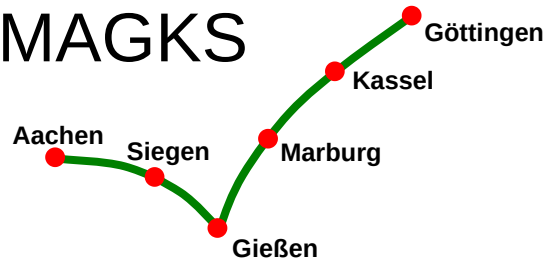
MAGKS



Joint Discussion Paper Series in Economics

by the Universities of

Aachen · Gießen · Göttingen
Kassel · Marburg · Siegen

ISSN 1867-3678

No. 29-2009

Johannes Paha

Using Accounting Data in Cartel Damage Calculations – Blessing or Menace?

This paper can be downloaded from
http://www.uni-marburg.de/fb02/makro/forschung/magkspapers/index_html%28magks%29

Coordination: Bernd Hayo • Philipps-University Marburg
Faculty of Business Administration and Economics • Universitätsstraße 24, D-35032 Marburg
Tel: +49-6421-2823091, Fax: +49-6421-2823088, e-mail: hayo@wiwi.uni-marburg.de

USING ACCOUNTING DATA IN CARTEL DAMAGE CALCULATIONS – BLESSING OR MENACE?

Johannes Paha*

ABSTRACT

Standard methods for calculating cartel-damages rely on data of prices charged and quantity sold. Such data may not easily be available. In this paper, it is shown that a lower bound for cartel-damages can also be computed from accounting data. In previous literature it is shown that economic profits can hardly be inferred from accounting data. Therefore, it is shown under which econometrically testable assumptions on accounting costs a meaningful lower bound for cartel damages can consistently be estimated from accounting data. An estimation of cartel-damages is performed for four vitamins producers that participated in the vitamins cartel. The results indicate that both the aggregation-level and the publication-frequency of accounting data pose a challenge to the estimation of cartel damages. A further challenge is to appropriately reflect the strength respectively effectiveness of the collusive agreement in the specification of any such estimation.

JEL: C22, L12, L13, L41

I. INTRODUCTION

Cartel firms jointly maximize their profits by simultaneously reducing quantity sold and increasing the price of goods sold. Hence, they damage their customers by charging an excess payment, i.e. the cartel-induced price overcharge times the quantity sold.[1] In USA, harmed customers have legal standing to recover three times the damages that were caused by the firms infringing antitrust laws (15 United States Code §15(a)). In Europe, the foundations of damage claims were laid by the European Court of Justice in its Courage-Crehan decision.[2] Currently, the conditions for private damage claims are debated intensively as in the European Commission's 2008 W*hite Paper on Damages Actions for Breach of EC Antitrust Rules*[3] and its accompanying working paper.[4]

* Justus-Liebig-University Giessen, Chair for Industrial Organization, Regulation and Antitrust, Licher Straße 62 D-35394 Giessen, johannes.paha@wirtschaft.uni-giessen.de

1 Robert Hall/Victoria Lazear, 'Reference Guide on Estimation of Economic Losses in Damages Awards', Federal Judicial Center Reference Manual on Scientific Evidence 2nd edition (2000), at 322

2 Case C-453/99, Courage Ltd v Bernard Crehan and Bernard Crehan v Courage Ltd and Others, Judgment of the Court of 20 September 2001

3 European Commission, 'White Paper on Damages actions for breach of EC antitrust rules', COM(2008) 165 final, (2008)

4 European Commission, 'Commission Staff Working Paper accompanying the White Paper on Damages actions for breach of EC antitrust rules', SEC(2008) 404, (2008)

Regarding damages as a compensatory instrument[5] requires an unbiased estimate of damages. However, the Commission is well aware that the quality of damage-estimates“ depends very much on the quality [... and] the complexity of the required input.”[6] Therefore, damages are intended to be calculated pragmatically trading-off accuracy with the “cost and time involved in bringing and assessing the required economic evidence.”[7]

The calculation of cartel-damages and cartels' profitability effects generally is based on data of goods' quantities sold and prices charged. Unfortunately, data on prices and quantities is not easily available to both, researchers and damage claimants, since firms are not required to publish it. In contrast, some cartels may even use lobbying to prevent such data from being published or they may actively withdraw it from the public. This was supposedly done by members of the vitamins cartel as is reported by Connor[8]. The unavailability of price- and quantity-data poses a difficulty for

1. researchers doing research about cartel damages,
2. competition authorities screening industries in order to detect collusion, and
3. private damage claimants who need to calculate their claims.

For these groups it would be beneficial if cartel-damages could be computed from data that is easily available and allows for a comparison among firms and across time. These requirements are largely satisfied by accounting data which follows standardized accounting rules. This facilitates comparability among firms in the same jurisdiction. For capital market-oriented firms that apply International Financial Reporting Standards (IFRS) comparability is made possible even on an international scale. Moreover, financial data of large, capital market-oriented firms may easily be obtained from financial databases such as Thomson Reuters Datastream. There are also databases that provide data of smaller firms such as the Hoppenstedt database for German enterprises.

One contribution of this paper lies in examining *if* accounting data may be used for econometrically estimating cartel damages. It is shown that under some testable assumptions on accounting costs a cartel members' change in revenues minus costs of goods sold can be used as a lower bound for cartel damages. By concentrating on *changes* in measures of accounting profit this paper does not affect the literature on inferring *absolute values* of economic profits from accounting

5 Id, at 55

6 Id, at 60

7 Id, at 55

8 John Connor, *Global Price Fixing – Our Customers are the Enemy* (Norwell, Kluver Academic Publishers 2001), at 296

data. This literature[9] centers around Fisher and McGowan's[10] article *On the Misuse of Accounting Rates of Return to Infer Monopoly Profits*. In this literature it is i.a. argued that capital in accounting does not match the economic definition of capital since e.g. research is considered an expense rather than being capitalized. This distorts depreciation and, thus, profit measures in subsequent years. This effect of a distorted time shape of depreciation is amplified when depreciation follows simplifying (e.g. linear) depreciation schedules rather than economic depreciation.[11] Moreover, the economic cost of equity is considered a part of profit in accounting and a cost component in economics. In sections II.C. and II.D. it is argued that these are valid points whose main effect is to drive apart the absolute values of economic profits and accounting profits. It is shown under which conditions these effects are unlikely to bias accounting-based estimates of cartel damages. Moreover, econometric procedures are proposed for testing whether these conditions are satisfied.

A further contribution of this paper lies in outlining, *how* a lower bound for cartel damages can be estimated consistently from accounting data of revenues and costs of goods sold. This is done in section II.A.. In section III. the propositions made in the previous sections are evaluated econometrically for four firms, BASF, Takeda, Daiichi, and Roche, that participated in the famous and well-researched vitamins cartel. Section IV. concludes.

II. USING ACCOUNTING DATA TO ASSESS CARTEL-EFFECTS – THEORY

A. Definition and Estimation of Cartel Damages

In this section I present a framework for analyzing cartel-damages. In doing so, economic analysis is aligned to accounting by employing accounting terminology for e.g. costs and profits. Since the empirical part of this paper is done with data obtained from the ThomsonReuters Datastream database, the terminology corresponds to the definitions made there. Consider a multiproduct-firm

9 See e.g.
William Long/David Ravenscraft, 'The Misuse of Accounting Rates of Return: Comment.” The American Economic Review', 74 (3) The American Economic Review (1984), 494-500 and
Franklin Fisher, 'The Misuse of Accounting Rates of Return: Reply', 74 (3) The American Economic Review (1984), 509-517 and
Kenneth Peasnell, 'Using Accounting Data to Measure the Economic Performance of Firms', 15 Journal of Accounting and Public Policy (1996), 291-303 and
Andrew Stark, 'Estimating economic performance from accounting data – a review and synthesis', 36 The British Accounting Review (2004), 312-343

10 Franklin Fisher/John McGowan, 'On the Misuse of Accounting Rates of Return to Infer Monopoly Profits', 73 (1) The American Economic Review (1983), 82-97

11 Harold Hotelling, 'A General Mathematical Theory of Depreciation', 20 (151) Journal of the American Statistical Association (1925), 340-353

that produces quantity q_i of various types of goods[12] i at constant marginal costs c_i and fixed costs[13] c_f. Thus, costs of goods sold (Datastream item WC01051) are given by

$$C = c_f + \sum_i c_i \cdot q_i \quad . \tag{1}$$

These goods are sold at price p_i, so that revenue (Datastream data type WC01001) is given by

$$R = \sum_i p_i \cdot q_i \quad . \tag{2}$$

Additionally, one measure of profit, that is relevant in accounting, is operating income per period π_{op} (WC01250) which is defined as revenues minus costs of goods sold, depreciation d (WC01151), and costs of administration and selling s (WC01101)

$$\pi_{op} = \left(\sum_i p_i \cdot q_i\right) - \left(\sum_i c_i \cdot q_i\right) - c_f - d - s \quad . \tag{3}$$

Now assume, the firm gets the opportunity to participate in a cartel in product j which raises j's price from its competitive level p_{Cj} to its higher cartel level p_{Kj}. This is achieved by restricting quantity $(q_{Kj} < q_{Cj})$. For the time being, fixed costs, depreciation, and costs for administration and selling are assumed to remain unaffected by the cartel.[14] Then, the cartel-related change in operating income is denoted by

$$\frac{\Delta \pi_{op}}{\Delta D_{Kj}} = \left(\frac{\Delta p_j}{\Delta D_{Kj}} \cdot q_{Kj} + \frac{\Delta q_j}{\Delta D_{Kj}} \cdot p_{Cj}\right) - \left(\frac{\Delta q_j}{\Delta D_{Kj}} \cdot c_j\right) \quad , \tag{4}$$

where D_{Kj} is a dummy-variable that takes value 1 if the firm participates in a cartel in good j and 0 otherwise. It is straightforward to check that under the above assumptions $\Delta\pi_{op}/\Delta D_{Kj} = \Delta\pi/\Delta D_{Kj}$ holds, where π is the difference between revenues and costs of goods sold

$$\pi = \left(\sum_i p_i \cdot q_i\right) - \left(c_f + \sum_i c_i \cdot q_i\right) \quad . \tag{5}$$

In the following, these results are used to show (a) that $\Delta\pi/\Delta D_{Kj}$ is a reasonable lower bound for cartel damages and (b) that this lower bound can be estimated consistently from accounting data.

Equation (4) can be re-ordered to give a price-effect and a quantity-effect

$$\frac{\Delta \pi}{\Delta D_{Kj}} = \frac{\Delta p_j}{\Delta D_{Kj}} \cdot q_{Kj} + \frac{\Delta q_j}{\Delta D_{Kj}} \cdot \left(p_{Cj} - c_j\right) \quad . \tag{6}$$

12 Please note that the analysis provided in this paper requires goods in segment i to be homogenous, such as cement or vitamins. The analysis of cartel damages may be more complex when goods in the same segment i are differentiated. Then, a uniform price p_i does not exist. This is the case for e.g. insurances.

13 It is left to further research to examine how marginal costs, that vary with output, and fixed costs, that vary over time, affect damage calculations.

14 These assumptions are relaxed in sectionsII.C. andII.D..

The first summand, the price-effect, makes clear that in comparison to the competitive situation the cartel-firm makes an additional profit on each unit sold of good j, i.e. q_{Kj}, worth the price-overcharge $\Delta p_j/\Delta D_{Kj} = (p_{Kj} - p_{Cj})$. The quantity-effect indicates, that the firm sells a lower quantity because of increased prices and looses the profit that was generated by this lost output. Given that excessive pricing is the firm's only infringement of competition laws[15], total damages TD_j can be defined as "the amount of the overcharge"[16]

$$TD_j = (p_{Kj} - p_{Cj}) \cdot q_{Kj} \quad . \tag{7}$$

A further standard assumption that is made here with reference to Fisher and Romaine[17] is that antitrust infringements are assumed to solely have a contemporaneous effect. I.e. an infringement of antitrust laws committed at time period t is assumed to only harm customers at period t and no later period. This assumption seems reasonable in most cases. Otherwise calculating damages would require to compute the present value of cartel-induced changes in damage claimants' cash flows. This would require making a variety of assumptions about future cash flows that may possibly cause a larger degree of inexactness than neglecting these effects.

One may wonder, if TD_j is really the damage caused by the cartel and, thus, the right measure to be used here. Fisher[18] notes that TD_j "is what is given in the standard damage award." However, real damages exceed TD_j by a deadweight-loss since some customers, who would have bought the good at the competitive price p_{Cj}, decide not to buy the good at price p_{Kj}. This group of customers generally has no legal standing to claim damages. Since the main focus of this paper is to assist damage claimants in calculating their claims, deadweight loss can reasonably be neglected, here. However, TD_j may not be the right measure for claims in all circumstances. If the damage claimant is a firm itself that uses the cartelized good as an input, TD_j may exceed the damage claimant's lost profit as the claimant may possibly "pass along part of the effect of the price increase to its own customers."[19] In some jurisdictions the defending cartel-firm may use such a pass-on defense-strategy in order to argue that actual damages are lower than TD_j. Then, the damage award should be lowered accordingly. This is just an additional step in computing damages that builds on computing TD_j as in (8). Hence, the findings of the present paper, that is only concerned with quantifying TD_j, are no less relevant when a pass-on defense is allowed. Consequently, regarding the objectives of this paper total damages can reasonably be defined according to equation (7).

15 Other types of competition law violations are "price-fixing or market-dividing cartel agreements, [...] or exclusionary practices, such as tying and bundling or predatory pricing by a dominant firm" (see below n 22, at 3).

16 Above n 1, at 322

17 Franklin Fisher/R. Craig Romaine, 'Janis Joplin's Yearbook and the Theory of Damages', 5 (1/2) Journal of Accounting, Auditing and Finance (Winter/Spring 1990), at 151

18 Franklin Fisher, 'Economic Analysis and Antitrust Damages', 29 (3) World Competition (2006), at 390

19 Above n 1, at 322

By combining equations (6) and (7) we find

$$TD_j = \frac{\Delta \pi}{\Delta D_{Kj}} - \frac{\Delta q_j}{\Delta D_{Kj}} \cdot (p_{Cj} - c_j) \quad . \tag{8}$$

From the above discussion we know that $\Delta q_j/\Delta D_{Kj} < 0$, while $(p_{Cj} - c_j) \geq 0$ as the firm is assumed to make at least zero economic profit in the non-cartel situation. Total damages exceed the firm's change in revenues minus costs of goods sold ($\Delta\pi/\Delta D_{Kj}$), while under the above assumptions (i.e. the cartel does not affect other cost components.) this change must be positive in order to make the cartel profitable, i.e. $\Delta\pi/\Delta D_{Kj} > 0$. Consequently, $\Delta\pi/\Delta D_{Kj}$ is a lower bound for cartel damages, that can be calculated from freely available accounting data[20]. A proxy for the cartel-related change in profits can be inferred as regression-coefficient β from a time-series regression of π on D_{Kj} and further explanatory variables X. ε is an error term. Vectors and matrizes are denoted by bold letters.

$$\boldsymbol{\pi} = \beta \cdot \boldsymbol{D_{Kj}} + \boldsymbol{\gamma X} + \boldsymbol{\epsilon} \tag{9}$$

Since D_{Kj} is a discrete variable β does not exactly match $\Delta\pi/\Delta D_{Kj}$ as defined in equation (6) since it refers to some average q_j and p_j rather than q_{Kj} and p_{Cj}

$$\beta = \frac{\Delta p_j}{\Delta D_{Kj}} \cdot q_j + \frac{\Delta q_j}{\Delta D_{Kj}} \cdot (p_j - c_j) \approx \frac{\Delta \pi}{\Delta D_{Kj}} \quad . \tag{10}$$

Equation (11) is an empirically estimable counterpart of equation (8)

$$TD_j \geq \beta \quad . \tag{11}$$

One finds that cartel damages cannot exactly be inferred from accounting data. However, using β as a lower bound for cartel-damages does have advantages over simply using the change in revenues and can have advantages over using price- and quantity-data. These points will be evaluated in turn.

Sometimes it is argued that “any estimates of the changes in the total value of sales of the cartelized product in a given market will also provide a lower bound on the harm done by the cartel's formation to customers in that market.”[21] To see this, write the change in revenues caused by the cartel in good j as

$$\frac{\Delta R_j}{\Delta D_{Kj}} = \frac{\Delta p_j}{\Delta D_{Kj}} \cdot q_{Kj} + \frac{\Delta q_j}{\Delta D_{Kj}} \cdot p_{Cj} \quad . \tag{12}$$

20 A discussion and evaluation of the accounting data needed is given in sectionII.B..

21 Julian Clarke/Simon Evenett, 'The deterrent effects of national anticartel laws: evidence from the international vitamins cartel', The Antitrust Bulletin (Fall 2003), in footnote 22

By plugging in equation (7) and rearranging, one gets

$$TD_j = \frac{\Delta R_j}{\Delta D_{Kj}} - \frac{\Delta q_j}{\Delta D_{Kj}} \cdot p_{Cj} \quad . \tag{13}$$

Obviously, the cartel-related change in revenues is a lower bound for cartel damages. However, β is a better lower bound. This is for two reasons. First, equation (4) immediately gives $\Delta\pi / \Delta D_{Kj} > \Delta R_j / \Delta D_{Kj}$ since $\left(\Delta q_j / \Delta D_{Kj}\right) \cdot c_j < 0$. Second, the cartel-related change in revenues can even be negative, thus, providing an unlovely lower bound for damage claims. A short discussion of cartels' revenue effects is motivated by Figure 1, which displays industry demand for good *j*, (symmetric) firms' marginal costs *c*, revenue *R*, marginal revenue *MR*, and a monopolist's profit π. If more than one firm is active in the industry, industry profits will be lower than π. It is assumed that firms do not incur fixed costs. Suppose the cartel is formed by all firms in *j*'s industry. Hence, prices and quantities are set according to a monopolist's rationale for profit-maximization, i.e. $MR = c$.

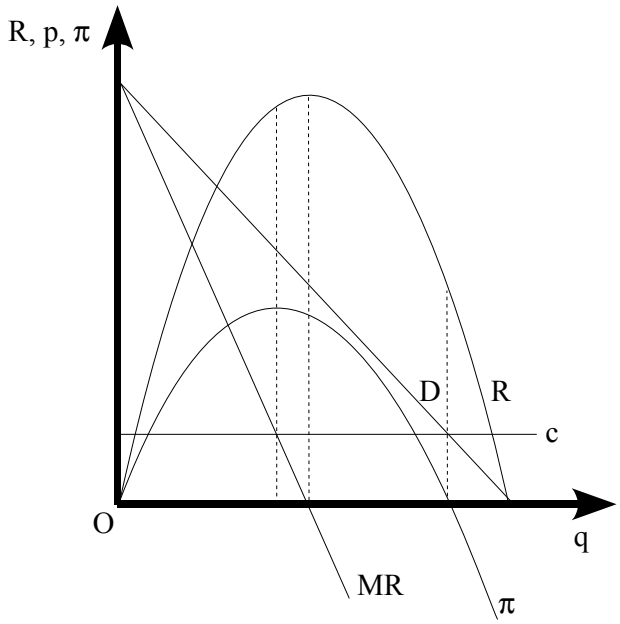


Figure 1: Revenue Effects

For Cournot-competition with *n* firms and a linear demand curve, with consumers' reservation price denoted as *A*, it can be shown that industry revenue (and consequently each cartel-member's individual revenue) rises when condition

$$\frac{c}{A} < \frac{n-1}{3n+1} \tag{14}$$

is satisfied. Thus, one can make the following statements:

1. The higher the intensity of competition (as represented by a higher number of firms) in the non-cartel situation (i.e. the closer prices are to marginal costs) the more probable is a positive revenue-effect.
2. Higher marginal costs (relative to the reservation price) induce lower cartel revenues and higher competitive revenues. This makes a cartel-related increase in revenues less likely. Hence, a positive revenue-effect is especially likely in industries where marginal costs are small compared to the reservation price.
3. The size of the market (as represented by the slope of the demand curve) does not enter condition (14) and, hence, only affects the absolute change in revenue but not its sign.

To sum up the above discussion, the cartel related change in revenues minus costs of goods sold is a better lower bound for cartel damages than the change in revenues alone, since the first is always positive and exceeds the latter.

VanDijk and Verboven[22] present further methods for computing total damages. The common concept of these methods is to determine the increase in prices that is caused by the cartel (i.e. the price overcharge). This can e.g. be done by comparing cartel-prices to prices in the same market in cartel-free periods (before-and-after approach) or to cartel-free prices in other geographical or product markets (benchmark approach). Then, total damages are calculated by either multiplying the absolute price overcharge with quantity sold in the cartel, or by multiplying the percentage price overcharge with revenue obtained by the cartel

$$TD_j = (p_{Kj} - p_{Cj}) \cdot q_{Kj} = \frac{p_{Kj} - p_{Cj}}{p_{Kj}} \cdot (p_{Kj} \cdot q_{Kj}) \quad . \tag{15}$$

In the latter case, it is important that the percentage price-overcharge is computed relative to the cartel-price. Otherwise, adjustments should be made accordingly. If high-quality data of prices and quantities is available, these methods allow for an exact calculation of total damages. In this case, one should rely rather on these calculations as on ones that are based on accounting data. However, unlike accounting data, price- and quantity-data is not routinely provided by firms.

22 Theon van Dijk/Frank Verboven, 'Quantification of damages', forthcoming chapter for Issues in Competition Law and Policy, ABA Publications in Antitrust, Ed. W. Dale Collins (2005), available at http://www.econ.kuleuven.be/public/ndbad83/Frank/Papers/Van%20Dijk%20&%20Verboven,%202006.pdf

B. Revenue and Costs of Goods Sold

It has been known for long, that "[e]conomists need measures of business performance [...] as guides to antitrust policy."[23] However, economists usually are sceptical about the use of accounting data for economic purposes, since often accounting data does not match economic definitions of e.g. costs and depreciation. This scepticism has been proven right by e.g. Hotelling[24], Fisher and McGowan[25], and Stark[26]. However, as Peasnell[27] points out "[a]ccounting reports constitute the only systematically compiled, publicly available, alternative source of information about the financial affairs of business corporations, and are largely standardized and audited, too." This is in line with the above reasoning of using accounting data for computing cartel damages. Therefore, in this section it will be evaluated, if revenues and costs of goods sold are defined such that an calculation of β gives economically sensible results.

Revenue (Datastream data type WC01001) according to IAS 18 is defined as "the gross inflow of economic benefits during the period arising in the course of the ordinary activities of an enterprise [that are defined as] the sale of goods, [...] the rendering of services, [...] and the use by others of enterprise assets yielding interest, royalties and dividends." Hence, accounting revenue is defined consistently with economic revenue. Please note, that in case of multi-period construction contracts revenues are recognized according to IAS 11. Collusion in such construction contracts is more likely to occur in the form of bid-rigging. Since in this case one infringement of antitrust laws affects revenues in multiple periods, damages from bid-rigging do not fit well in the framework used and proposed here.

Costs of goods sold (Datastream item WC01051) include among others employee benefits, costs of purchase, materials expenses, and other costs that are incurred in bringing goods sold to the location and condition necessary for sale. According to IAS 2.9 materials expenses are determined as the lower of cost and net realizable value when selling the materials or supplies. The term *cost* comprises "all costs of purchase, costs of conversion and other costs in bringing the [materials and supplies] to their present location and condition." (IAS 2.10) Hence, the accounting cost of raw materials is consistent with economic theory.

Accounting of employee benefits follows the rules of IAS 19 which "identifies four

23 Kenneth Peasnell, 'Using Accounting Data to Measure the Economic Performance of Firms', 15 Journal of Accounting and Public Policy (1996), at 291

24 Above n 11

25 Above n 10

26 Andrew Stark, 'Estimating economic performance from accounting data – a review and synthesis', 36 The British Accounting Review (2004), 312-343

27 Above n 23, at 291

categories of employee benefits:

(a) short-term employee benefits, such as wages, salaries and social security contributions […] payable within 12 months of the end of the period [...];
(b) post-employment benefits such as pensions [...]
(c) other long-term employee benefits [...] payable 12 months or more after the end of the period [...]; and
(d) termination benefits."

Short-term employee benefits (a) clearly are consistent with the economic definition of wages since they are recognized as an expense "when an employee has rendered service in exchange for those benefits." (IAS 19.I.3) The treatment of post-employment benefits (b) is equally simple. Post-employment benefits can be seen as a reward for employees' current supply of labor that only results in a future payment to the employee. Thus, they must be recognized as an expense in the current period. Matters are not that clear for other long-term employment benefits (c) and termination benefits (d) since these lack a clear relationship to the current period's production. However, if other long-term employment benefits and termination do not systematically vary with the formation of a cartel they do not affect estimates of cartel-related profit effects and damages.

One finds that revenue and costs of goods sold are defined quite consistently with their economic counterparts. Consequently, a regression as specified by equation (9) appears to be a valid way for computing a lower bound for cartel damages. One might object that revenues and costs of goods sold might be biased by techniques of earnings management. From a theoretic standpoint it is not clear how such measures will affect damage estimates. To illustrate this point consider that a firm's financial statements are addressed to a variety of groups that have different interests in the firm. Shareholders may be assumed to have a desire for high profits. However, with regard to tax payments and cartel prosecutions the firm will be interested in showing low profits. Which of these effects is stronger, cannot be assessed theoretically but must be evaluated in each case separately. In this context, one should also take into account different accounting standards' tolerance for earnings measurement, which is e.g. higher in German GAAP than in IFRS or US-GAAP.

C. The Effect of Depreciation on Cartel Damages

In sectionA. the assumption was made, that the cartel affects nothing but prices charged and quantity sold by the cartel members. In this situation, the cartel-induced change in (accounting) operating income was found to be identical to the change in revenues minus costs of goods sold, whose empirical counterpart may be used as a lower bound for cartel-damages. This finding does not hold any longer if the cartel also systematically affects depreciation. This is because

depreciation has a fixed cost component (E.g. production facilities loose some value by ageing.) and a variable cost component. I.e. the cartel-induced reduction of quantity sold will also cause a lower quantity produced which affects production facilities' depletion. As a consequence, some part of depreciation must be considered an element of marginal costs that determine cartel-firms' pricing behavior and, thus, cartel damages. Conceptually, this challenge can be overcome by proxying damages with the cartel-induced change in gross income (WC01100) rather than the change in revenues minus costs of goods sold. Gross income is defined as revenue minus costs of goods sold minus depreciation, depletion and amortization (*d*; WC01151)

$$\pi_g = \left(\sum_i p_i \cdot q_i\right) - \left(\sum_i c_i \cdot q_i\right) - c_f - d \quad . \tag{16}$$

Then the cartel induced change in gross income is given by

$$\frac{\Delta \pi_g}{\Delta D_{Kj}} = \frac{\Delta p_j}{\Delta D_{Kj}} \cdot q_{Kj} + \frac{\Delta q_j}{\Delta D_{Kj}} \cdot \left(p_{Cj} - c_j\right) - \frac{\Delta d}{\Delta D_{Kj}} \tag{17}$$

under the assumption that fixed costs are not affected by the cartel.

In practice, computing this lower bound for cartel damages is not as easy as it may seem from a conceptual viewpoint. This results from depreciation, depletion and amortization *d* being one of *the* items that prevents interested parties from drawing economic inferences from accounting data. This is because economic depreciation and accounting depreciation rarely correspond to each other and can hardly be made matching at reasonable cost and accuracy. Economic depreciation should be computed following the ideas of Hotelling[28] while accounting depreciation often follows simplifying (e.g. linear depreciation) schedules. Putting Hotelling's ideas into modern words the value of an asset should be determined as the present value of net cash flows (i.e. revenue minus production costs) generated by the asset plus its discounted scrap value. Thus, economic depreciation (respectively appreciation) is the change in the asset's value between two periods. In accounting practice tangible assets according to IAS 16.29 shall either be valued at their cost less any accumulated depreciation and impairment losses (cost model) or at their fair value (revaluation model). The revaluation model resembles economic depreciation pretty closely. However, when the cost model is applied, economic and accounting depreciation may deviate since the cost model is based on fixed (e.g. linear) depreciation plans that do not necessarily match economic depreciation. As a consequence the size and time-shape of gross income will differ depending on whether economic or accounting depreciation is used. These effects impact coefficient-estimates of regressions that rely on gross income as a dependent variable.

As a consequence, one should test if *d* is independent of the formation of a cartel. In this

28 Above n 11

case, the lower bound for cartel damages can consistently be estimated following the procedure outlined in section A., which relies on the difference between revenues and costs of goods sold rather than on gross income. Such a test requires regressing *d* on possibly explanatory variables and a cartel-dummy. *d* can be omitted in damage calculations if one must accept the hypothesis that the coefficient of the cartel-dummy from this regression does statistically not significantly differ from zero. If depreciation is found to be affected by the cartel one needs to use gross income as the relevant measure of profit. However, in this case one should be extremely cautious in interpreting the β-coefficients as a lower bound for cartel damages. This is because of the above problems concerning the economic interpretability of *d*.

D. Cost Efficiencies and Fining of Cartels

In section A. the assumption was made, that the cartel affects nothing but prices charged and quantity sold, so that a lower bound for cartel damages can be found as the cartel-induced change in revenues minus costs of goods sold. In section C. the assumptions on costs was relaxed by allowing depreciation to be affected by the cartel. It was found that in this case estimating a lower bound for cartel damages requires determining the cartel-induced change in gross income. However, this measure must be assumed to be biased since accounting depreciation does not necessarily match economic depreciation. In this section D. the assumption on costs is further relaxed by allowing the cartel to also affect further cost components such as costs for administration and selling, and capital costs. In this situation the cartel may give cartel firms more benefits but overcharging customers. This causes a situation where cartel members' additional profits exceed damages awards. Fisher[29] argues that all such profits should be extracted from a cartel's members in order to guarantee that the cartel is rendered unprofitable. This requires calculating additional profits.

First, the cartel may affect depreciation. In this case. the change in total profits equals the change in gross income, which can be assessed as described in section C. Second, the cartel may also affect expenses for selling and general administration (*s*; Thomson Reuters Datastream item WC01101). Selling, general and administrative expenses contain e.g. marketing and advertising expenses, employee costs, directors' remuneration as well as expenses for research and development (R&D). As long as prices are above total average costs, these cost components can be considered fixed costs whose change does not affect prices. Hence, changes in *s* affect profits but do not affect total damages. Thus, in this case damages must not be inferred from any definition of profits that is broader than gross income as defined in equation (16). However, in order to see if all excess profits are extracted from cartel firms in form of damages awards one needs to test, if the cartel gives its members a cost-advantage in costs for administration and selling. Unfortunately, this measure does

29 Above n 18

not give an exact assessment of excess profits either. One reason for this is that accounting for R&D, which is included in *s*, does not match economic criteria. From an economic viewpoint R&D creates an intangible asset such as a patent that creates value over its lifetime and must be depreciated accordingly. However, according to German accounting principles R&D is expensed immediately. According to IFRS, research is expensed immediately while development expenses are recognized as an intangible asset according to IAS 38. As a consequence the accounting stream of R&D does not reflect economic profitability well. Hence, estimates of cartel-induced changes in e.g. operating income do not necessarily reflect well the economic profitability effects of the cartel. One may test the hypothesis of *s* being independent of collusion by running a regression of *s* on possibly explanatory variables and cartel-dummies, taking value 1 if a cartel is in force and 0 otherwise. Then one may test whether the coefficients associated with the cartel-dummies differ significantly from zero.

Third, the cartel may also affect firms' cost of capital. This may occur via two channels. First, the cartel may affect share- and debtholders' interest requirements, causing the weighted average cost of capital (WACC) to change. Second, this change in interest rates may animate cartel-firms to adapt their capital structure accordingly. These effects affect firms' economic profits and can theoretically be inferred from e.g. the cartel-induced change in firms' earnings before taxes (EBT). However, even if one suspects these effects, the below analysis suggests that they are hardly quantifiable. This is because capital costs can hardly be computed at a high level of accuracy which also makes testing for such effects difficult. Therefore, more research is needed in this area.

Much input to this discussion is provided by the literature on the economic value added (EVA) as e.g. summarized by Hostettler.[30] In order to compute a firm's true cost of capital one would first need to transform its total assets into invested capital. This requires removing assets that are related to non-operating activities and add non-capitalized operating assets.[31] An example for the latter are assets from research that generate profits but were expensed rather than capitalized in the past (e.g. expenses for research) since it was uncertain then whether they would ever generate profits. Another example are non-capitalized, leased assets (operating leases). In a second step, one needs to estimate the firms' cost of capital rate. Since transforming total assets into invested capital is *only* tedious while estimating the cost of capital rate is conceptually more difficult. This is because methods such as regressions based on the famous capital asset pricing model or the more complex arbitrage pricing theory give plausible estimates that, however, are sensitive to altering assumptions e.g. about the time period used for estimations. Bartholdy and Peare[32] find both

30 Stephan Hostettler, *Economic Valued Added (EVA) Darstellung und Anwendung auf Schweizer Aktiengesellschaften* (Bern, Verlag Paul Haupt 1997, 5th ed.)

31 Above n 30

32 Jan Bartholdy/Paula Peare, 'Estimation of expected return: CAPM vs. Fama and French', 14 International Review of

methods to yield similar estimates. Moreover, Bruner et al.[33] find that differing assumptions can well drive a wedge between estimated costs of equity of 4 percentage points. This indicates that cartel-induced changes in capital costs can hardly be quantified empirically. This leads to the question if one should expect cartels to affect its members' capital costs at all.

Investors require an interest on their investment which at least equals the interest that they could earn when investing in a project with a similar risk-structure elsewhere. Hence, the assumption of a constant cost-of-capital rate requires that the cartel neither affects cartel-firms' risk-structure nor the interest paid by other firms. These assumptions are not a priori satisfied. Participating in a cartel may lead to a higher volatility of revenue and profits since e.g. cartel-periods may be interrupted by price wars while the discovery of the cartel is likely to cause fines imposed on the firms by competition authorities. This volatility mainly carries over to dividends paid to shareholders who might, therefore, adjust their interest requirements upwards. This requires shareholders to being able to perceive the volatility in profits that is caused by a secret agreement. Such a change in the interest on equity may also alter the relation of interest on equity and interest on debt which may cause cartel-firms to adjust their capital structure. This capital-structure effect of the cartel should be more likely if also the minimum required interest on debt changes. In this context, one might want to consider that non-colluding firms in the cartelized industry may also raise prices under the cartel's price umbrella. This makes non-cartel firms more profitable and allows for higher interest requirements of debtholders. It is unclear if this effect is strong enough to affect interest rates on debt that are also charged from firms in other industries, i.e. the overall interest level. These effects deserve further theoretical as well as empirical research. However, as they are not crucial for the quantification of damages but only for the question whether all excess profits are extracted by damage awards, these effects are not evaluated here any further.

III. USING ACCOUNTING DATA TO ASSESS CARTEL EFFECTS – EMPIRICS

In this section the method for quantifying cartel-induced damages, that is proposed in section II.A., is implemented for the famous and well-researched vitamins cartel. Connor[34] considers the vitamins cartel to be “the first, the biggest, most elaborate, most complete, longest lasting, and most influential of the cartel pandemics of the 1990s.” Section A. briefly describes the vitamins cartel and the data used.

Financial Analysis (2005), at 423

33 Robert Bruner/Kenneth Eades/Robert Harris/Robert Higgins, 'Best Practices in Estimating the Cost of Capital: Survey and Synthesis', Financial Practice and Education (Spring/Summer 1998), at 23, 27

34 Above n 8, at 277

Connor[35] states that the vitamins cartel "extracted historically unprecedented monopoly overcharges from customers. These overcharges later appeared on the profit statements of the vitamin manufacturers." Hence, section B. is concerned with identifying a lower bound for damages brought about by the vitamins cartel. This is done using the techniques outlined above. In section C. the difficulties are presented and evaluated that arise when using these techniques.

A. The Vitamins Cartel

Between 1989 and 1999 several European, Japanese, and North-American producers of vitamins colluded in prices.[36] Among these firms were BASF, Roche, Daiichi, and Takeda that agreed to jointly raise prices of the vitamins shown in Table 1. Vitamins can be regarded as a relatively homogeneous good. This facilitates the detection of deviations from agreed cartel prices and contributes to cartels' stability. Moreover, vitamin production requires detailed technical skills which prevents quick entry into the industry. Different vitamins cannot be substituted and require different production techniques. Therefore, each type of vitamin constitutes its own separate market. Table 1 gives basic information on the structure of these cartels. The supposed cartel-leader (i.e. Hofmann-La Roche in five cases) is highlighted in bold. One may note that the cartels in vitamins B1, B6, and folic acid and the one in vitamins C and B2 faced strong competition from Chinese exports and, thus, lasted only for 4 respectively 5 years. In vitamin B4 cartel-firms were put under competitive pressure by some small competitors. Market concentration was especially high for vitamins A, E, B5, and beta-carotene. Markups on vitamins are quite high for vitamins that are sold for human use on retail level. Here, manufacturers' prices of raw vitamins account only for 5-6% of the retail price. In comparison "mark-ups for feed- and food-grade vitamins are fairly modest."[37] Still, demand for vitamins is found to be fairly inelastic.[38] The cartel-firms were prosecuted and fined by the US-American and the European competition authority in 1999 after Rhône-Poulenc had sought leniency in 1998.

35 Id at 277

36 More detailed descriptions of the vitamins cartel can be found in John Connor, *Global Price Fixing – Our Customers are the Enemy* (Norwell, Kluver Academic Publishers 2001) and Julian Clarke/Simon Evenett, 'The deterrent effects of national anticartel laws: evidence from the international vitamins cartel', The Antitrust Bulletin (Fall 2003), 689-726 and Harry First, 'The Vitamins Case: Cartel Prosecutions and the Coming of International Competition Law', 68 Antitrust Law Journal (2001), 711-734

37 Above n 8, at 294

38 Id, at 319

	A and E	B1, B6, and folic acid	C and B2	B5	beta-carotene	B4	Fines (in 1999)	
(1) duration	1990-1999	1991-1994	1991-1995	1991-1998	1991-1998	1989-1996		
(2) no. of participants	4	3	4	3	2	6		
(3) strong competition		X	X			X		
(4) market share	70% (in '90) 100% ('91-)	45-60%		90%	90%			
(5) BASF	X		X	X	X	X	225m USD	296m EUR
(6) Roche	**X**	**X**	**X**	**X**	**X**		500m USD	462m EUR
(7) Takeda		X	X				72m USD	37m EUR
(8) Daiichi		X		X			25m USD	23m EUR

Table 1: The Vitamins Cartel

Prices for vitamins are found to be raised gradually over time rather than being lifted up in one big price-step after the formation of the cartel. Moreover, after the discovery of the cartel prices dropped by about 50% within two months leaving prices 30-40% lower than in the pre-cartel period. However, these price movements are not uniform across all vitamins affected. E.g. prices for liquid vitamin A almost tripled during the collusive phase. Even after the end of the conspiracy this price was 62% above its pre-conspiracy level.[39] Moreover, the prices for vitamins B1, B6, folic acid, C, and B2 were not raised as strongly as those for vitamins A and E. Because of the strong Chinese competition some prices even dropped below the pre-conspiracy level during the cartel-phase. The cartel in vitamin B4 also highlights the importance of looking at transaction prices rather than list prices. In this case list prices remained fairly constant while the gap between list prices and transaction prices was reduced because of the cartel.

Yearly firm-level data of the above firms' revenues and costs of goods sold is collected from the ThomsonReuters Datastream database for the period 1985 to 2007.[40] These variables are measured in thousands of each national currency, i.e. Euro for BASF, Swiss Franks for Roche, and Yen for Daiichi and Takeda. Figure 2 gives an overview on the development of these four firms' revenue and costs of goods sold as well as the difference and ratio of these two values. Obviously, there is no change in these values that might clearly be attributed to the cartel. Solely for BASF it is remarkable that the ratio of revenue and costs jumps on a higher level during the cartel period. Moreover, it is much smaller than the other firms' ratios and follows a different time trend. Converting revenues and costs to US-$ does not change much for Roche, Daiichi and Takeda but strongly impacts the time-series for BASF. Therefore, it appears reasonable to maintain national currencies.

39 Id, at 322

40 For Daiichi data is used for the period 1985 to 2005 since in 2006 it merged with Sankyo. Data of the merged firm is not easily comparable to data of Daiichi alone.

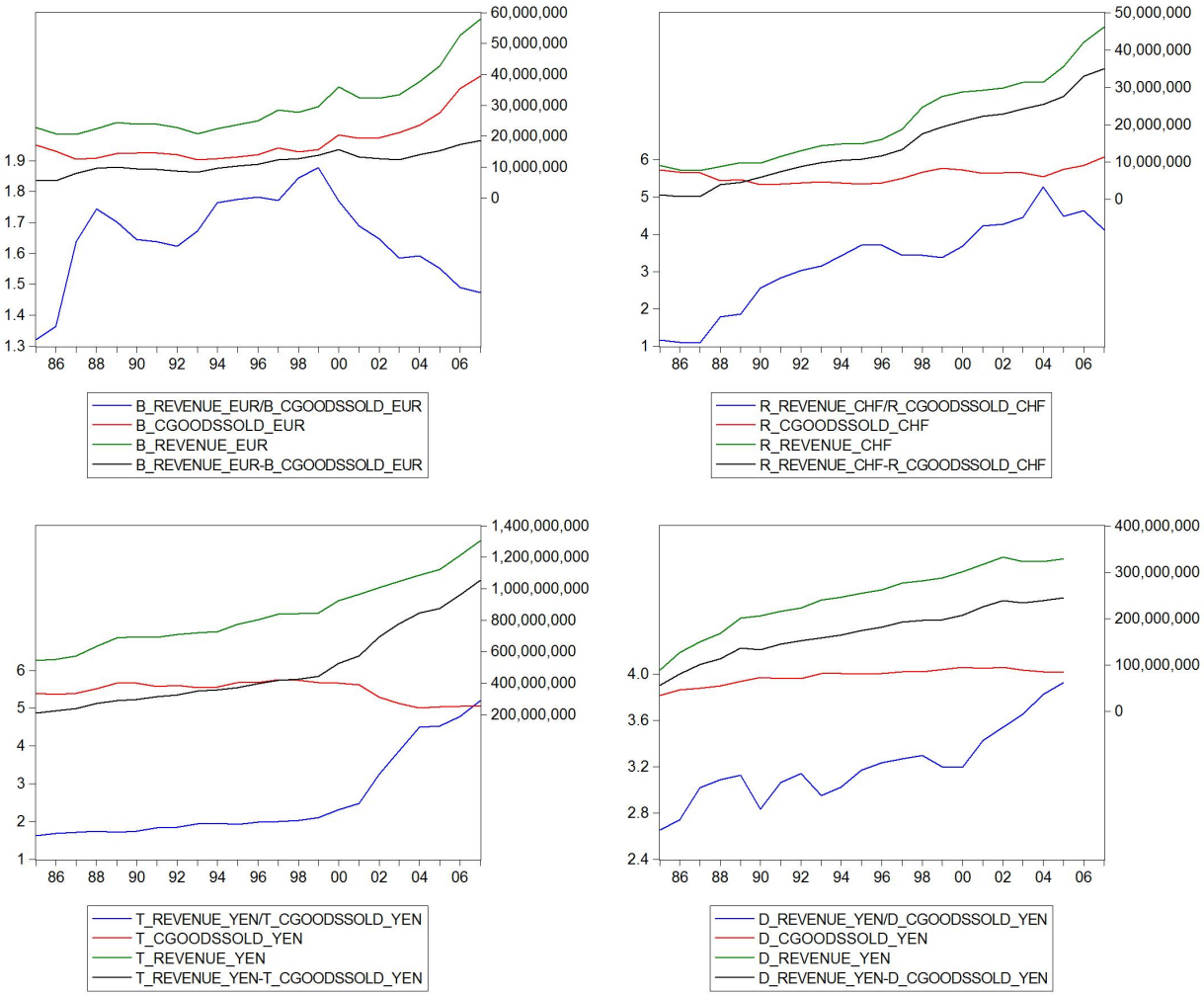


Figure 2: Revenues and Costs

B. Quantifying Cartel Damages in the Vitamins Cartel

As proposed in section II.A. an estimate of the lower bound for cartel-damages $\Delta\pi/\Delta D_{Kj}$ as defined in equation (4) can be found as β from a time-series regression as defined in (9), given that the cartel affects nothing but firms' revenues and costs of goods sold. Please note, that only one cartel-dummy can be used for BASF's and Roche's participation in the cartels of vitamins B5 and beta-carotene as both cartels occurred at the same time. Since using yearly data keeps time-series short (23 respectively 21 observations in case of the present dataset) one must be parsimonious in specifying the set of further explanatory variables X.

For BASF an IFRS-dummy is included covering the effects of BASF switching from German-GAAP to IFRS in 2004. A further dummy is included that takes value 1 from 1999 on and

0 otherwise which captures the effect of the introduction of the Euro. A further variable is incoming orders in the chemical industry.[41] Since the US-market for vitamins is quite important, the US-$/Euro exchange rate is also included in X. A White-test indicates heteroscedasticity, while a Jarque-Bera test implies normally distributed error terms. Therefore, estimation is done by standard ordinary least squares (OLS) with heteroscedasticity-consistent standard errors. None of the coefficients is significant except for the one associated with incoming orders (p-value 2.2%). However, the Durbin-Watson statistic indicates positive, first-order autocorrelation in the error term which implies misspecification of the model. This autocorrelation can be reduced by including dummy variables in 1987, '88, '99, and '00. This also increases coefficients' statistical significance but partly reverses the signs of the cartel-coefficients. However, such a procedure would appear arbitrary since it is uncertain, what real events these dummies shall represent. An Augmented Dickey-Fuller test indicates that both, the dependent variable and incoming orders, have a unit root. Since the error term of a regression of the difference between revenues and costs of goods sold on incoming orders indicates stationarity, the variables must be assumed to be cointegrated. Therefore, an error correction model is estimated where the first difference of revenues minus costs of goods sold $\Delta\pi_t$ is regressed on a constant a, the first differences of the cartel-dummies $\Delta D_{Kj,t}$, the exchange rate of the Euro relative the US-Dollar e_{EURUSD}, the first difference of incoming orders ΔIO_t and an error correction term $(\pi_{t-1} - \theta IO_{t-1})$. The exchange rate is used in levels since it is found to give a higher R^2 and lower information criteria. The first differences of the IFRS- and the Euro-dummy remain unconsidered for reasons of parameter-parsimony. Each would take value zero in all periods except for one, so that the informational content of the related estimation-coefficients would be low.

$$\Delta\pi_t = \alpha + \boldsymbol{\beta}\cdot\boldsymbol{\Delta D_{Kj,t}} + \gamma e_{EURUSD} + \delta_1\cdot\Delta IO_t + (\delta_2 - 1)\cdot\left(\pi_{t-1} - \theta\cdot IO_{t-1}\right) + \epsilon_t \qquad (18)$$

This regression gives an adjusted R^2 of 59% with $(\delta_2 - 1)$ not being significantly different from zero. Therefore, a regression in first differences can be performed, thus, omitting the error correction term.

$$\Delta\pi_t = \alpha + \boldsymbol{\beta}\cdot\boldsymbol{\Delta D_{Kj,t}} + \gamma e_{EURUSD} + \delta_1\cdot\Delta IO_t + \epsilon_t \qquad (19)$$

The adjusted R^2 of this regression amounts to 53% with a, γ, and δ_1 being significant at the 1%-level and taking the expected signs ($\gamma < 0$ and $\delta_1 > 0$). The β-coefficients for the cartels in vitamins B4, C, and B2 are insignificant, which is reasonable since these vitamins were subject to competition. The β-coefficients for the cartels in vitamins A, E, betacarotene and B5 are significant at the 1%- respectively 10%-level. However, these β's are negative which is counterintuitive since one should expect revenues minus costs of goods sold c.p. to rise when a cartel is formed and to fall when a

41 Due to the German reunification the time series of incoming orders in the chemical industry starts in 1991. In the appendix it is described how the missing values for 1985-1990 are constructed from similar data for West Germany.

cartel breaks down. Therefore, the above models respectively the quite aggregate data used must be considered inappropriate for quantifying a lower bound for cartel damages.

For Roche the regression's explanatory variables include the cartel-dummies, a dummy for the application of international generally accepted accounting principles (GAAP) from 1990 on, a linear trend, and the exchange rate of the Swiss Frank and the US-$. A further explanatory variable is sales in the Swiss chemical industry provided by the Swiss statistical office.[42] Since a White test does not suggest the error term to be heteroscedastic, the model is estimated by OLS. None of the cartel-coefficients is found to be statistically significant. Although the dependent variable and industry sales are found by an augmented Dickey-Fuller test to have a unit root, an Engle-Granger test does not indicate cointegration. However, estimating the model in first differences does not give statistically significant coefficients.

In case of Takeda it is found that π kinks upwards in 1999 such that a simple linear trend rises too strongly prior to 1999 and too softly afterwards. As a consequence, a second linear trend is included starting in 1999. Since for the Japanese chemical industry no data of orders or sales was available the only additional variable is the YEN/USD exchange rate. The estimation is done using heteroskedasticity-consistent standard errors. The cartel-coefficients are significant and positive at the 5%-level for the conspiracy in vitamins B1, B2, and folic acid, and negative and significant at the 1%-level for the conspiracy in vitamins B and C2. An F-test also indicates at the 5%-level that both coefficients must jointly be different from zero. This indicates that the cartel in vitamins B1, B2, and folic acid (C and B2) increased (decreased) Takeda's π by 2.63% (4.18%). However, one should also consider that the larger part of π's variation is explained by the trend terms and the constant.

The specification for Daiichi is quite rudimentary since, besides the constant and the cartel-dummies, it only includes a linear trend. Because a White-test does not indicate heteroscedasticity the estimation is done using standard OLS. Neither of the cartel-coefficients is found to be statistically significant. Moreover, the Durbin-Watson statistic suggests first-order autocorrelation in the error term and, thus, indicates misspecification of the model.

42 Since no sales data is available for 1985-1989 the missing values are backcasted based on a regression of the natural logarithm of sales on a constant and a linear trend. This regression explains 99% of the dependent variable's variation.

	adj. R^2	P_F(all = 0)	P_{JB}(No)	DW	P_F(all Dcartel = 0)
BASF	84.87%	0.00%	90.93%	1.04	7.77%
Roche	98.97%	0.00%	10.75%	2.48	46.97%
Takeda	99.69%	0.00%	94.67%	1.77	0.24%
Daiichi	97.17%	0.00%	12.57%	0.75	21.94%

Table 2: Summary Statistics

Table 2 reports summary statistics for the above regressions, i.e. the adjusted coefficient of determination, the p-values of F-tests examining the hypotheses that (a) all coefficients or (b) all cartel-coefficients jointly equal zero, the p-value of the Jarque-Bera test for normally distributed error terms, and the Durbin-Watson statistics. The latter's values indicate misspecification for at least BASF and Daiichi. However, the effects of autocorrelation must be traded off with parameter-parsimony that is required by the limited number of observation per series.

C. Difficulties in the Above Analysis

The above regressions may be considered inappropriate to identify the cartels' effects on firms' π. This may be attributed to two broad categories of difficulties. On the one hand, the *data* used may be inappropriate for analyses of the above form. On the other hand, the *econometric techniques* and specifications might be considered sub-optimal. These difficulties will be analyzed in turn to give recommendations for improvements and further research.

First, the data used is highly aggregated since all analyzed firms employ several lines of business. Therefore, both variables, revenue and costs of goods sold, are affected by the entirety of managerial decisions in an enterprise such as investments, divestitures, and mergers, even if those decisions do not affect the vitamins segment at all. Given the short time-series (and, thus, the required parameter-parsimony) as well as the fact, that not all important managerial decisions are made public, the above estimates clearly suffer from an omitted-variable bias. These challenges can be adressed by using less aggregated, segment-level data. Then, one *only* needs to control for decisions and factors that affect the segment of interest rather than the entire firm, which is a much easier task. Unfortunately, segment-level analyses often cannot be performed since firms (such as BASF, Roche, Takeda, and Daiichi) use to alter segment classifications every few years. Therefore, no segment-level time-series for revenues and costs can be constructed that meets sufficient quality-standards. In this context, it might be one objective for competition policy makers to cooperate more strongly with accounting standard setters in order to provide accounting standards that prevent firms from altering segment-delineation too often. Considering divestitures, mergers and other factors that alter a firm's structure, steady segment-delineations may not be feasible under all circumstances. However, in these cases it would be helpful if firms had to provide a detailed and

long-term reconciliation of figures.

Second and as is standard with regressions, the quality of estimates depends on how well the specification captures the underlying dynamics. This concerns changes in demand such as business cyclicality as well as supply side factors such as input price shocks or the introduction of a new technology. Such information can hardly be obtained from firms' financial statements and requires detailed information about the industry. However, with sufficient efforts and good access to industry experts and high-quality data this task may well be mastered. A more important aspect is how to model unobserved factors such as tacit collusion or competitive conduct in an industry. In this context, the period 1985-1989 might e.g. not be a good representation of a competitive period in the vitamins industry since Marshall et al.[43] find that most price announcements for vitamin A were already joint announcements of the cartel-firms. This is consistent with Connor's[44] observation that vitamin-prices after the end of the cartel dropped below pre-conspiracy prices. Moreover, as vitamin prices were raised stepwise during the cartel[45] one may not expect damages and cartel-profits to be the same in every year. Modeling such effects requires at least two things. On the one hand, one must know about these effects. This requirement is unlikely to be satisfied short time after the discovery of an collusive agreement. On the other hand, it must be possible to model these effects. In this context it is not sufficient to only capture the cartel's effect by a simple dummy-variable. Instead, one needs to model the strength of the collusive agreement. To put it into terms more common in the damages-literature, in order to assess cartel damages (from accounting data) one needs to do econometric modeling rather than performing a simple before-and-after regression.[46] In this context, more research is needed adressing the question of how to measure the degree of anticompetitiveness of a collusive agreement. This also requires to impose more structure about the competitive and collusive conduct on the model in order to keep the model estimable, given the length of the time-series used. This, in turn, requires to develop tests for the applicability of the structural assumptions made.

Third, estimating the above models by (heteroskedasticity-consistent) OLS is probably inappropriate since it is not unreasonable to assume a correlation between the occurrence of a cartel (i.e. cartel dummies) and unobserved effects (i.e. the error term). Here, one may e.g. think of the state of demand that both affects profits and the probability for forming a cartel respectively the stability of a cartel. Moreover, the existence of buyer power does directly influence profits but also

43 Robert Marshall/Leslie Marx/Matthew Raiff, 'Cartel price announcements: The vitamins industry', 26 International Journal of Industrial Organization (2008), at 769

44 Above n 8, at 320

45 Id, at 312

46 See e.g. Emily Clark/Mat Hughes/David Wirth, 'Study on the conditions of claims for damages in case of infringement of EC competition rules: Analysis of Economic Models for the Calculation of Damages', Ashurst Study for Directorate General Competition of the EU Commission (2004)

may affect the probability of forming a cartel by stimulating firms' desire to create a force in opposition to strong buyers. Principally, there are two possibilities for dealing with this endogeneity issue. On the one hand, one may attempt to proxy such variables and include them in the above model. This means advancing the approach towards econometric modeling. On the other hand, the effect of endogeneity may be alleviated or removed by using an instrumental variables estimation. In this case, one instruments the model with variables that are highly correlated with the presence of a cartel but little correlated with the unobserved effects in the error term. Applying the IV-regression in two stages we first regress the cartel dummies on variables θ that possibly explain the probability of forming a cartel. This regression can be interpreted as a linear probability model. In a second step one regresses the profitability measure on the probabilities of forming a cartel, estimated in the first stage, given the current values of θ.

IV. CONCLUSION

Concluding the above analysis, accounting data may neither be considered a blessing nor a menace in calculating cartel damages. It is shown that under some testable assumptions accounting data can be used for estimating a lower bound for cartel damages. This lower bound can be obtained from a regression of the difference between revenues and costs of goods sold on possibly explanatory variables and cartel-dummies. This allows for estimating a lower bound for cartel damages even when data of prices and quantity sold is unavailable.

It is shown that one may expect accounting data based estimates of damages and/or cartel firms' excess profits to be most exact if the cartel *only* affects infringers' revenues and costs of goods sold. This is because these accounting items are defined rather consistently with their economic counterparts. If the cartel also affects further cost components such as depreciation d and expenses for administration and selling s (including R&D-expenses) one needs to account for these effects in the calculation of damages and/or cartel firms' excess profits. Since both depreciation and expenses for administration and selling are not necessarily defined consistenly with economic theory, one is advised to rely on such estimates only with care. In this paper it is proposed how to econometrically test whether s and/or d systematically vary with the cartel. Additionally, one must be aware that the above variables might be affected by measures of earnings management. This may bias damage-estimates in either direction. Interpreting such estimates, thus, requires taking into account different accounting standards' tolerance for earnings measurement.

The proposed estimation procedures are applied to four firms that participated in the vitamins cartel. These estimations highlight further challenges when using accounting data. If only yearly data is available time-series are short. As a consequence, regression-specifications have to be

parsimonious leaving much variation unexplained. Preferably, quarterly or even monthly data should be used. Moreover, for multiproduct firms time series of a sufficient length may only be available at an aggregated level. Such firm-level data is exposed to many influences besides the cartel-effect. Therefore, cartel-effects are hard to quantify. Preferably, one may want to use segment-level data. However, at segment level time series must be expected being too short for a meaningful econometric analysis as firms generally alter their segments' delineation every few years.

To my knowledge, this is the first paper that explicitly explores the benefits and obstacles of using accounting data in econometric analyses of cartel-damage calculations. It is found that economists should not discard accounting data for calculating cartel damages per se. Under some assumptions a lower bound for cartel damages can consistently be estimated from accounting data. Further research might be directed to augmenting the above estimation procedures with prior knowledge and structural assumptions that are based on economic theory. In this context, one challenge is to correctly model the strength of the collusive agreement. Modeling the cartel by a dummy-variable taking value one if the cartel is in force and zero otherwise appears to be over-simplifying. This is because a dummy-variable of this form neither adequately reflects adaption processes in the cartel establishment process nor periods of price wars. Therefore, more research is needed addressing the question of how to measure the degree of anticompetitiveness of a collusive agreement.

APPENDIX

Incoming Orders in the German Chemical Industry

The German Statistical Office (Destatis) provides a monthly value index for incoming orders in the chemical industry with base value 100 in year 2000. Since this value index applies to the reunified Germany the time series starts in 1991. A similar index is provided for West Germany from 1991 to 2003. Destatis also provides a value index for incoming orders in the west German chemical industry with base year 1985 ($IOw85_t$). In principle, the missing values of IO_t can be computed in two ways.

First, a two-step procedure may be applied. The index for entire Germany (IO_t) can be calculated from the values of the index for West Germany (IOw_t) based on equation (20). This equation results from an OLS-regression of IO_t on IOw_t, a constant, and a linear monthly trend in the overlapping interval 1991 to 2003. Standard errors are given in parentheses and the adjusted R^2 of this regression amounts to 99.65%.

$$IO_t = \underset{(0.54)}{-3.93} + \underset{(0.0079)}{0.9978} \cdot IOw_t + \underset{(0.0016)}{0.0217} \cdot trend \tag{20}$$

This value index can be related to IOw_t via equation (21). This equation is the outcome of an OLS-regression of IOw_t on $IOw85_t$, a constant, and a linear monthly trend in the overlapping interval 1991 to 1994. Standard errors are given in parentheses and the adjusted R^2 of this regression amounts to 74.54%.

$$IOw_t = \underset{(5.73)}{-26.34} + \underset{(0.0414)}{0.4783} \cdot IOw85_t - \underset{(0.027)}{0.087} \cdot trend \tag{21}$$

The missing values of IO_t for the interval 1985 to 1990 can, thus, be constructed from $IOw85_t$ using equations (20) and (21).

Second, the missing values of IO_t can be obtained in one step by directly regressing IO_t on IOw_t, a constant, and a linear monthly trend in the overlapping interval 1991 to 2003. The results are shown in equation (22). Standard errors are given in parentheses and the adjusted R^2 of this regression amounts to 68.25%.

$$IO_t = \underset{(6.33)}{28.44} + \underset{(0.0458)}{0.4511} \cdot IOw85_t - \underset{(0.02986)}{0.0916} \cdot trend \tag{22}$$

This second method is used for supplementing IO_t since in the overlapping period 1991 to 1994 the forecasted values of IO_t from (22) match the true ones slightly better than those generated by equations (20) and (21).

REFERENCES

Jan Bartholdy/Paula Peare, 'Estimation of expected return: CAPM vs. Fama and French', 14 International Review of Financial Analysis (2005), 407-427

Yuliya Bolotova/John Connor/Douglas Miller, 'Factors Influencing the Magnitude of Cartel Overcharges: An Empirical Analysis of Food-Industry Cartels', 23 (1) Agribusiness (2007), 17-33

Yuliya Bolotova/John Connor/Douglas Miller, 'Factors Influencing the Magnitude of Cartel Overcharges: An Empirical Analysis of the U.S. Market', Journal of Competition Law and Economics (2008), published online on 28 August 2008 , 1-21

Robert Bruner/Kenneth Eades/Robert Harris/Robert Higgins, 'Best Practices in Estimating the Cost of Capital: Survey and Synthesis', Financial Practice and Education (Spring/Summer 1998), 13-28

Emily Clark/Mat Hughes/David Wirth, 'Study on the conditions of claims for damages in case of infringement of EC competition rules: Analysis of Economic Models for the Calculation of Damages', Ashurst Study for Directorate General Competition of the EU Commission (2004)

Julian Clarke/Simon Evenett, 'The deterrent effects of national anticartel laws: evidence from the international vitamins cartel', The Antitrust Bulletin (Fall 2003), 689-726

John Connor, *Global Price Fixing – Our Customers are the Enemy* (Norwell, Kluver Academic Publishers 2001)

John Connor, 'Price-Fixing Overcharges: Legal and Economic Evidence', *Purdue University Staff Paper* No. 04-17 (2005), available at http://www.agecon.purdue.edu/staff/connor/papers/PRICE%20FIXING_OVERCHARGES_FULL_TEXT_8-20-05.pdf

European Commission, 'White Paper on Damages actions for breach of EC antitrust rules', COM(2008) 165 final, (2008.a)

European Commission, 'Commission Staff Working Paper accompanying the White Paper on Damages actions for breach of EC antitrust rules', SEC(2008) 404, (2008.b)

Harry First, 'The Vitamins Case: Cartel Prosecutions and the Coming of International Competition Law', 68 Antitrust Law Journal (2001), 711-734

Franklin Fisher, 'The Misuse of Accounting Rates of Return: Reply', 74 (3) The American Economic Review (1984), 509-517

Franklin Fisher, 'Economic Analysis and Antitrust Damages', 29 (3) World Competition (2006), 383-394

Franklin Fisher/John McGowan, 'On the Misuse of Accounting Rates of Return to Infer Monopoly Profits', 73 (1) The American Economic Review (1983), 82-97

Franklin Fisher/R. Craig Romaine, 'Janis Joplin's Yearbook and the Theory of Damages', 5 (1/2) Journal of Accounting, Auditing and Finance (Winter/Spring 1990), 145-157

Robert Hall/Victoria Lazear, 'Reference Guide on Estimation of Economic Losses in Damages Awards', Federal Judicial Center Reference Manual on Scientific Evidence 2nd edition (2000), 277-332

Stephan Hostettler, *Economic Valued Added (EVA) Darstellung und Anwendung auf Schweizer Aktiengesellschaften* (Bern, Verlag Paul Haupt 1997, 5th ed.)

Harold Hotelling, 'A General Mathematical Theory of Depreciation', 20 (151) Journal of the American Statistical Association (1925), 340-353

International Accounting Standards Board (IASB), *IFRS 2008* (Weinheim, Wiley-VCH Verlag 2008)

William Long/David Ravenscraft, 'The Misuse of Accounting Rates of Return: Comment." The American Economic Review', 74 (3) The American Economic Review (1984), 494-500

Robert Marshall/Leslie Marx/Matthew Raiff, 'Cartel price announcements: The vitamins industry', 26 International Journal of Industrial Organization (2008), 762-802

Massimo Motta, *Competition Policy Theory and Practice* (Cambridge University Press 2004, 8th ed.)

Kenneth Peasnell, 'Using Accounting Data to Measure the Economic Performance of Firms', 15 Journal of Accounting and Public Policy (1996), 291-303

Andrew Stark, 'Estimating economic performance from accounting data – a review and synthesis', 36 The British Accounting Review (2004), 312-343

John Taurman/Jeffrey Bodington, 'Measuring damage to a firm's profitability: ex ante or ex post?', 37 (1) The Antitrust Bulletin (1992), 57-106

Theon van Dijk/Frank Verboven, 'Quantification of damages', forthcoming chapter for *Issues in Competition Law and Policy,* ABA Publications in Antitrust, Ed. W. Dale Collins (2005), available at http://www.econ.kuleuven.be/public/ndbad83/Frank/Papers/Van%20Dijk%20&%20Verboven,%202006.pdf

Samuel Weaver, 'Measuring Economic Value Added: A Survey of the Practices of EVA® Proponents', 11 Journal of Applied Finance (2001), 50-60

Anastasios Xepapaedes, 'Measuring Internal Rates of Return: The Transfer Function Approach', 16 Empirical Economics (1991), 267-285