Abstract
Every day M&A are arranged bringing together separate companies to make larger ones. M&A can worth billions of dollars and dictate the gains/loses of the involved companies’ shareholders, managers, employers, competitors and consumers for years to come. Most empirical studies that evaluate the motives and gains of M&A conclude that, in average, the target has positive gains, while the acquiror, at best, does not lose from such deal. With a database rich in bids proposals, final bids and the number of competitors; a richer approach may be used to estimate the acquirors’ gains from merging. Since a bid situates a corporation into the game of an auction, this paper proposes to interpret mergers as first price auctions in order to provide a powerful analytical tool for evaluating gains in M&A. It builds on some dissatisfaction with event studies and with operating performance studies. By estimating acquirors’ “true valuation” we are able to compute the “true gains” of the bidder in a first price auction using nonparametric methods. The gains of bidding in a first price independent private value auction are positive on average contrary to what is found in the event study.

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

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

This paper proposes to interpret a merger as an auction in order to provide a powerful analytical tool for evaluating gains from merging. It builds on some dissatisfaction with “event studies” and with “operating performance” studies that estimate the gains of a group of mergers with financial and accounting data respectively, but without any structural economic approach behind those market models.

Most of these empirical studies that evaluate the motives and the gains in mergers and acquisitions conclude that, even when the joint gains in stock prices are positive in average, the distribution of gains is not symmetric, that is, while the target has positive gains, the acquiror, at best, does not lose from such deal\(^1\).

A major proportion of those studies employ the already standard financial technique called “event study” which consists on computing the “abnormal returns” due to the merger announcement. Event studies attempt to determine the effects of mergers on the merging firms and sometimes, on the market as a whole. However, stock market event measurements of the net returns provide a prediction of gains (losses) of the merging firms rather than evidence that such gains (losses) actually occurred.

Furthermore, the gains of mergers may not necessarily be immediately reflected in the change of stock prices because stock market reactors may have neither the same information, nor the same long-run perspective than the merging firms do when joining their sets of assets. Only insiders can anticipate when/how their particular bundle of assets operated separately can be combined in new ways to generate additional value. Thus, as market reactors may not posses the same information to estimate the “true

\(^1\) Andrade, Mitchell and Stafford 2001, findings reveal that the value-weighted average of the two firms’ return is positive, with most of the gains accruing to the target company.
gains” of the game as insiders do; outsiders’ computations may differ from those of the players of the merger, for instance, because of underestimation of true synergies, which might be the reason for financial empirical studies concluding that acquirors do not gain from merging. In a previous work, based on the event-study methodology, we have found these classical results, i.e., positive joint abnormal returns, positive abnormal returns for targets and negative abnormal returns for acquirors none of them significant.

Bearing in mind that stock price studies may be unable to provide evidence on the gains of merging and on the source of any merger-related gains in the short run\(^2\), an alternative assessment of the merging gains based on an accounting approach has also been largely performed, it is called “operating performance study”. An operating performance study analyzes merger performance by measuring the (accounting) profits of the merging parties before and after the integration. These studies estimate returns and the effect of mergers using accounting data to measure changes in profits and in market shares. They are less homogeneous between them because different measures of profitability are adopted: cash flows, gross profits, profits net of interest and taxes, profit ratios (returns on equity, on total assets, or on sales). Different alternatives are also used to control for external shocks, i.e., comparing the merging firms with their base industry or with matching firms (firms similar to the merged ones in industry and size).

However, these studies are no more perfect that event studies because accounting data are imperfect measures of economic performance and they can be affected by managerial decisions. In fact, these outcome studies show a smaller variance of results

\(^2\)Some of the event studies collect stock prices for the long-run after announcement, but do not converge in general results. Furthermore long-run movements in stock prices may not be very merger informative because inevitably, too much noise after the merger will be preset e.g., external industry shocks; other operations of the merged entity, etc.
due to different methods (sample composition with respect to time horizons, control
groups, merger motives, firms’ characteristics, etc.) than the variance of the results in
general. Their findings do not differ very much from those of event studies: in most cases
post-merger profits of the merging firms are weaker and sales perform worse with respect
to the merging-control group.

If we rely on event studies and on outcome studies in order to have an opinion
about merging gains, we end asking ourselves why mergers continue to happen if
acquirors do not show evidence of significant gains from such transaction? We consider
that the pitfalls in the evaluation of mergers might precisely be in the employed
methodology to estimate gains. Limiting the analysis to financial and/or accounting
techniques risks a lack of the economic rational behind bidders’ decisions. Introducing a
rational strategy in the decision to merge might be useful to understand the motives to
merge and to compute the “true gains” of merging. Molnar (2004) models and tests the
pre-emption hypothesis specifying that merging is a rational strategy even when
acquirors lose from merging. Using auction theory Molnar models how even rational,
shareholders’ value-maximizing managers could pursue value-decreasing mergers, and
then using the event study methodology he proofs his hypothesis. Fridolsson and Stennek
in a model of endogenous mergers develop a similar idea to explain why value-
decreasing mergers occur.

Our study concentrates on the acquirer side and not on the distribution of the
gains. It tries to show that if mergers continue to happen and even to growth in time and
at the rhythm of economic waves, it is simply because bidders win from merging. It
provides evidence of the positive gains of acquirors contrary to the general results of financial and accounting empirical studies.

In this paper we hypothesize that the process of horizontal mergers parallels the process of a first-price auction because a bid situates a corporation into the game of 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. With a database rich in bidders' and targets' characteristics, bids proposals as well as the final bid paid for the deal and the number of competitors; a richer approach may be used to estimate the acquirors’ "true value" for a target and the “true gains” of merging. Furthermore, with this more economic approach of the merger process, the exploration of the motives for merging may be more accurate.

As far as we know, analyzing whether an actual takeover auction (a merger or an acquisition) performs as an auction has received little attention in the economic literature. Mergers and acquisitions have not been evaluated by an auction process even when the course of mergers and acquisitions clearly behaves as an auction. Klemperer and Bulow (1996) support the idea that a takeover is an auction and that targets’ managers get higher expected profits by auctioning the firm than by negotiating with fewer bidders. The value of negotiating is small relative to the value of additional competition between bidders (running an auction is more profitable than trying to extract one buyer’s surplus by negotiation).
On the other hand, we are neither aware of any empirical study that estimates the gains of mergers and acquisitions on the basis of a more economically structural model as would be the auction model when available data is cross sectional\textsuperscript{3}.

In this study, we investigate the auction process in mergers. By computing the economic gains of acquirers in mergers within a first-price sealed bid auction, this study shows that merging is a profitable activity for bidders.

We apply the Guerre, Perrigne and Vuong (2000) methodology to estimate an independent private value auction game. The procedure consists in a two-step nonparametric estimation to recover the bidders’ private valuation distribution without making any a priori assumption of the latter. The advantages of this method are that, it is easily implemented and that it does not require to compute or to inverse the Bayesian Nash equilibrium strategies of the auction model and that the estimated latent distribution is not subject to misspecification.

Section 2 presents the data. Section 3 interprets mergers as auctions. Section 4 presents the nonparametric estimation methodology and its identification concerns. Section 5 presents the empirical results. Section 6 compares the estimated gains obtained from with auction model with the ones obtained with the event study. Section 7 summarizes and concludes.

\textsuperscript{3} Structural economic models are used in “case by case” econometric studies or “clinical research” studies. In those studies, data contains detailed information about sales and prices of the product where the merger has taken place that allows them to measure merger effects on productivity, market shares and market power.
2. Data

Our data are drawn from two versions of the SDC databases received in different periods and therefore not treated at the same time. Those SDC databases consist on the record of the world mergers and acquisitions for the 1977-2003 periods. The database includes the date of the announcement of the merger as well as the year the merger is effective. Both firms’ characteristics at the announcement day are also available, that is, their balance sheets elements, as well as their industry and country. Data on competition issues are also included, we can observe if the merger has being challenged and, more interestingly for our purposes we have been able to detect if the bidder has faced competitors.

For estimations of the independent private value auction gains we kept a subsample for which we have also data on stock prices in order to make a comparison with the event study gains. Then, due to the fact that we have complemented our SDC database with the stock market information from DataStream our final sample contains only US firms. This subset of mergers has registered a non zero bid and an effective year of the deal (to ensure that the merger has been completed). The final sample contains data of 150 horizontal mergers drawn over the period Feb 2000 – Feb 2003. 40% of the deals belong to the manufacturing industrial sector, 37% to the Services sector, 14% to the Finance-Insurance-Real Estate industrial sector, 4% to the Retail Trade sector and the remaining 5% is distributed in the Mining, Construction and the Wholesale sector.

3. Mergers and Auction Models

Using auction theory for analysing M&A is a natural step because in either arrangement, a merger or an acquisition, the acquiror has the self-determination of choosing the best
target for him knowing that other potential acquirors will be also interested in submitting a bid while the target maximizes its gains not by choosing itself a buyer but by letting the different buyers compete for it, that is, by running an auction.

The auction aspect of corporate takeovers is explicitly recognized by regulators. Under Delaware law (the predominant corporate law in the US), when a potential acquirer makes a serious bid for a target, the target’s board of directors is required to act as would “auctioneers charged with getting the best price for the stockholders at a sake of the company”\(^4\). Furthermore, the Williams Act requires takeover bids to remain open for at least 20 business days on the grounds that the delay facilitates auctions\(^5\). Moreover, as well as bids in acquisitions, bids in mergers are subject to delay and disclosure provisions which facilitate the entry of competitors to a merger. Corporate regulators might have this preference for auctions because they know that auctions maximize shareholders returns and that they promote efficiency by shifting corporate assets into the hands of those that value them most highly.

In this context, matching theory of auctions with practice of takeover auctions, mergers and acquisitions, seems reasonable. In a takeover process, the auction starts when the first bidder has arrived, the starting time depends on the first potential bidder, and once this bidder has made public his interest to obtain the target; other bidders came along and participate in the auction. The main characteristics of targets like their market


\(^5\)“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. The Williams Act was created in 1968 in order to protect investors from these occurrences. This federal act defines the rules in regards to acquisitions and tender offers. 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” The Securities and Exchange Commission Rule 14e-1
value and the assets composition are publicly available in the market, and there is no rule that limits the number of bids an acquirer can propose for a target.

Accordingly, the auction process is a natural mean to analyse M&A since targets’ managers obtain the highest price by running an auction instead of by negotiating with potential bidders. The important aspect is that the target has only incomplete information about the potential buyer’s valuations. If this were not the case and targets knew the potential acquiror and its private valuation for it, its pricing problem will be resolved and it will ask the price that matches the acquirer’s private valuation.

Even when a takeover auction can take the form of a merger or of an acquisition; we believe that there is a clear difference between the two types of arrangements. Once passing by the process of the merger announcement and the highest bid is proposed, the merger takes place if the two firms agree going forward as a new single company rather than remaining separately owned and operated; and new company stock is issued in its place. On the other hand, there is no exchange of stock or consolidation as a new company in acquisitions. Several acquisitions even happen in a hostile/unfriendly environment, that is, the target company does not want to be purchased but still, the auction process is open.

In this sense, there is a clear difference between a merger and an acquisition. Their common aspect is that they are both a mean to control a publicly held firm by an auction process but; while a merger contract is in search of a unique and specific combination of target and bidder assets to become a new more valuable entity, an acquisition is interested in a portion of the target shares without necessarily re-combining
their respective bunch of assets neither forming a new company but instead becoming the parent/subsidiary of the other.

Comparably, the auction literature distinguishes two auction environments: the private and the common value auctions that we briefly describe below. For the auction description we will denote random variables in upper case, their realizations in lower case and vectors in bold letters.

The utility each bidder $i=1,\ldots,N$ would receive from owning the good is given by $U_i$ with the same support $F_{U_i}(\cdot)$ for all $i$. $U_i$ is referred to as $i$’s valuation. Each bidder $i$’s private information consists of a signal $X_i$ which is informative in the sense that 

$$E[U_i|X_i=x_i, X_{i'}=x_{i'}]$$ strictly increases in $x$ for all realizations $x_{i'}$ of $i$’s opponents’ signals. Signals play a purely informational role and any monotonic transformation $\theta(X_i)$ contains the same information as $X_i$ itself. The marginal distribution of $X_i$ is irrelevant, that is, without normalization on $X_i$ the auction theoretical model is over-parameterized. Without loss of generality the following normalization can be imposed $X_i=E[U_i|X_i]$.

An auction is a common value auction if each bidder $i$ updates his beliefs about his valuation $U_i$ when he learns $X_j$ in addition to his own signal $X_i$. That is, bidders have common values if $E[U_i|X_i=x_i, \ldots, X_N=x_N]$ strictly increases in $x_j$ for all $x_j, j\neq i$. In the common value paradigm, knowledge of opponents’ signals would alter the expectation of the own valuation of $i$. The way information about the value of the good is dispersed among bidders may vary, for instance, there is the pure common value auction in which the value of the object is identical for all bidders, with $U_i=U_0$. 
In private values auctions, bidders do not have private information about the valuations of their opponents, then $E[U_i|X_i=x_i, \ldots, X_N=x_N] = E[U_i|X_i = x_i]$ for all $x_i, \ldots, x_n$, this is equivalent to assuming that bidders know their own valuations $X_i=U_i$.

We hypothesize then that while mergers parallel a private value auction mechanism, acquisitions parallel a common value auction mechanism. The reasoning is that when acquiring a portion of a target’s share at a publicly known price, each of the potential bidders pursues essentially the same objective: obtaining a technical efficiency by acquiring control of the target and not necessarily obtaining merger-specific gains or synergies. Thus we believe than in the case of an acquisition every bidder $i$ has essentially the same value for the shares of the target, and this value is influenced by his competitors’ signals. That is, as no merger-specific gains are expected in the case of an acquisition any bidder will obtain the same additional value when acquiring shares of the target.

On the other hand, for merger-specific gains to be possible it must be the case that this specific combination of acquiror-target assets gives the highest gains to bidder $i$, and given that the deal is processed as an auction the target also maximizes gains. Synergies and merger-specific gains are our particular concern, for that reason this study concentrates on horizontal mergers leaving aside acquisitions deals and testing for the private value auction paradigm in the a first-price auction. We do not observe any data on the product market but we can still evaluate for potential synergies directly by computing the gains of merging with the auction model. We assume that horizontal mergers are run in the context of a first-price sealed bid auction and that the “true gains” of the acquiror
should be computed not only with the change in the stock price but also adding the informational rent obtained when winning the target by the auction process.

The independent private value auction approach is a reasonable approximation of the merger process because in mergers different potential bidders have their own and particular perspectives of recombination of acquiring-acquired assets that are independent of the others’ bidders valuations. The first price sealed bid rule is chosen for simplicity of estimations; the ascending auction could also apply to the context of merger. Nevertheless, we consider this assumption is not very strong because in the first price sealed bid auction the winner pays the expected second highest valuation, \( E[v_2] \), while in the ascending auction the winning bidder will pay the second highest valuation, \( v_2 \). Given the efficiency of the markets it should not exists a big difference, that is, we could expect \( |E[v_2] - v_2| = \epsilon \). The first-price sealed bid auction with independent private value is then briefly described below.

### 3.1 Merges as First-Price Sealed-Bid Private Value Auctions

Data containing bids and the number of actual bidders allow us to compute the equilibrium bidding strategy of the auction game because it is a function of the bidders’ private value and their underlying distribution. Assume there is no reservation price in these takeover auctions, so that the number of potential bidders is equal to the number of actual bidders. Although, we could assume that the reserve price of a target is its market value, it is clear that for a bidder, that expects synergy gains from merging and which internalizes the additional value the acquisition of the target is going to bring him, the market value of the target; stated by outsiders at the moment of the bid, is far from being a reserve price to him. Assuming that bidders are symmetric and that available data consist of bids from independent auctions of identical and indivisible goods, the rules of the first-price sealed bid auction are that bidders submit bids simultaneously and the
target is awarded to the highest bidder at a price equal to his bid. Then characteristics of
the bidders are supposed to be drawn by nature from the same probability distribution
which is common knowledge to all bidders. Each bidder is supposed to know his own
valuation as well as the number of participants to the auction but does not have private
information about the valuation of his opponents.

Then bidder \(i\)'s equilibrium bid is the expectation of his valuation conditional on
his own signal and the highest competing bid, which in the symmetric case is expressed
as:

\[
v_i(x,x,N) = v(x,x,N) = E[U_i|X_i = \max_{j \neq i} X_j = x].
\]

Bidders’ private value are drawn independently from a common distribution absolutely
continuous, \(F(.)\) with density \(f(.)\) and with support \([v,v]\subset R^+\). Assuming bidders are risk
neutral, and establishing their utility for the target as \(U(v_i) = v_i\), bidder \(i\)'s expected profit
\(\pi_i\) conditional on its own signal and on it’s the highest competing bid can be expressed
as:

\[
E(\pi_i) = (v_i - b_i) \Pr(b_i \geq b_j, j \neq i) \quad (3.1)
\]

where \((v_i - b_i)\) is the profit from the auction, and \(\Pr(b_i \geq b_j, j \neq i)\) is the probability of
winning the auction. The bidder maximizes his expected gain with respect to his own bid
and will bid independently of the private value of its competitors, that is, in the Bayesian
Nash equilibrium, the bid is only in function of its own private value \(b_i = s(v_i)\). Because
bidders are assumed to be symmetric \(\Pr(b_i(x_i) \geq b_j(x_j, j \neq i))\) can be expressed as \(F^{-1}(v_i)\)

\[6\] The bidders are assumed to be symmetric in the sense that they draw their characteristics from the same
distribution.
and, the inverse function of the equilibrium strategy as \( s^{-1}(.) = s^{-1}(.) \). Then, the expected gain of the bidder can be expressed as:

\[
E(\pi_i) = (v_i - b_i) F^{N-1}(s^{-1}(b_i)) \tag{3.2}
\]

Maximizing (3.2) with respect to \( b_i \) and requiring that \( b_i = s(v_i) \) solves the first order condition for \( s(.) \). The symmetric Bayesian Nash Equilibrium strategy gives then the following differential equation for \( N \geq 2 \):

\[
1 = [v_i - b_i](N - 1) \frac{f(v_i)}{F(v_i) s'(v_i)} \tag{3.3}
\]

where \( s'(.) \) is the derivative of \( s(.) \). The solution of (3.3) is the equilibrium strategy \( s(.) \) which is subject to the boundary condition \( s(v) = v \) then solving for \( s(.) \) one obtains

\[
b_i = s(v_i) = v_i - \frac{1}{(F(v_i))^{N-1}} \int_{-\infty}^{v_i} (F(z))^{N-1} dz \tag{3.4}
\]

the equilibrium strategy, \( s(v(x), F(v(x)), N) \), is in function of the number of bidders, the bidder’s private value and the distribution of private values and; it is strictly increasing in \( v_i \) on \([v, \bar{v}]\). This last equation will be the basis of the estimations.

4. Estimation and identification

4.1 Identification

The primitive of interest in the structural private value auction analysis is the joint distribution \( F(.) \) of bidder valuations. This joint distribution characterizes acquirors demand and information. Equilibrium is defined by (3.4) which lead to a closely related structural econometric model since bids are functions of private values, which are random and distributed as \( F(.) \) implying that the observed bids are also random with a
distribution noted $G(.)$. $G(.)$ consists on a single mapping from the true distribution of valuations to a distribution of bids implied by the assumption of Bayesian Nash Equilibrium. Given that equilibrium is attained when each player is acting optimally against the distribution of behavior of competitors, both the distribution of opponent behavior and the optimal (equilibrium) choice of each bidder are observable enabling identification of the latent joint distribution of bidders’ valuations. Then if the bidders’ private valuations distribution is uniquely determined from observed bids, the identification problem is solved. However, given that $G(.)$, the distribution of observed bids, depends on $F(.)$, the distributions of bidders’ private values directly through $v$ and indirectly through the equilibrium strategy $s(.)$ which depends on $F(.)$, 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 $G(.)$ and their density $g(.)$.

As proposed by Guerre, Perrigne and Vuong (2000), let $g(.)$ be the density of observed bids in the differential equation (3.3), introduction of $g(.)$ and $G(.)$ in equation (3.3) simplifies its expression by eliminating the first derivative $s'(.)$, the distribution $F(.)$ and its density $f(.)$. Note that for every $b \in [b, \bar{b}] = [v, s(v)]$, we have

$$G(b) = \Pr(\tilde{b} \leq b) = \Pr(v \leq s^{-1}(b)) = F(s^{-1}(b)) = F(v) \quad (4.1)$$

Then, the distribution of observed bids is absolutely continuous with support $[v, s(v)]$ and density $g(b) = \frac{f(v)}{s'(v)}$ where $v = s^{-1}(b)$, the ratio will then be $\frac{g(b)}{G(g)} = \frac{f(v)}{s'(v)F(v)}$. Finally, the differential equation (3.3) can be expressed as:
\[ v_i = \varphi(b_i, G, N) = b_i + \frac{1}{N-1} G(b_i) \quad (4.2) \]

The bidder’s latent private value in equation (4.2) can be expressed as a function of his equilibrium bid \( b_i \), the joint distribution of the competing equilibrium bid he faces \( G(.) \), its density \( g(.) \) and the number of bidders \( N \). Equation (4.2) is the inverse of bidder \( i \)'s equilibrium bid function, 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 distributions \( F(.) \) follows directly from (4.2).

That is, if \( b_i \) is the equilibrium bid, then the bidder’s private value, \( v_i \), corresponding to \( b_i \) must satisfy (4.2).

Then the gains of merging to the acquiror are the change and its market value due to the merger announcement plus the informational rent obtained from the auction process

\[ G_t^{A} = \frac{MV_t^A - MV_{t-1}^A + IR_t}{MV_{t-1}^A} \quad (4.3) \]

where \( MV_t^A \) is the acquirer’s market value at the day of merger announcement, \( MV_{t-1}^A \) is the acquirer’s market value prior to the merger announcement and \( IR_t \) are the gains from the merger process, that is, \( (v_a - b_a) \) the acquirer’s true valuation for the target minus the actual bid paid for it.

4.2 Estimation method

If one knows \( G(.) \) and \( g(.) \), expression (3.4) can be estimated so as to recover every bidder’s private valuation \( v_i \). There exist many different ways to estimate such
distribution. Parametric methods would require to specify an *apriori* parametric family distribution for $G(\cdot)$, which may bring some correspondence problems between $G(\cdot)$ and $F(\cdot)$ and moreover, this choice could be subject to misspecification.

Without assuming any specific functional form neither on the bidders’ distribution of their private values nor on the observed bids’ distribution, but instead letting the data reveal the shape of the distribution, we first estimate the empirical cumulative bid distribution $G(\cdot)$ and then its corresponding density $g(\cdot)$ using nonparametric kernel density estimators. Second, introducing the estimated $G(\cdot)$ and $g(\cdot)$ in (4.2), a sample of pseudo private values is obtained. Third, using the estimated private values of the second step, the *pseudo private values* $\hat{\nu}$ we are able to compute the informational rents of the bidder using estimated $\hat{\nu}$ and observed bids $b$. Finally, equation (4.3) the “true gains” of the merger can be computed by adding the informational rents accruing to the bidder from the merger process to the change in its market value due to the merger announcement.

Hereafter, consider $L$ auctions, each one of them with a number of bidders $N_l$, $l=1,\ldots,L$. To simplify the presentation assume this number does not vary across mergers, and that no heterogeneity across auction objects is present. We observed all the bids $b_{nl}$, $n=1,\ldots,N$, $l=1,\ldots,L$. Let $v_{nl}$, $n=1,\ldots,N$, $l=1,\ldots,L$ denote the private values. The first step consists in obtaining the pseudo private values

$$v_{nl} = \varphi(b_{nl}) = b_{nl} + \frac{1}{N-1} \frac{G(b_{nl})}{g(b_{nl})}$$  \hspace{1cm} (4.4)

Let

$$\tilde{G}(b) = \frac{1}{NL} \sum_{i=1}^{L} \sum_{n=1}^{N} 1(b_{nl} < b)$$  \hspace{1cm} (4.5)

be the empirical distribution of observed bids; and
\[ \tilde{g}(b) = \frac{1}{NL h_g} \sum_{i=1}^{L} \sum_{n=1}^{N} K \left( \frac{b - b_{nl}}{h_g} \right) \]  

(4.6)

be the kernel density estimator of observed bids, where \( K \) is the triweight kernel, \( h_g \) is the bandwidth and it is defined as \( h_g = c_g(NL)^{-1/(2R+3)} \) with \( c_g = a \times 1.06\sigma_b \), \( a \) is the factor of the kernel, \( \sigma_b \) is the empirical standard deviation of observed bids and \( R \) is the number of derivatives of the density. Now, (4.4) can estimated by

\[ \hat{v}_{nl} = b_{nl} + \frac{1}{N-1} \frac{\tilde{g}(b_{nl})}{\tilde{g}(b_{nl})} \]  

(4.7)

Equation (4.7) defines the pseudo private values. As these estimates are based at the boundaries of the support the following trimming rule must also be applied:

\[ \hat{v}_{nl} = \begin{cases} 
  b_{nl} + \frac{1}{N-1} \frac{\tilde{g}(b_{nl})}{\tilde{g}(b_{nl})} & \text{if } b_{min} + h_g \leq b_{nl} \leq b_{max} - h_g \\
  \infty & \text{otherwise}
\end{cases} \]  

(4.8)

where \( b_{min} \) and \( b_{max} \) are the minimum and the maximum bids, respectively. Once (4.8) obtained the estimated true gains of the merger auction game are obtained by

\[ \hat{G}_{i} = \frac{MV_{i}^{T} - MV_{i-1}^{T} + I\hat{R}_{i}}{MV_{i-1}^{T}} \]  

(4.10)

5. Empirical Results

Recall that our final sample consists on 150 horizontal mergers in the US. Comparing the winning bid \( b_i \) to the market value of the target \( MV_{i-1}^{T} \) one day prior to the merger announcement and to the estimated private valuation of the bidder \( v_{1i} \), we note that the winner has proposed much more than the actual market value of the target at the time of announcement. See table 5.1.
Table 5.1: Summary Statistics of Winning Bids, Target’s Market Values and Estimated private valuations (In millions of dollars)

<table>
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<th></th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>Min</th>
<th>Max</th>
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<td>187.2195</td>
<td>2.1436</td>
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<td>255.6766</td>
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</tbody>
</table>

As private values are recovered, we can compute the informational rents to the acquiror in the auction model which are denoted by $IR$ and $IRp$ where, $IR=(\hat{v} - b)$ and $IRp=(\hat{v} - b)/\hat{v}$ respectively. Equation (4.10) of the gains of the bidders can also be computed. See table 5.2

Table 5.2: Summary Statistics of Informational Rents of the Bidder in Mergers

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>$IR$</td>
<td>150</td>
<td>4.405605</td>
<td>3.307211</td>
<td>3.053146</td>
<td>20.1291</td>
</tr>
<tr>
<td>$IRp$</td>
<td>150</td>
<td>.0575628</td>
<td>.0888126</td>
<td>.009174</td>
<td>.600102</td>
</tr>
<tr>
<td>$G^a$</td>
<td>150</td>
<td>.1332539</td>
<td>1.438508</td>
<td>-.4967854</td>
<td>17.3912</td>
</tr>
</tbody>
</table>

In average bidders obtain a 5.7% of their valuation of the target which might appear a small number but taking into account that targets value millions of dollars those gains are not negligible. The return to the bidder from merging as indicated by equation (4.10) is positive, in average the value of the acquirors increases in 13% due to the auction process implied by the merger announcement.

Comparison with the Event Study

Event studies rely on the presumption that stock prices reflect the present value of the expected profits created by the merging firms, under the assumption that the stock market is efficient. An event study is based on the analysis of the stock return of bidders and targets relative to a portfolio of stock representing the market where they operate. The
“event” is the merger announcement. Differences in returns of the target and the acquirer relative to market returns are usually calculated over a period of time (before and after announcement). The objective is to determine whether the announcement of the merger causes the stock return of the bidder and of the target to perform differently than the general market return. That is, the abnormal return is the return that is observed in excess of what it would have been if the stock had behaved relative to market in the same way as in a benchmark period. The behaviour of the stock relative to the market is estimated before announcement from a market model: \( R_i = \alpha_i + \beta_i R_{m_t} + e_i \), where \( R_i \) are the actual returns to firm stock \( i \) at time \( t \), \( R_{m_t} \) are the actual returns to a market portfolio for firm stocks at time \( t \), for example, the value-weighted index of the sector stock. The market model is estimated in a period of time called “estimation window” Using predicted values from the market model, one obtains the abnormal returns to firm \( i \) a time \( t \) by: \( AR_i = R_i - (\hat{\alpha}_i + \hat{\beta}_i R_{m_t}) \) for the “event window”, that is a selected period of time after the “estimation window”.

The market response can be tested by computing the cumulative abnormal returns of the merging firms over the span of the event window \( T \), that is, \( CAR = \sum AR \). Finally to test for their significance, a t-test is constructed as: \( t(CAR) = \frac{CAR}{\sigma_{CAR} \sqrt{T}} \).

Expected gains of acquiring estimated with the auction model are much higher that the ones registered in our previous study based on the “event-study” methodology, were the acquiror has abnormal returns for acquirors that are negative in average and not
significant; the t-test for the sample with stock information is of -0.038867. See table 4 and figure A.6.

Table 5.3: Abnormal Returns, Informational Rents (Absolute and Relative) and Auction Gains

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>AR</td>
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<td>-.0027418</td>
<td>.0203888</td>
<td>-.1295185</td>
<td>.0875158</td>
</tr>
<tr>
<td>IR</td>
<td>150</td>
<td>4.405605</td>
<td>3.307211</td>
<td>3.053146</td>
<td>20.1291</td>
</tr>
<tr>
<td>IRp</td>
<td>150</td>
<td>.0575628</td>
<td>.0888126</td>
<td>.009174</td>
<td>.600102</td>
</tr>
<tr>
<td>G_i</td>
<td>150</td>
<td>.1332539</td>
<td>1.438508</td>
<td>-.4967854</td>
<td>17.3912</td>
</tr>
</tbody>
</table>

As it can be seen in Table 5.3 the computed true gains of the merger with the auction process differ to the ones computed by the event study methodology. While the movements in stock prices show a decrease in the acquirer’s standing alone value, the auction gains are positive in average.

7. Conclusion

This paper proposes to interpret a merger as an auction in order to provide a powerful analytical tool for evaluating gains from merging. It builds on some dissatisfaction with “event studies” and with “operating performance” studies that estimate the gains of a group of mergers with financial and accounting data respectively, but without any structural economic approach behind those market models. We hypothesize then that horizontal mergers searching for synergies parallel a private value auction mechanism. The reasoning is that a bid situates a corporation into the game of 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 bids and the number of actual bidders allow us to compute the equilibrium bidding strategy of the auction game and therefore the informational rents accrue to the bidder from the auction.
process. Then, by computing the economic gains of acquirers in mergers within a first-price sealed bid auction, this study shows that merging is a profitable activity for bidders. The return to the bidder from merging is positive, in average the value of the acquirors increases in 13% due to the auction process implied by the merger announcement. A parallel event study has been performed for purposes of comparison; the abnormal returns to acquirors in the event study are negative and not significant.

References


Figure A.1

Estimated private values and observed bids in mergers
solid line: 45°

Figure A.2

Densities of bid and of estimated private values
Figure A.3

Informational Rents of Bidders in Mergers

Figure A.4

Informational Rents in Percentage of Bidders in Mergers
Figure A.5

Conditional Density of Bidders’ Private Values in Mergers

Figure A.6

Abnormal Returns of Bidders in Mergers
Kernel densities of the true gains from merging evaluated with the merger process “cmv” and the abnormal returns “ar” of the event study.