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## Mergers and Rivals' Mark-ups: Evidence from European Paper Manufacturers

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### Abstract

This paper investigates the effect of merger-driven market concentration on the mark-ups of non-merging rival firms in Europe's paper manufacturing industry. Using a representative data set of 400 independently-owned companies spanning a ten-year period, we aim to disentangle the impact of full-scale mergers and acquisitions from that due to other concentration-increasing developments. We find a positive and statistically significant relationship between price-cost margins and overall industry consolidation, as captured by the Herfindahl-Hirschman and four-firm indexes. However, takeover-related market share amalgamation has a negative impact, albeit of more modest proportions. The latter result seems to be driven by vertical transactions, suggesting that input-side channels, much as product price competition, may explain non-merging firms' mark-up response.

*Keywords:* Mergers and acquisitions; Concentration; Mark-up; Competition policy

*JEL Codes:* C23; G34; K21; L11

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## Introduction

This paper studies the effect of corporate restructuring via mergers and acquisitions on the competitive environment in paper manufacturing across the European Economic Area (EEA). Focusing on non-merging firms' mark-ups, we empirically test the conventional wisdom that concentration-increasing takeovers weaken competitors' incentives to pursue productive efficiency. While data limitations prevent a distinction between price-side and cost-side developments, increased price-cost margins in response to mergers can generally be perceived as a sign to that effect.<sup>1</sup> By contrast, a negative impact on outsiders' mark-ups, through either channel, would indicate impending pressure to enhance efficiency. The question has policy relevance in as much as theoretical predictions that form the basis of antitrust enforcement point to enhanced scope for slack in firms' internal organization in the aftermath of concentration-increasing transactions. Indeed, the possibility for an efficiency defence was not explicitly admitted under the old EU merger regulation, in force until 2004. Even if the feared anti-competitive outcome of a takeover could be offset by efficiency gains, they were not likely to receive adequate weight in the Commission's assessment.

We base our investigation of takeover-related competitive effects on a sample of European paper manufacturing firms, as the sector has been marked by important transactions over the time period for which we have data. Moreover, while certainly present, product differentiation may be relatively less pronounced in that industry, which is in line with our econometric model's assumptions.<sup>2</sup> We find that non-merging firms' mark-ups are increasing with overall market concentration, as captured by the Herfindahl-Hirschman and four-firm indexes. However, takeover-related output consolidation generally has a depressing effect on price-cost margins, indicating some pressure to pursue productive efficiency. Additional evidence, linking this result to ver-

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<sup>1</sup>Even if the result is driven by cost-cutting, it may reflect industry-wide spillovers that enable cost reduction without lasting impetus to improve efficiency.

<sup>2</sup>An overview of the European Commission's market assessments with regard to paper manufacturing is provided in the Appendix. We must also note that our data reflect company *activities* and not specific *products*, which constrains our approximation of relevant markets.

tical integration, points to possible post-merger factor market repercussions rather than enhanced output price competition. Although a mark-up framework is not ideally suited for comprehensive merger assessments, it offers a befitting link to structural models of firm behavior and it is actually quite rich in terms of uncovering hard facts. We must nevertheless keep in mind that results may be obscured by methodological problems and limitations inherent in the available data. While an investigation of merger control's effectiveness is beyond the scope of this paper, our findings highlight the importance of ex post evaluations, which could be systematically carried out by competition authorities.

The paper is organized as follows: we begin by providing a more detailed background to our investigation and proceed to describe our econometric approach. A discussion of data sources and related measurement issues precedes the presentation of results. A summary of the findings concludes.

## Background

Competition policy's primary concern with takeovers is the scope for anti-competitive harm, which has traditionally been viewed as an increasing function of market concentration. Mergers may facilitate the emergence and abuse of dominance, be it unilateral or collective, typically perceived to result in price increases to the detriment of consumers.<sup>3</sup> In the textbook case of a homogeneous product and no input market rigidities, a dominant position enables the merged entity to profitably raise price above marginal cost, regardless of the resulting drop in sales, while competitors benefit from both the higher mark-up and the diversion of demand. Thus, the new equilibrium implies a transfer of wealth from consumers to producers and a dead-weight loss to society as a whole, relative to the previous state. Using a framework of Cournot competition in a homogeneous product market, Farrell and Shapiro (1990) demonstrate that a horizontal merger must involve considerable cost savings in order to trigger a price drop. Specifically, the combined entity must

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<sup>3</sup>As product quality could also be affected following a merger, the underlying notion is that of quality-adjusted price effects.

achieve a substantially lower marginal cost than did any of the pre-merger constituents. The result is even more pronounced if the takeover prompts a reduction in the intensity of rivalry relative to Cournot behavior. Under the assumptions of symmetric product differentiation and constant marginal cost, the models of both Deneckere and Davidson (1985) and Werden and Froeb (1994) also offer a fairly general proof that a price-raising merger would trigger price increases by rivals. Overall, higher industry-wide mark-ups may be a plausible outcome of takeover-driven consolidation in the absence of input market rigidities or internal efficiencies of sufficient magnitude.<sup>4</sup>

On the other hand, the recombination of assets via mergers and acquisitions may enable firms to achieve significant economies of scale or scope, as well as more favorable terms of funding or input sourcing. It is also possible that the combined entity's production possibility frontier extends beyond joint pre-integration capabilities, altogether.<sup>5</sup> In such cases, the merger may constitute a shortcut to extensive experience or a necessary guarantee for undertaking specific investments.<sup>6</sup> Thus, a takeover may create an aggressive competitor that would undercut output prices and force lower mark-ups upon rivals, unless they have the ability to rapidly reduce costs as well. A similar outcome can also emerge through the cost channel if the merged entity is able to influence input markets to competitors' disadvantage. Focusing on vertical mergers without an efficiency component, Ordober et al. (1990) demonstrate that an equilibrium involving foreclosure is possible, as long as the downstream firms' revenues increase with the input price.

The various modes and models of competition yield ambiguous predictions about the conduct of merged firms, relative to the pre-integration situation. While efficiency and market power considerations underpin the analysis of post-merger competitive outcomes, they do not exhaust the plausible reasons why companies integrate, which in turn may have a bearing on the

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<sup>4</sup>Introducing spacial considerations, Reitzes and Levy (1995) demonstrate that price discrimination under asymmetric competition may limit the impact on both outsider firms and potential rivals' entry incentives.

<sup>5</sup>Neven and Seabright (2003) highlight the importance of intangible assets for efficiency-enhancing mergers, but also note the volatile success prospects of such transactions.

<sup>6</sup>The latter channel is emphasized in the property rights approach to the firm. See Hart (1995) for a discussion.

intensity of rivalry. In line with the Coasian view, mergers can offer a way of internalizing exchange transactions that would not be feasible through the market mechanism. Managers are also prone to engage in takeovers in pursuit of personal ambitions, or on the basis of erroneous expectations stemming from their bounded rationality. Moreover, the competitive environment is also affected by the possibility of new entrants, failing rivals, upgrades to product specifications, and supplier (customer) bargaining power in the input (product) markets. Unfortunately, the available theoretical frameworks cannot reflect the complex interaction of possible takeover consequences in a comprehensive manner. Quantitative analyses could shed additional light on outcomes, but are also prone to ambiguity.

The empirical literature on mergers and acquisitions is largely dominated by investigations of the integrating firms' performance, typically relying on stock market or accounting data.<sup>7</sup> Event studies find mostly positive abnormal stock market reactions upon takeover bid announcement, driven mainly by an increase of the target firm's share price. Ex post evidence on shareholder valuation is mixed, but suggests that long-term performance may be related to the type of deal concluded. Profit-flow investigations generally reveal a high incidence of unprofitable mergers and modest gains for the successfully merged firms. However, any ex post analysis of integrating firms' returns is constrained by the inability to observe the corresponding counterfactual. On the other hand, evidence from a relatively limited number of studies points to a positive relationship between takeovers and product price increases.<sup>8</sup> Outsider firms' share price reactions upon announcement of a merger and its subsequent challenge by antitrust authorities have been the subject of a few investigations. Unfortunately, the evidence available to date is inconclusive and biased toward concentrations in the United States. The findings of Stillman (1983), Eckbo (1983) and Schumann (1993) suggest

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<sup>7</sup>See Pautler (2003) or Tichy (2001) for recent surveys. Event studies rely on the assumption that share prices reflect firm values, including accurate discounting of the merged entity's future performance. On the other hand, company accounts data provide noisy measures of true factor utilization.

<sup>8</sup>Barton and Sherman (1984) analyze the price effects of two acquisitions in the micro-film market. Fare changes associated with airline mergers have been investigated by Kim and Singal (1993), Borenstein (1990) and Werden et al. (1991).

modest positive effects on rivals' share prices at the time takeover bids are made. However, outsider firms' stock market returns are not sensitive to the announcement of antitrust complaints. By contrast, Banerjee and Eckard (1998) report that non-merging competitors suffered significant value losses during the 1897-1903 U.S. merger wave. Focusing on airline mergers between 1985 and 1988, Singal (1996) observes that rivals' share prices do not differ, on average, from a value-weighted index of non-merging and non-competing airlines. Nevertheless, competitors' abnormal returns are positively correlated with changes in route-specific concentration, but negatively correlated with the number of airports the merging firms share. By and large, the available evidence precludes robust inferences regarding mergers' effects on the competitive environment. This study aims to supplement the empirical literature with indicative findings from a relatively unexplored angle.

## Empirical Framework

Our empirical investigation is based on an approach to mark-up estimation developed by Roeger (1995) that builds on a methodology pioneered by Hall (1988). In an imperfectly competitive setting, firms' profit maximization would drive a wedge between the value of marginal product and the corresponding factor cost.<sup>9</sup> As suggested by Hall (1988), the price-cost margin can be estimated from the relationship between contemporaneous fluctuations in output and average factor input.

Consider firm  $i$  operating at time  $t$  according to a standard production function, homogeneous of degree  $\gamma$ :

$$Y_{it} = A_{it}F(L_{it}, M_{it}, K_{it}) \quad (1)$$

In the adopted notation  $A$ ,  $L$ ,  $M$  and  $K$  stand for Hicks-neutral technical progress, labor, material inputs and capital, respectively.<sup>10</sup> Under the cur-

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<sup>9</sup>In the assumed Cobb-Douglas functional form, there is a uniform gap between each input's cost and respective marginal product.

<sup>10</sup>Following Domowitz et al. (1988), Norrbin (1993) and Oliveira-Martins, Pilat, and Scarpetta (1996), the production function is extended to incorporate material inputs and

rent specification, the technical progress term can accommodate both inter-industry heterogeneity and firm-specific differences in technology. Logarithmic differentiation of the production function yields:

$$\left(\frac{dY}{Y}\right)_{it} = \left(\frac{\partial Y}{\partial L} \frac{dL}{Y} + \frac{\partial Y}{\partial M} \frac{dM}{Y} + \frac{\partial Y}{\partial K} \frac{dK}{Y} + \frac{dA}{A}\right)_{it} \quad (2)$$

Assuming Cournot behavior in imperfectly competitive product markets, the partial derivatives with respect to the factors of production can be derived from the first-order conditions for profit maximization.<sup>11</sup>

$$\left(\frac{\partial Y}{\partial N}\right)_{it} = \left[\frac{1}{1 + \left(\frac{Y_{it}}{P_t} \frac{\partial P_t}{\partial Y_{it}}\right)}\right] \left(\frac{P_N}{P}\right)_t = \mu_{it} \left(\frac{P_N}{P}\right)_t, \text{ where } N = L, M, K \quad (3)$$

Market power enables firms to set the value of each input's marginal product,  $P_t(\partial Y/\partial N)_{it}$ , above the respective factor cost  $P_{Nt}$ . Retaining a general formulation for the production function's degree of homogeneity, the inputs' shares in total revenue sum to  $(\gamma/\mu)$ , where  $\gamma$  – the scale parameter – does not necessarily equal one.<sup>12</sup> Denoting logarithmic differences with lower case letters, substituting for the partial derivatives and rearranging terms yields an extended version of the framework proposed by Hall (1988):

$$(dy - dk)_{it} = \mu_{it} [\alpha_L(dl - dk) + \alpha_M(dm - dk)]_{it} + (\gamma_{it} - 1)dk_{it} + da_{it}, \text{ with} \quad (4)$$

$$\mu\alpha_N = \mu \frac{P_N}{P} \frac{N}{Y} = \frac{\partial Y}{\partial N} \frac{N}{Y}$$

While this variant of the original methodology allows separating the mark-up defined over sales, rather than value added. In cases where a significant portion of variable cost is attributed to intermediate inputs, their omission would cause an upward bias in the mark-up estimates. Moreover, as pointed out by Basu and Fernald (1997), value added is a problematic proxy for output in the absence of perfect competition.

<sup>11</sup>Likewise, the first-order conditions for cost minimization imply  $(\partial Y/\partial N)_{it} = P_N/\lambda$ . By the Envelope Theorem  $\lambda = (\partial C/\partial Y)_{it}$ , the marginal cost of production. Thus,  $(\partial Y/\partial N)_{it} = \mu_{it}(P_N/P)_t$

<sup>12</sup>The production function  $Y = AL^a M^b K^c$  is homogeneous of degree  $\gamma$ , so  $\frac{\partial Y}{\partial L} \frac{L}{Y} + \frac{\partial Y}{\partial M} \frac{M}{Y} + \frac{\partial Y}{\partial K} \frac{K}{Y} = a + b + c = \gamma$ . Substituting for the partial derivatives from the first-order conditions yields  $\frac{P_L}{P} \frac{L}{Y} + \frac{P_M}{P} \frac{M}{Y} + \frac{P_K}{P} \frac{K}{Y} = \frac{\gamma}{\mu}$

up and scale coefficients, it does not avoid the inherent endogeneity problem. Proper estimation of equation 4 depends on the availability of suitable instrumental variables to address the correlation between unobservable productivity shocks and input choices.<sup>13</sup> As suggested by Levinsohn (1993), fixed effects estimation could be used if the nature of the endogeneity is assumed to be constant over time. Olley and Pakes (1996) propose a polynomial of investment expenditure to address the possible simultaneity bias, whereas Levinsohn and Petrin (2003) favor intermediate inputs as a control proxy. In turn, Roeger (1995) applies Hall's reasoning to the corresponding cost function and uses the interaction of the primal and dual approaches to derive a testable equation in nominal terms.

From the cost side, firm  $i$  faces the following optimization problem:

$$C(P_{Lt}, P_{Mt}, P_{Kt}, Y_{it}, A_{it}) = \min_{L, M, K} \{(P_L L_i + P_M M_i + P_K K_i)_t \mid A_{it} F(L_{it}, M_{it}, K_{it}) = Y_{it}\} \quad (5)$$

The linear function is homogeneous of degree 1 in  $L_{it}$ ,  $M_{it}$  and  $K_{it}$  and can be expressed in terms of unit cost as  $Z(P_{Lt}, P_{Mt}, P_{Kt}) = C(P_{Lt}, P_{Mt}, P_{Kt}, 1)$ . Since  $F(\cdot)$  is homogeneous of degree  $\gamma$  in the respective factor inputs,  $C(\cdot)$  is homogeneous of degree  $\frac{1}{\gamma}$  in  $F(\cdot)$ . By Euler's rule  $\frac{\partial C}{\partial Y} = \frac{1}{\gamma} \frac{C}{Y}$ , so the corresponding expression for marginal cost can be written as:

$$\left(\frac{\partial C}{\partial Y}\right)_{it} = MC_{it} = \frac{1}{\gamma_{it}} \frac{Y_{it}^{(1/\gamma_{it}-1)}}{A_{it}^{1/\gamma_{it}}} Z(P_{Lt}, P_{Mt}, P_{Kt}) \quad (6)$$

Making use of Shephard's lemma, logarithmic differentiation of equation 6 yields:

$$dmc_{it} = \left(\frac{1}{\gamma_{it}} - 1\right) dy_{it} - \frac{1}{\gamma_{it}} da_{it} + \frac{\mu_{it}}{\gamma_{it}} (\alpha_{Li} dp_L + \alpha_{Mi} dp_M + \alpha_{Ki} dp_K)_t, \text{ with} \quad (7)$$

$$\frac{\mu}{\gamma} \alpha_N = \frac{NP_N}{\gamma Y \frac{\partial C}{\partial Y}} = \frac{NP_N}{C} = \frac{\partial C}{\partial P_N} \frac{P_N}{C} = \frac{\partial Z}{\partial P_N} \frac{P_N}{Z}$$

<sup>13</sup>The instruments Harrison (1994) relies on include the nominal exchange rate, an energy price index, the real sectoral wage and the firm's debt.

Taking the difference between the respective movements in output price and in marginal cost, and substituting for the technological change term in equation 4, we obtain a convenient expression in nominal values:<sup>14</sup>

$$(dy_i + dp - dk_i - dp_K)_t = \frac{\mu_{it}}{\gamma_{it}} [\alpha_{Li}(dl_i + dp_L - dk_i - dp_K) + \alpha_{Mi}(dm_i + dp_M - dk_i - dp_K)]_t \quad (8)$$

It is straightforward to derive the equivalent expression in terms of the Lerner index,  $(1 - \gamma/\mu)$ , as in Roeger (1995). Denoting the left-hand side as  $dq$  and the right-hand side as  $dx$ , we obtain a simple testable equation, which we extend with additional interaction terms to study the effects of market concentration:

$$dq_{it} = \beta_1 dx_{it} + \beta_2 dx_{it} \times CTR_t + \beta_3 dx_{it} \times MPT_t + \beta_4 dx_{it} \times GRW_{ct} + \tau_i + \epsilon_{it} \quad (9)$$

Since productivity shocks are eliminated by substitution in the interaction of the primal and dual approaches, a non-zero error term in equation 9 would capture measurement error that is likely to stem from inadequate accounting for the inputs' true utilization levels. To study the effects of mergers and acquisitions on firms' price-cost margins, we interact  $dx$  with alternative measures of market concentration,  $CTR_t$ , computed at the 3-digit level of NACE industrial classification.<sup>15</sup> We focus primarily on takeover-driven market share amalgamation figures, along with auxiliary breakdowns by deal type, but consider also the Herfindahl-Hirschman and four-firm indexes traditionally used to assess competitive outcomes. As mergers have a direct bearing on insider firms' production decisions, we use output consolidation proxies based, in turn, on market shares at the time of transaction and the corresponding figures for the subsequent year. An impulse dummy variable,  $MPT_t$ , is included to control for firms' involvement in more than one deal

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<sup>14</sup>The derivation of equations 7 and 8 is underpinned by the assumption that  $\mu$  and  $\gamma$  remain constant within the period of differentiation. See Joergensen and Hylleberg (1998) for a discussion and an alternative derivation using the definition of average mark-up. A comparative analysis of the primal and dual approaches is presented by Kee (2004).

<sup>15</sup>Further disaggregation would separate companies with diversified operations into an outside market of their own, as they cannot be associated with a primary 4-digit code. Since in reality firms rarely focus exclusively on the production of a single good, it is preferable to avoid a distinction that may constitute a stronger deviation from the unobservable relevant markets.

over time. As an alternative, we also consider the effects on a sub-sample of outsiders that excludes firms upon their initial participation in a merger. Country-level real GDP growth is included as an additional interaction term to account for cyclical effects. Time-invariant firm-specific characteristics, such as managers' abilities or sunk costs, are captured by  $\tau_i$ . We use a dummy variable to distinguish between price-cost margins corresponding to the industry's broadly defined downstream and upstream subsegments at the 3-digit level. Controls for country-specific differences in mark-ups, as well as time fixed effects, are also incorporated in the regressions.<sup>16</sup>

A number of critical remarks regarding our methodology are in order. An important tradeoff between the approaches of Hall (1988) and Roeger (1995) is the ability to take account of actual returns to scale versus minimizing endogeneity and measurement biases. Estimating mark-ups with the former method is hindered by data requirements that become virtually unattainable at a higher level of sectoral disaggregation. Besides appropriate deflators for output, capital and materials, one needs to find suitable instruments to address the endogeneity resulting from potential correlation between unobserved demand or productivity shocks and the individual firm's input choices. Considerable firm heterogeneity within a single sector would imply a lot of noise when aggregate deflators and poor instruments are applied to accounting figures. By introducing a cost-based expression for the unobservable technology term, Roeger (1995) offers a convenient solution to the most important endogeneity and measurement problems.<sup>17</sup> Clearly, the underlying constant returns presumption would lead to downward (upward) biased mark-up estimates in the presence of increasing (decreasing) returns to scale. However, any attempt to compute the influence of non-constant returns would raise additional questions regarding the appropriate functional form and estimation technique. As long as the mark-up estimates are consis-

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<sup>16</sup>Implementation of the Single Market programme has been beset with delays and continues to be far from uniform across member states. Accordingly, it is not unrealistic to expect different reactions across national markets, especially among firms whose operations are geographically concentrated.

<sup>17</sup>However, the transformation of book value capital figures into current replacement cost implies recourse to an aggregate price index for both approaches. This issue is present in all estimations based on accounting data.

tently biased, the corresponding intertemporal evolution should be unaffected and would allow us to adequately capture the impact of market concentration. This amounts to making the assumption that over the studied period outsider firms did not experience significant downsizing or rapid growth. For empirical tractability, the literature on mark-up estimation typically assumes that companies within the same industry face identical productivity shocks to inputs and apply the same mark-up, which is constant in a given period. How reasonable these assumptions are depends crucially on the exact nature of the panel data set and the hypotheses tested. Finally, a shortcoming of the data derived from financial statements of multi-product firms, a considerable portion of our sample, is the inability to disentangle figures corresponding to individual products. Therefore, we must study more broadly defined structures than what is typically likely to qualify as the relevant market.

## Data and Measurement Issues

### *Data Description*

Standardized annual company accounts were obtained from the Amadeus database maintained by Bureau van Dijk Electronic Publishing. This unique source with pan-European coverage offers harmonized financial statements based on registered filings with the respective national statistical offices. We focus our investigation on manufacturing firms operating primarily in the paper manufacturing sector (NACE heading 21) across the 15 core EU member states and Norway, which at the time constituted the European Economic Area.<sup>18</sup> To minimize the noise prone to arise from complex ownership arrangements, we constrain our sample to the consolidated accounts of ultimate owners and the financial statements of independent companies without any subsidiaries. Any affiliate linked to a parent firm by more than 50 per cent of its shares, or with an unknown percentage, is not taken into account

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<sup>18</sup>For lack of firm-level data, Iceland and Liechtenstein are not included in the analysis. This omission should not bias the results significantly, unless the headquarters of major paper manufacturers were based in those countries.

as a separate entity in the investigation. The financial statements of such subsidiaries are reflected in the owners' consolidated accounts on the basis of the respective shareholdings. We construct our sample from 5 annual versions of Amadeus in order to trace target companies' sales volumes and input costs up to the time of the merger, as well as rivals that may have exited the market for other reasons.<sup>19</sup> The available data constitute an unbalanced panel of 402 enterprises spanning the period 1993-2002, after differencing.

**Table 1:** Summary Statistics

	Outsiders	Insiders	Full Sample
Turnover	278287.6 (1032680)	2553310 (3650919)	371483.8 (1329046)
Tangible Fixed Assets	104927.7 (434820.4)	1910052 (3166548)	178874.6 (846032.7)
Material Costs	121887.5 (405237.3)	1434585 (2076044)	170505.9 (614119)
Personnel Costs	51200.21 (224203.9)	432732.1 (598120.4)	66829.64 (261586.7)
Employees	1537 (7162.26)	9344 (12521.84)	1887 (7651.71)

Note: Standard deviations in parentheses; values expressed in thousands of U.S. dollars.

Summary statistics of the variables derived from company accounts, along with a comparative breakdown according to firms' involvement in mergers and acquisitions, are reported in table 1. Clearly, merger activity has, on average, been dominated by the larger firms in the sector. Insiders' figures considerably exceed the corresponding means for both the overall sample and the subset of outsiders. The dataset is fairly representative of paper manufacturing activity across the EEA. A comparison with aggregate statistics on turnover and personnel costs available from Eurostat suggests that our data cover approximately 75 per cent of the respective total figures for the sector. These general observations lend support to expectations that takeovers

<sup>19</sup>The annual data extracts are from editions 1998, 1999, 2000, 2003 and 2004, but the data coverage corresponding to each release date is exhausted 1 to 2 years earlier due to lags in reporting. Unfortunately, previous versions of the database are not available.

would have an impact on the studied market.

Data on completed mergers and acquisitions were obtained from the SDC database of Thomson Financial Securities. This source of comprehensive information on worldwide markets covers corporate transactions that are either valued above USD 1 million or involve ownership transfers of at least 5 per cent. The information is compiled and cross-referenced from various sources, such as stock exchange commissions, trade publications, law firms, surveys of investment banks, etc. We restrict our study to transactions that result in a fusion of companies or a complete acquisition (100 per cent) of a target firm's stock. Although deals that constitute a transfer of controlling interest are also likely to have an impact on the competitive environment, their inclusion would involve making an arbitrary choice regarding the cutoff value. Therefore, we prefer to focus exclusively on full-scale mergers and acquisitions.

For lack of a better common identifier, the extracts from Amadeus and SDC are matched by company name in a 3-step procedure.<sup>20</sup> In this way, we were able to identify the parties to 28 completed takeovers over the studied period. Cumulative turnover over all deals in a year did not exceed 26 per cent of total 3-digit industry turnover at the time of transaction. The corresponding figure for the subsequent year was 28 per cent. Individual mergers accounted for at most 19 per cent in the current year and 27 per cent in the next period.

### ***Measurement Issues***

The use of nominal values, rather than deflated ones, offers the advantage of avoiding poor proxies for the actual price levels of inputs and output. Nevertheless, some measurement error is inevitable, as company accounts data do not accurately reflect true factor utilization. Specifically, fluctuations in the average work time per employee or per physical capital employed are inadequately captured in financial statements. Besides actual flows of labor

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<sup>20</sup>After controlling for blanks and accented characters, we perform successive matches on (i) the full company name; (ii) the string of characters excluding 3 initial and 3 ending ones; and (iii) the initial 9 characters of a name. Mismatches are then manually discarded.

and capital services, ideally, we should also account for variations in the respective inputs' quality. Inaccurate measurement of true factor utilization will result in a cyclical component in the error term. To control for the cyclical impact in the regression, we introduce time fixed effects and the growth rate of GDP as an additional macroeconomic variable capturing variations in demand. Conventional accounting principles also deviate from economic reasoning in the treatment of durable capital inputs acquired by the firm. Although financial accounts offer the possibility to distribute the purchase cost of an asset throughout its useful life, the interest tied up in the acquisition typically is not recognized as a true economic cost. Similarly, any anticipated change in purchase price over the respective period is not reflected in the input's recorded value. Accordingly, we follow established practice in the literature and transform the book value of tangible fixed assets into the corresponding figure at current replacement cost, using a simplified rental price of capital:

$$P_K = (r_{ct} + \delta_t) \times P_{ct}$$

Country-level real interest rates,  $r_{ct}$ , and investment goods price indexes,  $P_{ct}$ , were obtained from the AMECO database of the European Commission's Directorate General for Economic and Financial Affairs (DG ECFIN). The annual depreciation rate is captured by  $\delta_t$ . Due to data limitations and different accounting conventions regarding the useful lives of assets, we assumed a uniform depreciation rate of 10 per cent for all firms. Alternative values for the depreciation rate produced qualitatively similar results.

## Results

To get a sense of the competitive environment in Europe's paper manufacturing sector, we first consider the evolution of average price-cost margins over time. In the analysis, firms are treated as outsiders up to the year of their initial participation in a merger. In regressions based on the full sample of rivals, we include an additional dummy variable,  $MPT_t$ , to control for the occurrence of a deal. Thus, we are able to take account of the fact that some

companies are involved in more than one takeover transaction over time.

**Table 2:** Average Annual Mark-up Evolution

	Outsiders	Rivals	Full sample
1993	1.134 [0.066]***	1.133 [0.066]***	1.132 [0.066]***
1994	1.162 [0.025]***	1.197 [0.026]***	1.198 [0.026]***
1995	1.229 [0.032]***	1.238 [0.036]***	1.238 [0.036]***
1996	1.235 [0.044]***	1.233 [0.041]***	1.236 [0.041]***
1997	1.179 [0.024]***	1.191 [0.023]***	1.2 [0.037]***
1998	1.243 [0.038]***	1.247 [0.042]***	1.247 [0.042]***
1999	1.258 [0.017]***	1.269 [0.022]***	1.27 [0.024]***
2000	1.251 [0.034]***	1.254 [0.037]***	1.257 [0.036]***
2001	1.281 [0.041]***	1.268 [0.034]***	1.268 [0.034]***
2002	1.3 [0.090]***	1.303 [0.090]***	1.303 [0.090]***
$MPT_t$		0.129 [0.187]	
N	1410	1476	1476
$R^2$	0.907	0.907	0.907

Note: Robust standard errors in brackets. \*/\*\*/\*\* indicate significance at 10/5/1 per cent, respectively.

The annual mark-ups reported in table 2 reveal a generally upward, albeit unsteady, trend. Furthermore, the observed pattern of fluctuation is identical across the sample of all firms, both with and without an explicit control for mergers' occurrence, and the outsiders's subset. While companies appear to have higher than average mark-ups at the time when they take part in a takeover, this result is not statistically significant. Moreover, the different sets of cross-section estimates do not reveal major discrepancies in magnitude.

Pooling all years, we test for the effects of market concentration. Our objective is to isolate the impact of merger-driven consolidation from that due to firms' internal growth, partial ownership transfers, downsizing or exits. Accordingly, we compare price-cost margins' sensitivity to the Herfindahl-Hirschman Index (HHI), the four-firm concentration ratio (C4) and the total annual output amalgamation resulting from takeovers in the industry (CMS). By construct, the latter measure is essentially a weighted dummy variable taking the value of the respective market share consolidation rather than

unity in every transaction year for a given 3-digit industry. For comparison, we also investigate the effect of takeovers, as captured by a conventional dummy variable (MD). Since the combined entity's output could differ from the respective constituents' cumulative figure upon merging, we consider an additional measure of takeover-driven concentration, based on actual market share in the subsequent year.

**Table 3:** Concentration vs. Merger Effects

	Outsiders				$(Q_{int})$		
$HHI_t$	1.151						
	[0.597]*						
$C4_t$	0.43						
	[0.232]*						
$CMS_t$	-0.169				-0.473		
	[0.073]**				[0.136]***		
$MD_t$	-0.07						
	[0.024]**						
$CMS_{t+1}$					-0.14		-0.246
					[0.040]***		[0.119]*
<i>Effect</i>	0.110	0.197	-0.012		-0.011	-0.035	-0.021
N	1410	1410	1410	1410	1410	705	784
$R^2$	0.915	0.915	0.914	0.915	0.914	0.926	0.925
	Rivals				$(Q_{int})$		
$HHI_t$	1.116						
	[0.563]*						
$C4_t$	0.409						
	[0.212]*						
$CMS_t$	-0.199				-0.405		
	[0.087]*				[0.149]**		
$MD_t$	-0.059						
	[0.025]**						
$CMS_{t+1}$					-0.183		-0.299
					[0.056]**		[0.132]*
<i>Effect</i>	0.108	0.188	-0.015		-0.015	-0.030	-0.025
$MPT_t$	0.047	0.047	0.039	0.044	0.036	0	0
	[0.112]	[0.109]	[0.111]	[0.108]	[0.093]	[0.000]	[0.000]
N	1476	1476	1476	1476	1476	738	823
$R^2$	0.915	0.915	0.915	0.915	0.915	0.927	0.926

Note: Robust standard errors in brackets. \*/\*\*/\*\* indicate significance at 10/5/1 per cent, respectively. Effects reported at sample means of the relevant interaction terms.

Point estimates for the respective concentration measures, along with corresponding average effects, are reported in table 3. Our results indicate that rival firms' mark-ups are positively related to overall output consolidation in the relevant 3-digit industry, but respond negatively to the component associated with the occurrence of takeovers.<sup>21</sup> Rather than undermining rivalry, the studied transactions seem to enhance pro-efficiency pressure, though the channel through which this may be achieved is unclear. In absolute terms, merger-driven amalgamation has more modest effects on price-cost margins than general market concentration. This finding is robust across alternative proxies, as well as across alternative samples of the merging entities' competitors. By and large, the effect of market share consolidation resulting from takeovers remains uniform from the time of transaction to the subsequent year, suggesting that the studied deals probably did not result in major output reallocations between the merging firms and outsiders.

We also investigate whether the response to takeovers varies across rivals, depending on their relative output ranking in the respective 3-digit industry. The last two columns of table 3 display estimates for the sub-samples of firms that belong to neither the top nor the bottom quartiles, defined according to individual market shares. While the vast majority of mergers can be traced to companies with top-ranking sales volumes, their effects are most pronounced, both in terms of magnitude and statistical significance, among competitors falling in the interquartile range. Results for the top and bottom quartiles are not presented, as they are statistically insignificant. This finding is somewhat surprising and merits more detailed investigation.

For further insights into the industry-wide impact of merger-driven concentration, we distinguish transaction years according to the magnitude of the corresponding total output consolidation using a market share threshold of 15 per cent.<sup>22</sup> Whenever aggregate market share amalgamations exceed this

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<sup>21</sup>To verify the robustness of our results, we replicated the regressions using the crude mark-up observed directly from company accounts as the dependent variable. The results are qualitatively analogous. Hausman tests strongly supported the appropriateness of fixed effects estimation in all specifications.

<sup>22</sup>A ranking of transaction years according to the largest, rather than total, market share consolidation yields qualitatively identical results.

**Table 4:** Large-Scale vs. Small-Scale Consolidation

	Contemporaneous				Next period			
	Outsiders		Rivals		Outsiders		Rivals	
$MD_L$	-0.054		-0.064		-0.038		-0.046	
	[0.018]**		[0.025]**		[0.012]**		[0.015]**	
$MD_S$	-0.024		-0.022		-0.043		-0.042	
	[0.028]		[0.030]		[0.020]*		[0.026]	
$CMS_L$	-0.197		-0.24		-0.155		-0.2	
	[0.087]*		[0.107]*		[0.044]***		[0.063]**	
$CMS_S$	-0.259		-0.229		-0.354		-0.359	
	[0.507]		[0.539]		[0.335]		[0.411]	
$Effect_L$	-0.047		-0.057		-0.033		-0.043	
$Effect_S$	-0.009		-0.008		-0.014		-0.014	
$MPT_t$			0.063	0.063			0.047	0.052
			[0.099]	[0.105]			[0.108]	[0.111]
N	1410	1410	1476	1476	1410	1410	1476	1476
$R^2$	0.915	0.916	0.915	0.916	0.915	0.915	0.915	0.916

Note: Robust standard errors in brackets. \*/\*\*/\*\* indicate significance at 10/5/1 per cent, respectively. Effects reported at sample means of the relevant interaction terms.

value, we consider that the respective period reflects a large-scale takeover-related shock. The opposite qualifier applies to years associated with a value below or equal to the threshold. As in the previous step, we study mark-ups' response using proxies based on market share values both at the time of transaction and for the subsequent year.

The results reported in table 4 suggest that only periods of large-scale output consolidation have an impact on the price-cost margins of outsiders and of rivals in general. This finding is consistent across alternative proxies and definitions of competitors. Unsurprisingly, the effects of large merger-related shocks exceed in magnitude both the overall mean estimates reported in table 3 and those of small shocks. The estimated average impact is also larger when firms that have participated in a merger at another point in time are not excluded from the regressions. A somewhat different picture emerges, however, when we combine the magnitude distinction of takeover-related shocks with the quartile breakdown of firms according to their market share positions.

**Table 5:** Merger Scale & Firm Market Share, next period

	Outsiders			Rivals		
	$Q_b$	$Q_t$	$Q_{int}$	$Q_b$	$Q_t$	$Q_{int}$
$CMS_{L_{t+1}}$	-0.418 [0.360]	-0.265 [0.182]†	-0.221 [0.144]†	-0.484 [0.330]	-0.552 [0.316]*	-0.316 [0.210]†
$CMS_{S_{t+1}}$	-1.302 [0.536]**	0.303 [0.478]	-0.253 [0.232]	-1.369 [0.380]**	0.654 [0.798]	-0.254 [0.315]
$Effect_L$	-0.087	-0.06	-0.047	-0.1	-0.125	-0.067
$Effect_S$	-0.051	0.011	-0.011	-0.055	0.024	-0.011
$MPT_t$				0 [0.000]	-0.065 [0.163]	0 [0.000]
N	279	574	557	291	603	582
$R^2$	0.942	0.916	0.929	0.94	0.917	0.935

Note: Robust standard errors in brackets. †/\*/\*\*/\*\*\* indicate significance at 18/10/5/1 per cent, respectively. Effects reported at sample means of the relevant interaction terms.

Table 5 reports estimates of price-cost margins' relationship to output consolidation, computed on the basis of market share figures from the post-transaction year.<sup>23</sup> The results reveal that the mark-ups of firms in the bottom quartile of the market share distribution respond negatively to periods of small-scale amalgamation. Similarly, the pricing behavior of companies with largest (relative) sales seems to be disciplined in years reflecting merger-driven market share consolidations in excess of 15 per cent. Large-scale takeover shocks also appear to have an effect, albeit somewhat more modest, on the mark-ups of firms remaining in the interquartile range. However, these two relationships are only statistically significant at 18 per cent in the sample of outsiders. These findings are consistent with the hypothesis that some firms are closer competitors than others within the same market. The results also reflect, at least in part, our inability to achieve a better approximation of the relevant market due to the nature of the available data. Most firms produce more than one good and engage in different activities,

<sup>23</sup>The corresponding estimates based on merging parties' combined market shares at the time of the deal reveal a similar pattern. The only difference is that bottom-quartile firms' response to both large- and small-scale takeover shocks is positive, but statistically insignificant.

some possibly in related markets. While multi-market contact could explain medium and large firms' response to sizable takeovers at the 3-digit level, the effect of small transactions on the firms with most modest sales could be explained by product space proximity or the fact that they belong to a separate market altogether. Nevertheless, we observe a negative relationship between price-cost margins and takeover-driven concentration at all instances of statistically significant estimates.

Naturally, a closely related question concerns the channel through which this result is achieved. Our findings could indicate that the studied mergers resulted in significant cost savings whose pass-on to consumers via lower prices disciplined rivals' mark-ups. Alternatively, the negative response may reflect enhanced influence of the integrated companies over factor markets and possible foreclosure effects. Unfortunately, we do not have data that would enable us to investigate parallel developments in input and output prices. Competition authorities across the EU are probably best positioned to undertake in-depth ex post assessments, which could also contribute to the fine-tuning of policy approaches.

In a second-best attempt to shed some light on the driving force behind our results, we distinguish the effects of horizontal and vertical mergers within the limits imposed by data availability. Ideally, we would like to determine if merging firms operate in the same relevant market, which would require detailed information on the range of products they manufacture. Short of product-level detail, however, we have information on the diversity of each company's activities according to the NACE and NAICS classifications, with corresponding levels of disaggregation up to the fourth and sixth digit. The latter breakdown may be regarded as an acceptable approximation of relevant markets, even though the actual combination of products that constitute a firm's output is unobservable. Nevertheless, we are unable to disentangle the shares of total revenue and costs associated with each line of operations. For lack of alternatives, we consider a transaction to be of horizontal nature if the target company's primary activity code matches any of the codes reported by its acquirer. A merger is regarded as vertical if there is no overlap between

the acquirer's scope of operations and the target's principal activity.<sup>24</sup>

**Table 6:** Joint Horizontal & Vertical Merger Effects

	Outsiders				Rivals			
	Nace		Naics		Nace		Naics	
$MD_{Ht}$	-0.052		-0.058		-0.04		-0.045	
	[0.026]*		[0.031]*		[0.025]		[0.030]	
$MD_{Vt}$	-0.079		-0.077		-0.069		-0.067	
	[0.029]**		[0.022]***		[0.029]**		[0.024]**	
$CMC_{Ht}$	16.262		14.564		20.247		18.135	
	[12.951]		[11.612]		[16.611]		[14.892]	
$CMS_{Vt}$	-0.166		-0.166		-0.196		-0.196	
	[0.076]*		[0.076]*		[0.089]*		[0.089]*	
$Effect_H$	0.016		0.029		0.020		0.036	
$Effect_V$	-0.012		-0.012		-0.014		-0.014	
$MPT_t$					0.052	0.043	0.052	0.043
					[0.111]	[0.110]	[0.105]	[0.110]
N	1410	1410	1410	1410	1476	1476	1476	1476
$R^2$	0.915	0.915	0.915	0.915	0.915	0.915	0.915	0.915

  

	Outsiders				Rivals			
	Nace		Naics		Nace		Naics	
$MD_{Ht+1}$	-0.082		-0.076		-0.078		-0.069	
	[0.094]		[0.090]		[0.092]		[0.088]	
$MD_{Vt+1}$	-0.132		-0.098		-0.127		-0.095	
	[0.098]		[0.095]		[0.100]		[0.094]	
$CMC_{Ht+1}$	-2.535		0.542		-3.134		0.65	
	[1.502]		[0.245]*		[0.774]***		[0.366]	
$CMC_{Vt+1}$	-0.15		-0.144		-0.195		-0.188	
	[0.042]***		[0.041]***		[0.054]***		[0.059]**	
$Effect_H$	-0.023		0.008		-0.028		0.009	
$Effect_V$	-0.013		-0.013		-0.017		-0.018	
$MPT_t$					0.032	0.064	0.035	0.053
					[0.105]	[0.086]	[0.106]	[0.104]
N	1410	1410	1410	1410	1476	1476	1476	1476
$R^2$	0.915	0.915	0.915	0.915	0.915	0.915	0.915	0.915

Note: Robust standard errors in brackets. \*/\*\*/\*\* indicate significance at 10/5/1 per cent, respectively. Effects reported at sample means of the relevant interaction terms.

Estimates and corresponding average effects at the time a deal came into

<sup>24</sup>In general, target firms tend to be smaller than the bidders and thus may be more closely associated with a primary activity code. As this particular line of operations is most likely to motivate the acquisition, it could provide an indication of the industry where the takeover's effects would be strongest.

effect, as well as based on figures from the subsequent year, are reported in table 6. The results are broadly in line with our previous findings, but highlight that the nature of takeovers may play an important role. Clearly, vertical mergers have a depressing effect on outsiders' and rivals' price-cost margins under both classifications of company activities. Evidence on horizontal transactions' impact is more mixed and sensitive to the level of disaggregation underpinning market definitions. In fact, some of the takeovers deemed horizontal under the NACE classification reflect a closer vertical relationship according to the six-digit NAICS breakdown. Thus, it is not surprising that the only positive and statistically significant coefficient is associated with the more precisely defined horizontal transactions. The observed pattern suggests that vertical integration accounts for most of the pressure on outsider firms to enhance efficiency. Therefore, it may not be unrealistic to expect that anti-competitive influence over upstream markets constitutes the predominant force in disciplining rivals' mark-ups. While our findings merely present broad-brush evidence, they point to the importance of carefully evaluating post-merger competitive outcomes.

## Conclusion

This paper draws on a representative data set of independently-owned paper manufacturing companies to study the competitive effects of full-scale mergers and acquisitions across the European Economic Area. Using alternative proxies, we find that non-merging competitors' mark-ups are increasing with overall market concentration, but tend to be disciplined upon occurrence of takeovers. This result contradicts the conventional wisdom that mergers may be conducive to slack in firms internal organization. Notably, the negative response of price-cost margins is primarily associated with vertical integration transactions. While data constraints prevent an investigation of parallel developments in input and output prices, the emphasis on non-horizontal takeovers could raise concerns about potential anti-competitive influence over input markets. Our findings highlight the importance of systematic ex post assessments of mergers' impact and suggest an interesting avenue for further

research.

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## Appendix

### The EEA Paper Manufacturing Market

We focus on paper manufacturing firms on the premise that the bulk of their output at the 3-digit NACE level could be considered a workable approximation of a homogeneous product. Accordingly, our investigation concerns two broadly defined markets: Pulp, paper and paperboard (NACE 211) and Articles of paper and paperboard (NACE 212). While further differentiation within each of these segments is certainly appropriate, compartmentalization into distinct product sub-categories may be relatively less pronounced than in other manufacturing industries. For instance, although pulp can be broken down into several types according to manufacturing processes or fibre input, the European Commission has traditionally regarded it as a single product market. Similarly, notwithstanding the distinct characteristics of wood-free coated and wood-free uncoated paper, relevant market delineation has been left open on the observation that manufacturers can switch from one type to the other without incurring major costs. For most products the Commission has also systematically found the relevant geographic market to have at least EEA dimension. The exceptions are tissue products and paper merchandising activities, for which national boundaries may be relevant.

A particular mention merits the subsegment of carbonless paper, which has been found to constitute a separate product market “due to its special characteristics, end uses and limited substitutability from the demand side”. In 2001, the Commission found evidence that 11 companies with operations in that subsegment took part in price-fixing and market-sharing agreements lasting from 1992 through at least 1995. However, as these manufacturers accounted for about 90 per cent of carbonless paper sales in Europe, their collusion may have had limited repercussions on other competitors within the relevant market. The lack of firm-specific product-level information makes it impossible to identify potentially affected rivals in related markets. EU competition authorities are probably best positioned to meet the informational requirements for a more detailed investigation. In any event, the cartel would

have weakened the involved firms' incentives to pursue productive efficiency, so that findings to the opposite effect in relation to mergers may be somewhat understated.