650	0.224
Adjusted R-squared		0.881	0.982	0.623	0.169

[a] *Standard errors are given in brackets; italic represent the t-statistic. (***), (**) and (*) significant at 1%;, 5% and 10%, respectively.*

We now turn to the determinants of the informational rents in mergers. In this respect, we test for the hypothesis stated by Farrell and Shapiro (2001). That is to say, we test whether in horizontal mergers, taking place as independent private value auctions, bidders are searching for merger-specific gains that could not be achieved by other means than merging. We conjecture then, that informational rents are a function of the combination of both firms' tangible and intangible assets as well as debt, denoted by $T_i^{T,i}, I_i^{T,i}, D_i^{T,i}$, respectively.

In particular, we expect to find the source of synergy gains in the operation of the merging firms' intangible assets. The reason is that, while tangible assets can be acquired in their respective market, intangible assets can be appropriated only by merger and this last issue turns their combination into merger-specific. If this statement is correct, we expect that the unique combination of both firms' intangible assets is the key element in generating gains in horizontal mergers. As with the private values, we expect the auction-merger environment factors to affect merger informational rents.

To summarize, we conjecture that bidders' informational rents are determined by the complementarity of both firms' assets and the auction-merger environment factors. Thus, we express merger-specific gains by means of the informational rents in mergers as:

$$\widehat{IR}_i = f\left(T_i^{T,i}, I_i^{T,i}, D_i^{T,i}, CHA, COM, ATT\right) \tag{15}$$

Estimation results for a linear version of Equation (15) estimated with GLS are exposed in Table 4. The first column of this table indicates that while the combination of the tangible assets, $T_i^{T,i}$, and debt, $D_i^{T,i}$, decrease informational rents; the complementarity of intangibles assets, $I_i^{T,i}$ strongly participates in the generation of such gains. Moreover, note that the coefficient of the combination of the intangible assets largely exceeds the one of tangible assets. These findings reveal that, keeping everything else constant, one extra unit of acquirers' tangible assets (or of debt) requires one less unit of targets' tangibles assets (or of debt) for generating gains. As well, extra units of acquirer's intangible assets require extra units of target's intangible assets to generate gains. To put it differently, in order to obtain gains by combining non-contractible intangible assets, firms are ready to lose from a non optimal reallocation of physical assets or from a duplication of fixed costs and debt because the gains of combining intangibles exceed the loss of combining tangibles.

TABLE 4

DETERMINANTS OF BIDDERS' INFORMATIONAL RENTS AND ABNORMAL RETURNS[A]

		Informational rents	Informational rents in logs	Informational rents per share	Abnormal returns
		$\widehat{IR_i}$	$\ln \widehat{IR_i}$	$\widehat{ir_i}$	CAAR
Interaction of both firms tangible assets	$T_i^{T,i}$	-2.608E-07*** (9.004^E-08)	-4.745E-08*** (1.562E-08)	-1.515E-08 (4.899E-08)	1.379E-09 (5.672E-09)
Interaction of both firms intangible assets	$I_i^{T,i}$	9.719E-06*** (2.883E-06)	1.809E-06*** (4.771E-07)	7.588E-07* (5.192E-07)	-2.934E-08 (4.297E-08)
Interaction of both firms debt	$D_i^{T,i}$	-1.816E-05*** (6.995E-06)	-2.452E-06*** (9.420E-07)	-3.324E-07 (1.541E-06)	6.259E-08 (1.849E-07)
Competition Authorities Challenge	CHA	-0.482 (1.109)	-0.924 (1.135)	0.926 (1.298)	4.620*** (1.144)
More competition	COM	-1.042 (1.055)	-0.709 (1.029)	-1.479 (1.560)	-5.725*** (1.084)
Attitude, Hostile or friendly	ATT	-1.549** (0.827)	-1.339** (0.767)	-0.786 (0.983)	-0.074 (0.258)
Constant		6.959*** (1.682)	1.698*** (0.246)	0.338*** (0.165)	3.367E-05 (0.004)
Observations		141	141	136	141
F-statistics		105.758	359.760	33.559	5.767
P-value		0.000	0.000	0.000	0.000
R-squared		0.847	0.950	0.646	0.232
Adjusted R-squared		0.839	0.947	0.626	0.191

[a] *Standard errors are given in. (***), (**) and (*) significant at 1%;, 5% and 10%, respectively.*

This implies that whereas the duplication of physical assets like property plant and equipment decreases the expected gains from merging, the complementarity of assets like know-how and reputation increases them. In other words, our results suggest that tangible assets are perceived as substitutes while intangible assets are perceived as complements for merging firms. Note that this result is robust to the log-linear version of informational rents exposed in the second column of Table 4.

Consistent with the determinants of private valuations, here, a hostile attitude towards the merger decreases informational rents. However, the remaining factors of the merger environment, namely, competition and antitrust authorities' intervention do not affect bidders'

private informational rents from merging (these variables by contrast are the only significant ones in the abnormal returns regression, exposed in the last column of Table 4.

Once again, the purpose of running Equation (15) with the informational rents per share and with the abnormal returns, exposed in columns three an for of Table 4, is to highlight that while the combination of both firms' assets explain a 62 percent of the variation of the informational rents per share, they only explain a 19 percent of the abnormal returns (as indicated by the Adjusted R-squares).

In summary, we find that, when merging gains are estimated by means of informational rents, they are well explained by the merger-specific combination of assets, while, when they are estimated by the event study technique, they are mostly explained by external (to the merger) factors. This suggests that the sources of financial gains (or abnormal returns) accrued to acquirers are not based on the fundamentals of the acquired target but mostly on the basis of external market shocks.

6. Extensions

Our previous estimations are limited to less than 150 observations because we wanted to compare our auction gains with the event study gains. We now perform the estimation of informational rents with a bigger sample in order to further test for the validity of our hypothesis of mergers as auctions. Using a sample of 804 horizontal mergers separated by industry we still find that informational rents are positive and significant in average. (See Table 5.)

TABLE 5
INFORMATIONAL RENTS OF HORIZONTAL MERGERS BY INDUSTRY [a]

Informational Rents $\widehat{IR}_i = (\hat{v}_i - b_i)$

Industry	Obs.	Mean	St.dev.	Student
Manufacturing	243	0.4769	0.2080	2.29
Services	183	0.4729	0.2075	2.28
Finance, Insurance	332	0.4587	0.1841	2.49
Utilities	46	0.4467	0.1413	3.16
Total	804	0.4682	0.1992	2.35

[a] *Units are millions of dollars.*

These numbers indicate that horizontal mergers generate informational rents. With respect to the determinants of the private valuations for targets we find consistency with our previous results, that is, the private value the acquirer estimates for its target is positively determined by the target's intangibles, I^T and by the complementarity of the target and bidder's intangible assets, $I_i^{T,i}$.[32]

A further objective of our analysis is to estimate an affiliated private value auction model with asymmetric bidders in horizontal mergers because the assumption of independence in competitors' bids and symmetry of bidders might be considered as inappropriate in a market for targets. Indeed, as there is some possibility of a resale market after the merger, it is likely that bidders' private valuations might be correlated or more generally affiliated. On the other side, a pure common value auction would also be inappropriate in horizontal mergers because it would be hardly the case that every acquirer would perceive the same synergy gains when putting his assets working together with those of the target. Still a common element may be present in competing bidders' private valuations for a target since they operate in the same market. It would be reasonable to consider that there are some interactions among bidders' valuations in the sense that, if one bidder perceives the value of the auctioned firm to be high, it is likely that other bidders also perceive this value to be high. Estimating the affiliated private values auction requires a conditional kernel with which we are still working on.

In a first tentative to relax the independence assumption we estimate the *true premium* of the acquirer when winning the target. That is, we try to investigate if the premium the acquirer is expecting to obtain, when bidding the highest price for the target is positive by estimating the first-price sealed-bid auction model not with the variable *bid* but instead, with the variable *premium*, defined as:

$$pre_i = \frac{b_i - MV^T}{MV^T},$$
(16)

where b_i is the winning bid of acquirer i and MV^T is the actual market value of the acquired target T at the time of the bid. As Table 6 shows the *estimated true premium* is positive in

---

[32] These results are available from the authors upon request.

average but not always significant. This might be because the number of observations has decreased from 804 to 401. This is due to two factors; the first one is that we do not always observe the market value of the target and the second one is the trimming rule of the kernel density estimator. In the case of the premium the tails of the kernel are strongly biased and therefore eliminated from the final sample of pseudo true premiums. Still, these numbers indicate that in the Finance and Insurance sector for example, bidders obtain a gain of around 0.06 percent of the value of the target.

We also intend to test for the common value auction hypothesis in acquisitions since for such test we only require data on bids as well, information that is available in our database. The test would be based on two characteristics of the common value auctions. The first one is the winner's course (because it only arises in the common values auction). The second one is based on the prediction about the conditional expectation of winning the auction in common value auctions which is decreasing in the number of competitors each bidder faces (while it is invariant in the private values model).

TABLE 6

ESTIMATED PREMIUMS OF HORIZONTAL MERGERS BY INDUSTRY [A]

Industry	Obs.	Mean	St.dev.	Student
Manufacturing	101	6.640E-04	4.340E-04	1.530
Services	85	6.060E-04	1.870E-04	3.250
Finance and Insurance	215	5.700E-04	9.600E-05	5.910
Total	401	6.160E-04	3.030E-04	2.030

[a] *Units are millions of dollars.*

7. Conclusion

This paper proposes to interpret a merger as an auction in order to provide a powerful analytical tool for evaluating the gains from merging. It builds up on some dissatisfaction with event studies and operating performance studies that estimate the gains of mergers. These studies make use of financial and accounting data respectively without specifying any structural economic model to infer merging gains and without investigating for the source of merging gains.

In this study, we hypothesize that horizontal mergers parallel a private value auction mechanism. The reasoning is that a bid situates a corporation into the game of an auction. Once a tender offer is open, any other potential bidder is free to propose a price for the target; and the winner is the bidder with the highest bid. Data containing the winning bids allow us to compute the equilibrium bidding strategy of the auction game and therefore to infer about the merging gains accrued to the bidder by means of informational rents from the auction. By computing the gains of acquirers in mergers within a first-price sealed-bid auction mechanism, this study shows that merging is a profitable activity for bidders. In other words, our estimations confirm that acquirers gain from merging as they show that the estimated informational rents are significantly positive.

A parallel event study is performed for purposes of comparison. Consistent with stylized facts, our event study finds that the cumulative average abnormal returns to acquirers are negative and not significant.

These results lead us claim that we provide evidence of the positive gains accrued to acquirers contrary to the general results of financial and accounting empirical studies.

Moreover, we find that private valuations of bidders for targets in horizontal mergers are not only determined by the composition of assets of the target that determine its stand alone value, but also by the value-added brought to the new entity by the complementarity of both firms' assets. Concerning the merging gains, we find that, when they are estimated by means of informational rents, they are well explained by the merger-specific combination of assets. In particular, we find that while tangible assets are substitutes in generating informational rents, intangibles assets are complements. Since intangible assets cannot be appropriated by other mean than merging, this result lead us to claim that we find evidence for the synergy hypothesis in mergers, namely mergers-specific gains that could not be generated otherwise.

On the other side, when gains are estimated by the event study technique, they are mostly explained by external (to the merger) factors. We conclude from this evidence that, whereas financial techniques may not be adequate for evaluating the *true* gains and motivations in mergers, our proposed structural approach of auctions is.

References

Andrade, G., Mitchell, M., and Stafford, E. (2001): "New Evidence and Perspectives on Mergers," *Journal of Economic Perspectives,* 15(2), 103-120.

Aktas, N., Bodt, E., and Roll, R. (2004): "European M&A Regulation is Protectionist," Working Paper 1252, University of California at Los Angeles.

Athey, S. and Ahile, P., A. forthcoming: "Nonparametric Approaches to Auctions," Handbook of Econometrics Volume 6, ed. by J. Heckman and E. Leamer. Elsevier.

Athey, S. and Haile, P., A. (2006): "Empirical Models of Auctions," Discussion Paper 1562, Cowles Foundation.

Bradley, M., Dessai, A., and Kim, E. (1988): "Synergistic gains from corporate acquisitions and their division between the stockholders of target and acquiring firms," *Journal of Financial Economics*, 21(1), 3-40.

Brannman, L., and Froeb, L. (2000): "Mergers, Cartels, Set-Asides, and Bidding Preferences in Asymmetric Oral Auctions," *Review of Economics and Statistics,* 85(2), 283-290.

Bulow, J. and Klemperer, P. (1996): "Auctions versus Negotiations," *American Economic Review*, 86(1), 180-194.

Cramton, P. and Schwartz, A. (1991): "Using Auction Theory to Inform Takeover Regulation," *Journal of Law Economics and Organization*, 7(1), 27-53.

Cramton, P. (1998): "Auctions and Takeovers" in the New Palgrave Dictionary of Law and Economics, ed. by Peter Newman. London: MacMillan Press, 1,122-125.

Crooke, P., Froeb, L,, and Tschantz, S. (1999): "Mergers among Asymmetric Bidders: A Logit Second-Price Auction Model," Working Paper of Vanderbilt University.

Crooke, P., Froeb, L., and Tschantz, S. (2000): "Mergers in Sealed vs. Oral Asymmetric Auctions," *International Journal of the Economics of Business*, 7(2), 201-213.

Elakime, B., Laffont, J.J., Loisel, P., and Vuong, Q. (2004): "Auctioning and Bargaining: An Econometric Study of Timber Auctions with Secret Reservation Prices," *Journal of Business Economics and Statistics*, 15(2), 209-220.

Fama, E. (1998): "Market Efficiency, Long-term Returns, and Behavioural Finance," *Journal of Financial Economics*, 49(1), 283-306.

Farrell, J., and Shapiro, C. (2001): "Scale Economies and Synergies in Horizontal Merger Analysis," *Antitrust Law Journal*, 68(3), 685-710.

Fridolfsson, S. and Stennek, J. (2005): "Why Mergers Reduce Profits and Raise Share Prices: A Theory of Preemptive Mergers," *Journal of European Economic Association*, 3(5), 1083-1104.

Guerre, E., Perrigne, I. and Vuong, Q. (2000): "Optimal nonparametric Estimation of First-Price Auctions", *Econometrica*, 68(3), 525-574.

Gugler, K., Mueller, D., Yurtoglu, B., and Zulehner C. (2003): "The Effects of Mergers: An International Comparison", *International Journal of Industrial Organization*, 21(5), 625-653.

Healy, P., Palepu, K. and Ruback, R. (1992): "Does Corporate Performance Improve After Mergers?," *Journal of Financial Economics*, 31(2), 135-175.

Ivaldi, M., and Verboven, F. (2005): "Quantifying the Effects from Horizontal Mergers in European Competition Policy," *International Journal of Industrial Organization*, 23(9-10), 669-691.

Jehiel, P., and Moldovanu, B. (1996): "Strategic Nonparticipation," *RAND Journal of Economics*, 27(1), 84-98.

Jehiel, P., and Moldovanu, B. (2000): "Auctions with Downstream Interaction among Buyers," *RAND Journal of Economics*, 31(4), 768-791.

Jensen, M. G., and Ruback, T. (1983): "The Market for Corporate Control: The Scientific Evidence," *Journal of Financial Economics*,11(1-4), 5-50.

Jensen, M. (1986): "The Agency Cost of Free-Cash Flow: Corporate Finance and Takeovers," *American Economic Review*, 76, 323-330.

Johnson, K. (1998): "Graphical Analysis for Event Study Design," *Journal of Financial and Strategic Decisions*, 11(1).

Molnar, J. (2000): "Pre-emptive Horizontal Mergers: Theory and Evidence," Working Paper Northwestern.

Motis, J., Neven, D., and Seabright, P. (2006): "Efficiencies in Merger Control," in European Merger Control: Do We Need and Efficiency Defence, ed. by F. Ilzkovitz and R. Meiklejohn. Edward Elgar.

Mueller, D. (1980): The determinants and effects of Mergers: An International Comparison, ed. by Oelgeschlager, Gunn & Hain. Cambridge, Massachusetts.

Mueller, D., and Rauning, B.*,* (1998), "Heterogeneities within Industries and Structure Performance Models," Working Paper 36 of the Austrian Central Bank.

Mueller, D., and Sirower M. (1998): "The Causes of Mergers: Tests Based on the Gains to Acquiring Firms' Shareholders and the Size of Premia," Working Paper 109 ESRC Centre for Business Research.

Muris, T. (2003): "Improving the Economic Foundations of Competition Policy," Winter Antitrust Symposium, George Mason University Law Review's.

Neven, D., and Seabright, P. (2003): "Synergies and Dynamic Efficiencies in Merger Analysis," Final Report carried out for the DG ECFIN, Brussels.

Pinkse, J., and Slade, M. (2004): "Mergers, Brand Competition, and the Price of a Pint", *European Economic Review*, 48(3), 617-43.

Ravenscraft, D., and Scherer, F. (1987): Mergers, Sell-offs, and Economic Efficiency, Brookings Inst Pr.

Roll, R. (1986): "The Hubris Hypothesis of Corporate Takeovers," *Journal of Business*, 59(2), 197-216.

Roller L-H, Stennek, J., and Verboven F. (2006): "Efficiency Gains from Mergers," in European Merger Control: Do We Need and Efficiency Defence, ed. by Ilzkovitz and Meiklejohn. Edward Elgar.

Schwert, G.W., (1996), "Markup pricing in mergers and acquisitions." *Journal of Finance*, 41(2), 153-192.

Shleifer, A., and Vishny, R. (1988): "Value Maximization and the Acquisition Process," *Journal of Economic Perspectives*, 2 (1), 7-20.

Silverman, B.W. (1986): Density Estimation for Statistics and Data Analysis, London: Chapman and Hall.

Tichy, G. (2002): "What do we know about success and failure of mergers," *Journal of Industrial Policy Competition and Trade*, 4(1), 347-394.

Appendix

A.1. Identification of the Auction Model

In the symmetric Independent Private Values (IPV herein) model, the underlying joint distribution of bidders' valuations $F(\cdot)$ is nonparametrically identified even if only one bid is observed (the winning one).

The primitive of interest is given by the equilibrium condition of the symmetric IPV model, Equation (4). GPV have shown that this equation leads to a closely related structural econometric model. They do so by departing for the assertion that since observed bids are functions of unknown private values and the latter are randomly distributed, then the former are randomly distributed as well. Denote the private values distribution as $F(\cdot)$, the observed bids' distribution by $G(\cdot)$. Given the assumption of Bayesian Nash Equilibrium, $G(\cdot)$ consists indeed on a single mapping from the true distribution of valuations, $F(\cdot)$ to a distribution of bids. That is, given that equilibrium is attained when each player is acting optimally against the distribution of competitors' behaviour, both, the distribution of opponents' behaviour and the optimal (equilibrium) choice of each bidder are observable. This last point is what enables the identification of the latent joint distribution of bidders' valuations. However, given that $G(\cdot)$ depends on $F(\cdot)$ directly through v and indirectly through the equilibrium strategy $s(\cdot)$, which in turn depends on $F(\cdot)$, the identification problem is not trivial. To solve for this, it must be that each private value v_i can be expressed as a function of the corresponding bid b_i, the distribution $G(\cdot)$ and its density $g(\cdot)$. The authors proposed the to let $g(\cdot)$ be the density of observed bids in the differential Equation (3), which is, $1 = [v_i - b_i](N-1)\left[f(v_i) f(v_i) / F(v_i) s'(v_i) \right]$. The introduction of $g(\cdot)$ and $G(\cdot)$ in Equation (3) simplifies its expression by eliminating the first derivative, $s'(\cdot)$, the distribution $F(\cdot)$ and its density $f(\cdot)$. If $G(\cdot)$ is the distribution of observed bids, for every $b \in [\underline{b}, \overline{b}] = [\underline{v}, s(\overline{v})]$, then

$$G(b) = \Pr\left(\tilde{b} \leq b\right) = \Pr\left(\tilde{v} \leq s^{-1}(b)\right) = F\left(s^{-1}(b)\right) = F(v). \tag{17}$$

This implies that the distribution of observed bids is absolutely continuous with support $\left[\underline{v}, s(\bar{v})\right]$ and density $g(b) = \dfrac{f(v)}{s'(v)}$, where v is the inverse of the equilibrium strategy, i.e., $v = s^{-1}(b)$. The ratio $\dfrac{f(v)}{s'(v)F(v)}$ will then be equal to $\dfrac{g(b)}{G(b)}$. The differential Equation (3) is rearranged to express the latent private value v_i in an estimable equation expressed as:

$$v_i = \varphi(b_i, G, N) \equiv b_i + \frac{1}{N-1}\frac{G(b_i)}{g(b_i)}. \tag{18}$$

Note that the bidder's latent private value in Equation (18) is expressed as a function of his equilibrium bid b_i, the joint distribution of the competing bids $G(b_i)$, its density $g(b_i)$ and the number of bidders N. Because Equation (18) is the inverse of bidder i's equilibrium bid function, it turns to be the mapping needed to infer valuations from bids. Since the joint distribution of bids is observable, identification of each private value v_i and therefore of the joint distribution $F(\cdot)$ follows directly from (18). In other words, if b_i is the equilibrium bid of the auction game, then the bidder's private value, v_i, corresponding to b_i must satisfy (18).

Now, let us now explain the underestimation problem we are incurring in by ignoring a random reservation price. To illustrate this, call p_0 the random reserve price of the target. Since in equilibrium, the strategy of the seller is to set the reserve price equal to his private value, the distribution of p_0 is the distribution of the target's private value, call it $F(p_0)$. If this random reserve price is included in the auction, a truncation factor must be introduced because a potential bidder with a private value lower than p_0 does not bid. That is, the probability for bidder i winning the target must be adjusted to $G*(b*) = \Pr\left(s(v) \leq b* \middle| v \geq p_0\right) = \left[F(v) - F(p_0)\right]/\left[1 - F(p_0)\right]$ where $b*$ is the equilibrium bid and $G*(b*)$ its distribution. When differentiating with respect to the equilibrium bid $b*$, one obtains a conditional density of the form $g(b) = \left(1/s'(v)\right)\left(f(v)/1 - F(p_0)\right)$. As a result, the private valuation would be modified upwards by this term as

$$v_i = \varphi\left(b_i, G, N\right) \equiv b_i + \frac{1}{N-1}\left(\frac{G\left(b_i\right)}{g\left(b_i\right)} + \frac{F\left(p_0\right)}{1 - F\left(p_0\right)}\frac{1}{g\left(b_i\right)}\right).$$ Since our interest is to investigate

for bidders' gains, which are statistically significant, such underestimation even reinforces our hypothesis, namely, acquirers gain from merging.

A.2. Issues about the determinants of the private values estimations

Concerning the verification of the two key assumptions for obtaining identifiable and consistent OLS estimators of specifications (14) and (15) we have performed tests of endogeneity and linear relationships among regressors. Endogeneity may be due to three reasons: omitted variables, measurement error due to imperfect measures of the latent or of the independent variables and simultaneity. We have performed a Ramsey regression specification error test (RESET) to investigate if we do have problems of endogeneity due to omitted variables and to verify then if regressors are correlated with the error term. We performed the Ramsey test in two ways, one using the powers of the fitted values and another using the powers if the individual elements of X, where X is the vector of the right hand side variables or specifications (14) and (15). Both RESETs favoured our private values specification. That is, even if we were missing some variable in our specification it is still the case this acquirers decisions about X don not depend on unobservable (to us) factors. Moreover, we can be sure that we do not have endogeneity problems in this expression due to simultaneity. Because neither the fundamentals of the target firm nor the interaction terms of such fundamentals with its acquirer's counterparts depend on the private valuations of acquirers for targets. Then, private valuations are unique to the acquirer and there is no manner they could influence the target's fundamentals. With respect to measurement errors concerns, the dependent variable $\hat{v}_i$ is by construction measured with a random error since it is itself an estimation of the true private value v_i. However, the size of the estimation error of $\hat{v}_i$, hereinafter denoted by $\varepsilon_{\hat{v}_i}$, is unlikely to be systematically related to the other variables X and should then not cause problems of measurement errors coming from the dependent variable. Concerning the measurement error in the explanatory variables, we are aware that the perception of the targets' intangibles for acquires might be different to the variable intangible reported in the balance sheets by the targets themselves, which is indeed what we can observe. In that case, it might be that the intangible fundamental is only incompletely observed to the analyst implying $I^{T*} = I^T + e_I$ where I^{T*} is the intangible asset as computed

and perceived by acquirers and I^T is the observed intangible, so that e_I is the measurement error of this variable.[33] We assume that we are facing the classical error in variables property, namely that the measurement error is uncorrelated with the unobserved explanatory variable, which implies in fact that our observed variable and its measurement error are correlated, as $Cov\left(I^T, e_I\right) = E\left(I^T e_I\right) = E\left(I^{T*} e_I\right) + E\left(e_I^2\right) = \sigma_{e_I}^2$. We then assume that the covariance between our measure of intangibles and its measurement error is equal to the variance of the measurement error. As it is well known, this causes a downwards attenuation bias to our OLS estimated coefficient of I^T (since the coefficient is positive). However, at the end of the day we are not deeply concerned for this attenuated bias since even underestimated the coefficient it is strongly significant and of considerable dimension which is what matters to prove our hypothesis.

On the other side, we have performed tests of variance inflation factors to detect if our regressors show close linear relationships among each other. Our tests show the elements of X are not highly collinear. Finally, our tests of heteroskedasticity by means of Lagrange multiplier $à\ la$ Breusch and Pagan indicate that the conditional variance of the error term ε_i is not constant, i.e. $Var(\varepsilon_i | X) = \sigma_i^2$. To ensure the asymptotic validity of the OLS standard errors and t-statistics we have performed weighted least squares correcting for the heteroskedasticity by dividing the dependent and the independent variables by an estimate of the conditional standard deviation of the error term on the squares of the explicative variables, $\left[\mathrm{var}\left(\varepsilon_i | x_i^2|\right)\right]^{1/2}$. Indeed; applying OLS to the weighted data largely improved the general goodness of fit of our model and the individual t-statistics.

---

[33] In Motis, Damien and Seabright (2006) we tried to construct a more accurate measure or the market value of intangibles that we called Total Value of Intangibles VA_A by setting $VA_A = I_A + G_A + V_A - E_A$ where, I_A are the identified intangibles (the ones reported in balance sheets), G_A is the goodwill, V_A is the market value of the target and E_A is equity. In this study we have also performed our regressions with this variable finding always a positive and significant coefficient for VA_A. However we could not get rid of multicolinearity problems since VA_A is by construction closely related to T_A.