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Audit regulations, audit market structure, and financial reporting quality

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SYMBOLS

α_i	$0 \leq \alpha_i \leq 1$ $0\% \leq \alpha_i \leq 100\%$	Market share of audit firm i
$(\bar{\alpha})$		(Mean market share)
$\Delta \dots$		Change in...
AA		Dummy variable that takes on the value of one for clients of Arthur Andersen
AC		Audit costs
AF		Audit fees
AQ		Measure for audit quality used in a regression model
$AUDITOR_PAIR$		Dummy variable that takes on the value of one for a certain auditor pair in a JA (e.g., $BIG4_BIG4$, $BIG4_SMALL$, ...)
$AWCA$		Measure of abnormal working capital accruals used in a regression model
$BIGN$		Dummy variable that takes on the value of one for (clients of) a Big N audit firm
$BIGN_PREM$		Measure of an audit fee premium charged by a Big N audit firm
$c(\dots)$		Audit costs in an analytical model
CC		Measure of conditional conservatism used in a regression model
$CHANGE$		Dummy variable that takes on the value of one for a change in the audit firm
$city$		Subscript indicating the city level
$CLIENT_ALIGNMENT$		Measure of an audit firm's fit to a client used in a regression model
COD		Measure of a client's cost of debt used in a regression model
$COMPETITOR_DISTANCE$		Measure of an audit firm's differentiation from its closest competitor used in a regression model

<i>COMMON₄</i>		Regression variable that takes on the value of one (two) [three] {four} if the four largest clients use a different audit firm (use three different audit firms), [use two different audit firms], {use the same audit firm}
<i>COMPETITION</i>		Measure of audit market competition used in a regression model
<i>CONCEN</i>		Measure of audit market concentration used in a regression model
<i>CR_n</i>	$0 < CR_n \leq 1$ $0\% < CR_n \leq 100\%$	Concentration ratio (i.e., the combined market share of the <i>n</i> dominant audit firms)
<i>DACC</i>		Measure of abnormal discretionary accruals used in a regression model
<i>DISTANCE</i>		Measure of the difference between an audit office's market share and the market share of the competing audit office that has the most similar market share
<i>e</i>		Audit effort in an analytical model
<i>E[...]</i>		Expected ...
<i>earn</i>		Earnings in an analytical model
<i>EARN</i>		Measure of earnings used in a regression model
<i>EARN_SURPR</i>		Dummy variable that takes on the value of one if the firm reports a positive earnings surprise
<i>FEE</i>		General fees (audit, non-audit, other, ...)
<i>FRAUD</i>		Dummy variable that takes on the value of one if a client is accused or convicted for fraud
<i>GCO</i>		Dummy variable that takes on the value of one if the auditor issued a going concern opinion
<i>GINI</i>	$0 \leq GINI \leq 1$	Gini coefficient
<i>HHI</i>	$1/N \leq HHI$	Herfindahl-Hirschman index
<i>i = 1, ..., n, ..., N</i>		Index for the audit firm
<i>I</i>		Indicator function

<i>IFRS_USE</i>		Dummy variable that takes on the value of one for a client's use of IFRS
<i>IMP</i>		Dummy variable that takes on the value of one for a client that recorded a goodwill impairment
<i>INF</i>		Measure for a client's influence on the audit firm used in a regression model
<i>INT_OPERATIONS</i>		Dummy variable that takes on the value of one for a client with assets located in at least one country outside its home country
<i>JA</i>		Dummy variable that takes on the value of one if a client employs two audit firms
<i>L</i>		Liability in an analytical model
<i>LN...</i>		Natural logarithm of...
<i>main</i>		Subscript indicating the main audit firm in a JA (i.e., the audit firm with larger work shares or fees)
<i>MAR</i>		Dummy variable that takes on the value of one if a MAR regulation is implemented
<i>MERGER</i>		Dummy variable that takes on the value of one for an audit firm that was involved in a merger
<i>MISSTATE</i>		Dummy variable that takes on the value of one for a client with misstated financial statements
<i>MISSTATE_RATE</i>		Measure for a clients' average misstatement rate (as revealed through subsequent restatements) used in a regression model
<i>MSHARE</i>		Measure for an audit firm's market share in a regression model
<i>N</i>		Number of (all) audit firms active in the market
<i>NAF</i>		Non-audit fees
<i>nat</i>		Subscript indicating the national level
<i>NE</i>	$1 \leq NE \leq N$	Numbers equivalent
<i>norm</i>		Subscript indicating normalization
<i>office</i>		Subscript indicating the office level

<i>P</i>	Profits in an analytical model
<i>PERIOD</i>	Dummy variable that takes on the value of one for observations from a specific period of time
<i>PERF</i>	Measure for a client's economic performance used in a regression model
<i>PRESSURE</i>	Dummy variable that takes on the value of one for fee pressure
<i>PROF</i>	Measure of an audit firm's profitability used in a regression model
<i>PUB</i>	Dummy variable that takes on the value of one for a public client
<i>Q</i>	Quasi-rents
<i>r</i>	Interest rate or rate of return in an analytical model
<i>rep</i>	(Some form of a) report in an analytical model
<i>rev</i>	Revenue in an analytical model
<i>ret</i>	Return in an analytical model
<i>RET</i>	Measure for a client's stock returns used in a regression model
<i>sign</i>	(Some form of a) signal in an analytical model
<i>SIZE</i>	Measure for a client's size used in a regression model
<i>SPEC</i>	Measure of an audit firm's industry leadership or specialization used in a regression model
<i>t</i>	Index for time
<i>TAC</i>	Total audit costs
<i>TACC</i>	Measure of total accruals used in a regression model
<i>T_{max}</i>	Maximum audit tenure under MAR in an analytical model
<i>T_{vol}</i>	Auditor tenure in a setting of a voluntary auditor change
<i>TAXF</i>	Tax fees
<i>TF</i>	Total (audit and non-audit) fees

<i>top4</i>	Subscript indicating the local top 4 audit firms (which are not necessarily Big 4 audit firms)
<i>V, v</i>	(Some form of) value in an analytical model
<i>vol</i>	Subscript indicating a voluntary audit firm change
<i>YEAR...</i>	Dummy variable that takes on the value of one for observations from a specific year

ABBREVIATIONS

AA	Arthur Andersen
AFC	Audit fee cap
AIM	UK Alternative Investment Market
AS	Audit services
ASEX	American Stock Exchange
DOJ	U.S. Department of Justice
E&Y	Ernst & Young
EU	European Union
FFR	Financial Reporting Release
FTSE	Financial Times Stock Exchange (Index)
GBP	British pound sterling
GCO	Going concern opinion
IFRS	International Financial Reporting Standards
IPO	Initial public offering
JA	Joint audit
KPMG	Klynveld Peat Marwick Goerdeler
MAR	Mandatory audit firm rotation
MPAE	Multi-period audit engagements
MSA	Metropolitan statistical area
NAS	Non-audit services
NYSE	New York Stock Exchange
OTC	Over the Counter Market
PCAOB	Public Company Accounting Oversight Board
PCAOB AS	PCAOB Auditing Standard
PWC	PricewaterhouseCoopers
S&P	Standard & Poor's (Index)
SEC	Securities and Exchange Commission
SIC	Standard industrial classification
SMA	Standard metropolitan area
SME	Small and medium-sized enterprise

SOX	Sarbanes Oxley Act
UK	United Kingdom
U.S.	United States of America
USD	U.S. Dollar

I. INTRODUCTION

After the financial crisis beginning in 2007, regulators, practitioners, and academics have resumed their discussion regarding the advantageousness of different audit market regulations in restoring investors', creditors', and the public's confidence in corporate financial disclosures. The main goals of regulators worldwide are to improve the quality of audited financial statements and to decrease the currently high level of audit market concentration.

The regulatory debate particularly focuses on designing incentives that increase the probability that auditors will exert sufficient effort to detect errors or intentional misstatements in their clients' financial statements, and will refrain from issuing a clean audit opinion in case of detections (direct *incentive effects* of regulations). For example, the prohibition on single-provider auditing and consulting reduces the economic benefit auditors risk losing should they issue an unfavorable audit opinion: The fees earned from providing non-audit services (NAS) are not at stake if the joint supply of audit services (AS) and non-audit services is prohibited. By reducing the auditor's maximum tenure, the mandatory audit firm rotation (MAR) after a pre-defined number of periods decreases the economic benefit auditors can earn from serving a specific client. Audit fee caps (AFCs) (i.e., a maximum percentage of the fees earned from one specific client, in relation to the auditor's total fees) directly restrict the relative economic importance of a client, and multi-period audit engagements (MPAEs) protect the auditor from dismissal during a certain number of periods. Whereas all these measures mainly aim at improving independence, joint audits (JAs) make use of the dual control principle to increase both audit effort and auditor independence.

However, audit regulations also can have unintended direct incentive effects. For example, low effort can result because of free riding in a JA setting. Moreover, since a prohibition to offer NAS to audit clients eliminates advantageous knowledge spillovers flowing from NAS to AS, audit costs (and eventually audit fees) will increase if the auditor wants to keep the probability to detect irregularities constant. Alternatively, if the auditor cannot raise the audit fee, the detection probability will decrease. A similar effect will occur under MAR due to repeatedly occurring learning costs. The net effect of regulations on incentives is thus far from straightforward. It is therefore unsurprising that the empirical findings on the effects of regulations on audit quality are mixed.

In addition to their direct incentive effects, however, audit market regulations are likely to have (positive or negative) effects on the number of auditors who are active in the market, the distribution of market shares among audit firms, and the degree of competition between the suppliers of audit services (*market structure effects* of regulations). An example for a direct market structure effect is a regulation prescribing JAs with a Big 4 and a non-Big 4 audit firm, because the implementation of this regulation would directly transfer market shares from the market leaders to smaller audit firms. Another example would be the implementation of MAR, since MAR is expected to increase the dynamics of the audit market and thus to decrease audit market concentration.

However, there is also the potential for indirect market structure effects, that is, changes in incentives caused by a regulation can affect market structure. For example, the prohibition to provide NAS to audit clients can reduce audit firms' profit contributions; given a certain amount of fixed costs, competition will force some audit firms to leave the market. However, market structure can also affect incentives (indirect incentive effect of regulations): The market shares of audit firms determine the relative economic importance of a specific client, and, thus, the auditor's incentive

to remain independent. Consequently, to assess the effect of regulations on audit quality, researchers should simultaneously take into account the incentive effects and the market structure effects.

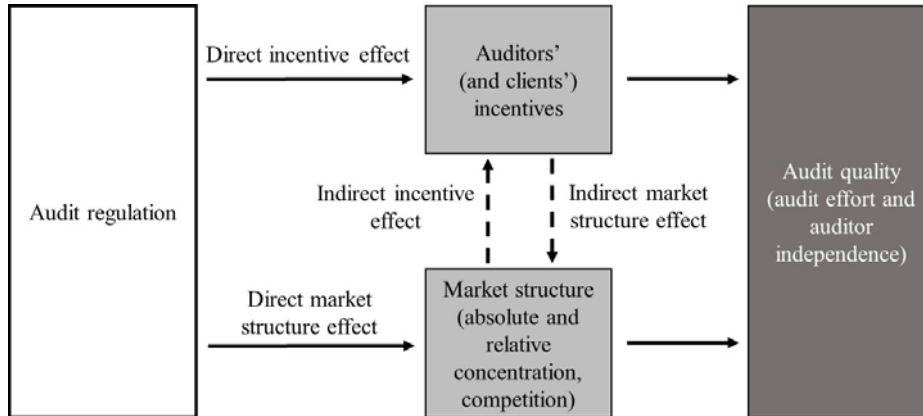


Figure 1: Effects of audit regulations on audit quality

However, most of the empirical and the analytical literature on audit regulations neglects the market structure effects of regulations, although these effects are important for two reasons: First, decreasing audit market concentration and strengthening competition are directly among the regulators' goals. Second, the structure of the audit market can affect the quality of audited financial statements and, thus, intensify or lessen the effect that altered incentives have on audit quality.

To date, little is known about the joint association between audit regulations, incentives, market structure, and the quality of audited reports. The idea of this article therefore is to discuss how these interactions can be analyzed. Identifying the channels through which audit regulations affect financial reporting quality is important for the advancement of analytical and empirical audit research, the understanding of the generally mixed empirical results, and the discussion of the effectiveness of audit regulations.

In the following, we provide a structured overview of the empirical and analytical literature on the effects of audit market regulations. However, we would like to emphasize that—because the literature is very comprehensive whereas the scope of this article is limited—we had to make a selection from a literature that is too voluminous for us to review in its entirety. Moreover, we would like to point out that when we summarize the publications that we include in our overview, we present what we consider the papers' main analyses in a compressed and stylized form to allow for comparisons between the studies (at least to a certain degree). We do, however, not include and discuss the numerous additional analyses and sensitivity checks provided in the original publication, and acknowledge that we might drop contents that researchers might deem essential. Further, to improve the readability of this article, we rename the variables used in the original regressions or analytical models.

The article is organized as follows. In Chapter II, we address the structure of the audit markets of industrialized countries. We first give an overview of the concentration metrics that are usually used to describe the structure of an audit market or a market segment. We then present the empirical findings on audit market concentration at the national level and provide an overview of the main reasons that led to the currently high degree of concentration. In Chapter III, we summarize the

reasons why regulators worldwide consider a high degree of concentration to be a concern. In particular, we discuss the regulator's assumption that a high degree of concentration inevitably leads to a low degree of competition and to the corresponding effects of low audit quality and high audit fees. We also give an overview of the empirical findings on the association between concentration and audit quality and fees, respectively. In Chapter IV, we briefly introduce the mandatory audit firm rotation, the prohibition on the joint supply of audit and non-audit services, and joint audits as examples for regulations that are likely to have both incentive and market structure effects. Chapter V summarizes the empirical findings on the effects of these regulations on audit quality and market structure. As the overview shows, the results are mixed. We believe that one reason for this observation could be that the market structure effects resulting from regulations so far have not been taken into account sufficiently. Turning to analytical papers on the mandatory audit firm rotation, the prohibition on the joint supply of audit and non-audit services, and joint audits, Chapter VI summarizes models that regard the market structure as given. The results from these models show that the effects of regulations are not straightforward, but depend on various factors related to the auditor, the client, and the legal environment. Chapter VII gives an overview of analytical research that simultaneously considers incentive effects and market structure effects. It also provides a brief overview of industrial organization models that seem suitable to expand the models applied to investigate the effects of audit regulations. Chapter VIII concludes and highlights avenues for future research.

II. THE STRUCTURE OF THE AUDIT MARKET

II.1. Introduction

The degree of concentration of a national audit market, particularly in the segment of statutory audits of large listed companies, has always been of great interest to regulators, researchers, and practitioners. Regulators assume that a given degree of audit market concentration is causally linked to a certain degree of competition. The concern is that a too low degree of competition (but also a too high degree of competitive pressure) could negatively affect audit firms' market behavior. Thus, regulators now and again propose measures that are intended to mitigate potentially harmful consequences of concentration on audit quality, audit fees, and the reliability of audited financial statements.

The regulators' interest in concentration has led to a corresponding need for audit market research. The empirical literature mainly addresses three topics: (1) The determination of concentration and its development (i.e., concentration metrics themselves are of interest, see Paragraph II.3); (2) the association between concentration and audit firms' performance, for example in the sense of audit quality and/or audit fees (i.e., concentration metrics are used as an (exogenous) input variable, see Paragraphs III.3.2 and III.3.3); and (3) the effect of exogenous shocks or regulatory measures on audit market concentration (i.e., concentration metrics are considered as the dependent variable, see Paragraph II.4).

In the following, we start with a description of the traditional metrics that are used to measure supplier concentration in a national audit market or in a segment of the audit market (i.e., the concentration ratio, the Herfindahl-Hirschman index, and the Gini coefficient). We also briefly describe metrics that recently have been proposed in the empirical audit literature to explain audit

firms' strategic behavior in a local market, as these metrics have been used as an input to estimate audit fees and audit quality.

Building on this, we provide an overview of some empirical studies on the level of absolute and relative concentration at the country level. Audit market concentration at the country-level is also important because the effect of a new regulation is likely to depend on the structure of the audit market that is observed before the regulation goes into effect. Moreover, we discuss the factors that have led to the development from a situation where eight large audit firms dominated the audit market into a tight oligopoly of currently four suppliers. In addition to mergers among the largest audit firms, the demise of Arthur Andersen, demand-side effects, and audit market regulations have played an essential role in shaping the competitive environment of audit firms.

II.2. Measures of concentration and competition

II.2.1. The concentration ratio

The literature often uses the concentration ratio, which measures the combined market share of the dominant audit firms (i.e., absolute concentration). The concentration ratio CR_n is the sum of the percentage market shares α_i of the $i = 1, \dots, n$ largest audit firms that are active in the market segment studied:

$$(1) \quad CR_n = \sum_{i=1}^n \alpha_i \quad (\text{with } 0\% < CR_n \leq 100\%).$$

To cover the combined market share of the currently dominating Big 4 audit firms, for example, n is set to four.

The preferred way to determine the market share is using the audit firm's proportion of the audit fees that all audit firms earn in the market segment studied. Market shares based on audit fees reflect the size and dominance of an audit firm relative to its competitors. If audit fees are not available, for example, because the disclosure of audit fees is (not yet) mandatory for the clients in the market or market segment, an audit firm's proportion of the clients' total assets or revenues being audited can be used as an alternative.¹ A second option is an audit firm's proportion of the number of audits conducted in the market segment. Concentration measures based on the number of audits are found to be highly correlated with the fee-based measures. Nevertheless, using market shares based on the number of clients to calculate the concentration ratio underestimates the fee-based measure because of the size effect (i.e., large clients are more likely to hire large audit firms) (Eichenseher and Danos (1981); Moizer and Turley (1987)).

The audit market segment is regarded as perfectly competitive if its concentration ratio is $CR_n = n/N$, where N is the total number of audit firms active in the market segment (i.e., all audit firms have an equal market share). If the concentration ratio is above 40%, then there is the assumption that the market represents an oligopoly (i.e., a small number of audit firms with significant market shares dominate the market segment). A concentration ratio above 60% indicates a tight oligopoly

¹ In the U.S., audit fee disclosure is mandatory since 2001. The EU Member States differ regarding the effective date of the respective regulation. In Germany, for example, the publication of audit fees became mandatory only in 2005. In Canada and in Japan, the mandatory disclosure of audit fees was introduced in 2004.

(Oxera Consulting Ltd. (2006)), and if the CR_n exceeds 70%, the market ranges from an oligopoly to a monopoly.

The calculation of the concentration ratio is straightforward and its interpretation is simple; however, the concentration ratio neglects the market shares of the $N-n$ audit firms that are smaller than n , and it also does not consider the market share distribution among the n largest audit firms. Because an imbalance in the distribution of market shares among the largest audit firms might have a stronger impact on market behavior than a large market share of the dominant audit firms as a group, it is useful to calculate measures of relative concentration (Dedman and Lennox (2009); Francis et al. (2013)).

II.2.2. The Herfindahl-Hirschman index

To provide a more complete picture of the market structure, the literature uses the Herfindahl-Hirschman index HHI (or, to be more precise, HHI_N) to measure the relative concentration between the $i = 1, \dots, N$ audit firms:

$$(2) \quad HHI = \sum_{i=1}^N (\alpha_i)^2 \quad (\text{with } 1/N \leq HHI),$$

where the market shares are expressed as fractions. Since the HHI is the sum of the squares of the market shares of all the audit firms active in the market, the HHI gives more weight to larger suppliers. The HHI increases both if the number of audit firms decreases and if the inequality in the market share distribution increases.

If the HHI is below 0.01, the market is regarded as highly competitive. A HHI above 0.01, but below 0.1 indicates a market with a low degree of relative concentration. A HHI above 0.1, but below 0.18 is seen as an indication of moderate concentration, and a HHI above 0.18 points towards high concentration (see, for example, the formal guidelines for business mergers of the U.S. Department of Justice (DOJ) and the U.S. Federal Trade Commission; United States Government Accountability Office (2008)).

Since the lower boundary of the HHI depends on the number N of audit firms, the HHI can be normalized, for example, to compare the equality in the market share distribution across different (national) audit market segments or across countries:

$$(3) \quad HHI_{norm} = \frac{HHI - 1/N}{1 - 1/N} \quad (\text{with } 0 \leq HHI_{norm} \leq 1 \text{ for } N > 1).$$

However, the HHI_{norm} is less suitable for comparing the degree of absolute concentration, since information about the total number of audit firms active in the market is lost.²

The reciprocal of the HHI is the numbers equivalent NE (with $1 \leq NE \leq N$), that is, the number of audit firms with equal market shares that are necessary to reconstruct the respective HHI value.

² Consider the case in which suppliers have identical market shares: For $N = 2$, $HHI = 0.5$ and $HHI_{norm} = 0$; for $N = 3$, $HHI = 0.33$ and $HHI_{norm} = 0$, although the market is less concentrated than in the case of $N = 2$.

HHI is often directly interpreted as a measure for competition. The CR_n and the *HHI* reflect distinctly different aspects of market concentration; in fact, Francis et al. (2013) and Boone et al. (2012) find that these measures (both calculated for the four largest audit firms) are uncorrelated.³

II.2.3. The Gini coefficient

Economic studies frequently use the Gini coefficient as a measure of statistical dispersion, that is, of the inequality in the distribution of wealth or income among people in a country or group. Mathematically, the Gini coefficient is defined based on the Lorenz curve: On a Cartesian coordinate system with the cumulative share of individuals with a certain income (ranked from the lowest to the highest income) on the abscissa, the Lorenz curve shows the cumulative share of the total income earned by these ranked groups of individuals. The line at 45 degrees on the coordinate system depicts the “line of perfect equality” of incomes. The Gini coefficient then is the ratio between (1) the area between the line of equality and the Lorenz curve, and (2) the total area under the line of equality. The Gini coefficient, expressed as a percentage, ranges from 0% (complete equality) to 100% (complete inequality).

Empirical studies of audit market concentration only occasionally use the Gini coefficient to measure the inequality in the market share distribution among the largest audit firms (see Quick and Wolz (1999); Abidin et al. (2010); Dunn et al. (2011); Dunn et al. (2019)). The Gini coefficient then is defined as:

$$(4) \quad GINI = \left(\frac{2}{\bar{\alpha} \cdot n^2} \right) \cdot \sum_{i=1}^n \left[\left(i - \frac{n+1}{2} \right) \cdot \alpha_i \right] \quad (\text{with } 0 \leq GINI \leq 1),$$

where n denotes the number of the largest among the N audit firms, $\bar{\alpha}$ indicates the mean market share for the n largest audit firms, and α_i is audit firm i 's market share. The Gini coefficient provides evidence on the relative concentration (i.e., on the inequality in the distribution of market shares among the suppliers of audit services in a specific segment of the audit market). Since the audit firms are ranked from the smallest to the largest market share, the below-median (above-median) market shares count as negative (positive) numbers in the second factor of equation (4). When the market shares are equally (unequally) distributed, *GINI* equals zero (one).

II.2.4. Measures based on spatial competition

The measures described above are used to measure concentration at the country level or at the level of local markets. However, Dedman and Lennox (2009) and Numan and Willekens (2012) argue that—both from a theoretical and an empirical perspective—the traditional concentration measures outlined above are not necessarily appropriate to measure competition. One reason is that these concentration measures implicitly assume that clients regard the audits performed within the market segment considered as a homogenous product. Approaches based on spatial competition models (see Chapter VII), in contrast, take into account product differentiation in the sense that audit firms are more or less specialized in the client's audit-relevant characteristics. Moreover, traditional concentration measures remain silent about the interdependency between the audit firm's payoffs,

³ Eichenseher and Danos (1981), on the contrary, show that the CR_4 and the *HHI* based on the square root of client's revenues are correlated.

since they implicitly assume that all audit firms within the group of suppliers of a certain size face the same level of competition and apply identical strategies (see, e.g., Simunic (1980)). Spatial competition models, in contrast, assume that audit firms' pricing strategies (or their strategies to provide a certain audit quality) are contingent on the strategy of their closest competitor(s). Taking into account empirical measures both for an audit firm's product differentiation through specialization and for the audit firm's market power due to differentiation from the closest competitor seems to be a fruitful extension of the existing literature:

Numan and Willekens (2012) claim that competition between audit firms mainly occurs at the local office level instead of at the national audit firm level. Thus, they define audit markets per industry segment (based on the clients' 2-digit SIC industry) and U.S. metropolitan statistical area (MSA) at the local audit office level. Numan and Willekens (2012) assume that audit firms can exploit their industry specializations to achieve product differentiation from their competitors, thus decreasing price competition (i.e., the audit market is a differentiated-product oligopoly). Numan and Willekens (2012) use two measures for competition through differentiation: First, they construct a measure for the alignment of the incumbent audit firm with the client ("auditor-client-alignment"). Numan and Willekens (2012) consider the degree of industry fit between an audit firm and a client as the main factor of the audit firm's expertise. Thus, they measure the degree of "auditor-client-alignment" with the audit firm's industry portfolio share (i.e., the revenue share the audit firm generates in a 2-digit SIC industry, relative to the total revenue generated by the audit firms in an MSA). Second, Numan and Willekens (2012) consider the incumbent audit firm's location relative to its closest competitor ("incumbent-competitor-distance"), which they also measure based on the client's industry. In constructing the "incumbent-competitor-distance" measure, they use the absolute difference between the incumbent audit firm's market share in the client's industry and the market share of the incumbent audit firm's closest competitor (in terms of market share). "Incumbent-competitor-distance" captures the incumbent audit firm's market power vis-a-vis its closest competitor. Numan and Willekens (2012) argue that the supplier whose market share is "closest" to the incumbent audit firm exerts the greatest pricing pressure.

Bills and Stephen (2016) assume that, although Big 4 and small audit firms generally serve two distinct markets (Simunic (1980); Ghosh and Lustgarten (2006); United States Government Accountability Office (2008)), there is an overlap with competition between small and Big 4 audit firms for public clients at the local (MSA) level. Thus, Bills and Stephen (2016) extend the "incumbent-competitor-distance" measure of Numan and Willekens (2012) by differentiating between Big 4 and small audit firm competitors to measure spatial competition within and between the distinct markets. More precisely, Bills and Stephen (2016) consider the absolute market share distances between (1) a Big 4 audit firm and its closest small competitor; (2) a Big 4 audit firm and its closest Big 4 competitor; (3) a small audit firm and its closest Big 4 competitor; and (4) a small audit firm and its closest small competitor.

Numan and Willekens (2012) assume a positive association between audit fees and the difference between the incumbent's and the closest competitor's market shares, irrespective of whether the competitor's market share is smaller or larger than the incumbent's market share. Chu et al. (2018), in contrast, argue that the largest audit firms in a market—not the smaller audit firms—exert the greatest pricing pressure. Moreover, Chu et al. (2018) argue that considering client-specific competition measures is important. Thus, they propose the "client's number of potentially efficient audit firms" as a measure. An audit firm is a potential supplier if the total audit fees this audit firm earns in the client's market are not lower than the incumbent's audit fees. Moreover, Chu et al.

(2018) use the measure “auditor size difference”, which is defined as the largest auditor’s total fees in a market less the incumbent’s total fees in a market, divided by the total audit fees in a market. Chu et al. (2018) find that the coefficient on the measure of Numan and Willekens (2012) is non-significant in a model that considers the measure introduced by Chu et al. (2018).

II.3. Empirical findings on the level of audit market concentration at the national level

The empirical findings regarding an audit market’s degree of concentration at the country-level crucially depend on the definition of the market segment considered. For example, the national audit market is split into the for profit and the not-for-profit sector. Within the for profit sector, one can distinguish between unlisted (private) and listed (public) companies, which can be further divided into stock market indices and industry sectors. The definition of an audit market depends on the substitutability of the services provided. A commonly used market definition thus is the market for statutory audits of (1) all listed companies included in a stock market index, (2) all companies listed on the main regulated market of a country, (3) all public companies, (4) companies of a certain size or from a certain industry, etc. (Oxera Consulting Ltd. (2007), p. 164ff).

Of course, the results of concentration studies also depend on the sample period, the metric used, and the calculation of the market shares (i.e., based on audit fees, on assets or revenues being audited, or on the number of audit clients). These limitations must be taken into account in the comparison of concentration over time, across countries, and/or across market segments.

Although the values obtained for the concentration measures differ, numerous studies confirm the qualitative result of a high level of concentration in industrial countries’ national markets for statutory audits of large listed companies. This market segment is a tight oligopoly where mid-tier and smaller audit firms face significant barriers to entry into the market.

II.3.1. Cross-country studies on audit market concentration

Table 1 summarizes some of the results obtained from cross-country studies on audit market concentration. As mentioned above, the values for the concentration measures cannot directly be compared across these studies or over time. However, although there is some heterogeneity across the countries considered, the evidence indicates that the vast majority of the national audit markets shows a high to very high degree of concentration.

Ballas and Fafaliou (2008) investigate the structure of the audit markets of 15 EU Member States. Their sample consists of 18,209 client-year observations from public companies and covers the period 1998–2004. Since Ballas and Fafaliou (2008) use the number of clients audited to calculate audit firms’ market shares, they report comparatively low values for the concentration ratio. The mean values for the CR_4 indicate that the highest concentration can be found in Luxembourg, Spain, the Netherlands, and in Sweden, whereas the national audit markets in France and in Germany are considerably less concentrated. Overall, the findings indicate the presence of an oligopolistic market structure in most of the countries.

Ewert and London Economics (2006) provide evidence for the concentration in the market for statutory audits of all domestic companies listed on the regulated market in several EU Member States for the year 2004. Since the values for the CR_4 (based on the revenues being audited) exceed

the critical value of 70%, the four largest audit firms seem to dominate the national markets for statutory audits of listed companies in every EU Member State included in the study. The corresponding values for the *HHI* are above 0.25 for Austria, Belgium, the Czech Republic, Germany, Hungary, Ireland, Italy, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Slovakia, Slovenia, and Spain. The audit markets of these EU Member States seem highly concentrated. For the remaining countries included in the study (Cyprus, Denmark, Estonia, France, Greece, Latvia), the value for the *HHI* based on clients' revenues exceeds 0.15, which still points towards moderate concentration. The concentration measures are of course higher if the segment of statutory audits for the companies included in the main stock exchange index of a country are considered.

Francis et al. (2013) report values for the *CR*₄ (calculated as the percentage of total clients audited by the Big 4 firms within a country-industry-year) and the *HHI*₄ (based on total client sales audited by each Big 4 audit firm in a country-industry-year) for a sample of larger listed companies in 42 countries (1999–2007). Francis et al. (2013) document a mean value for the *CR*₄ of 59%. Among the countries with a low absolute concentration are China, Poland, and Greece, whereas Spain and Hungary show comparatively high values. The *HHI*₄ of the four largest audit firms has a mean value of 0.65 and is comparatively low in Singapore and in the United Kingdom,⁴ but rather high in Columbia, Argentina, and Poland.

Le Vourc'h and Morand (2011) also analyze the market segment of statutory audits of those companies listed on the regulated market of an EU Member State. For 2009, Le Vourc'h and Morand (2011) document values of the *CR*₄ (based on the turnover of the company being audited) of 100% for Malta and Sweden; of more than 95% for Denmark, Finland, Germany, Hungary, Ireland, Italy, Lithuania, Luxembourg, Slovakia, Spain, and the United Kingdom; of more than 90% for the Netherlands and Portugal; of more than 80% for Austria, Belgium, the Czech Republic, France, and Poland; and of more than 70% for Greece. The values for the *HHI* (based on the client's turnover) are above 0.25 (indicating a critical level of concentration) for Denmark, Finland, Germany, Hungary, Ireland, Italy, Lithuania, Luxembourg, Malta, Portugal, Slovakia, Spain, Sweden, and the United Kingdom, and above 0.15 (indicating moderate to high concentration) for Austria, Belgium, the Czech Republic, France, Greece, the Netherlands, and Poland.

Willekens et al. (2019) analyze a sample of 32,638 client-auditor-year observations from statutory audits of listed public interest entities in 28 EU Member States. The authors document heterogeneity in the *CR*₄ and in the *HHI* (both based on audit fees) across the EU Member States both before (2013–2015) and after (2017) the EU Audit Reform. The *HHI*, for example, seems rather low during the entire sample period for Poland and France, but rather high for Hungary and Slovakia.

⁴ Oxera Consulting Ltd. (2006) provide an analysis of a sample of more than 700 UK-listed companies (1995–2004). The results indicate that in 2005, the Big 4 audited 99% (96.8%) of the FTSE 100 (FTSE 250) companies. The corresponding values for the *HHI*, based on audit clients, were 0.29 (FTSE 100) and 0.25 (FTSE 250), respectively. If audit fees are used to calculate the market shares, the values for the *CR*₄ (*HHI*) in 2004 are 100% (0.28) for the FTSE 100 and 96.9% (0.26) for the FTSE 250.

	Ballas and Fafaliou (2008)		Ewert and London Economics (2006)	Francis et al. (2013)		Le Vour'h and Morand (2011)	
	<i>CR</i> ₄ (clients)		<i>CR</i> ₄ (revenues)	<i>CR</i> ₄ (clients)	<i>HHI</i> ₄ (sales)	<i>CR</i> ₄ (turnover)	<i>HHI</i> ₄ (turnover)
	1998	2004	2004	1999–2007	1999–2007	2009	2009
Argentina				47	0.96		
Australia				71	0.46		
Austria	50	73	93	50	0.67	83	0.23
Belgium	62	62	96	54	0.63	89	0.23
Brazil				51	0.66		
Canada				69	0.47		
Chile				77	0.70		
China				17	0.64		
Colombia				73	0.91		
Cyprus			90				
Czech Republic			94			90	0.24
Denmark	78	69	77	83	0.61	96	0.35
Estonia			94				
Finland	82	80		75	0.75	99	0.40
France	58	44	71	45	0.52	81	0.18
Germany	45	58	92	40	0.54	97	0.33
Greece	60	74	73	33	0.67	73	0.17
Hong Kong				72	0.69		
Hungary			99	93	0.64	98	0.39
Indonesia				44	0.62		
Ireland	80	93	99	79	0.74	98	0.30
Israel				42	0.76		
Italy	85	93	100	86	0.60	98	0.28
Latvia			81			87	0.22
Lithuania			93			95	0.31
Luxembourg	100	90	96	78	0.83	99	0.45
Malaysia				53	0.43		
Malta			100			100	0.28
Mexico				70	0.54		
Netherlands	87	91	100	82	0.55	91	0.24
New Zealand				57	0.69		
Norway				74	0.64		
Peru				55	0.68		
Philippines				42	0.87		
Poland			83	30	0.98	88	0.23
Portugal	53	72	93	44	0.82	94	0.32
Russia				40	0.73		
Singapore				72	0.41		
South Africa				45	0.54		
Slovakia			100			97	0.53
Slovenia			100				
Spain	86	92	99	86	0.64	99	0.41
Sweden	80	91		79	0.53	100	0.35
Switzerland				76	0.64		

Taiwan				74	0.52		
Thailand				40	0.60		
Turkey	77	85		58	0.70		
United Kingdom				50	0.42	99	0.30
Venezuela				65	0.81		

Table 1: Concentration measures as documented in cross-country studies

II.3.2. Audit market concentration in the United States

Zeff and Fossum (1967) were the first to address audit market concentration. From descriptive statistics of the market shares that audit firms obtained in 1964 from auditing the largest industrials, merchandising, transportation, and utilities companies (based on clients' sales, assets, and (net) income), Zeff and Fossum (1967) conclude that audit firms have built up industry specializations. The authors do not provide concentration measures, but the CR_4 for the whole sample (based on clients' sales) can be calculated to 63.8% (see Zeff and Fossum (1967), Exhibit I-A), pointing to a rather high level of concentration already in the 1960s. Rhode et al. (1974) present a replication of the study of Zeff and Fossum (1967) for data from 1971. The corresponding CR_4 of 63.5% (calculated from their Exhibit I-A) suggests that the market dominance of the largest four audit firms remained stable. The CR_8 (based on clients' sales) increased only slightly from 94.8% in 1964 (Zeff and Fossum (1967)) to 96.4% in 1971 (Rhode et al. (1974)). Moreover, market leadership within an industry remained remarkably constant.⁵

Analyzing a significantly larger number of clients than Zeff and Fossum (1967) and Rhode et al. (1974) from 54 industries for the year 1977, Eichenseher and Danos (1981) find that audit market concentration in the U.S. is higher in regulated than in non-regulated industries, which suggests the existence of economies of scale in the production of audit services. Eichenseher and Danos (1981) use the square root of a client's revenues as a proxy for audit fees to determine market shares, which are used as inputs for the CR_4 (mean 0.66%) and the HHI (mean 0.149). From analyzing auditor choice decisions of 299 clients between 1964 and 1980, Danos and Eichenseher (1986) also conclude that the combined Big 8 market share is rather stable over time, that is, competition between the Big 8 and smaller audit firms seems less pronounced. However, the Big 8 client percentages in 1950, 1960, 1970, and 1980 indicate that there is competition among the Big 8. Danos and Eichenseher (1982) document that the changes in the audit firms' industry market shares between 1972 and 1979 (based on clients' assets) depend on their initial industry market shares, their overall involvement in the audit market, and the regulatory nature of the client's industry.

Today, the market for statutory audits of large public companies in the U.S. also shows a high level of concentration. Thus, the United States Government Accountability Office (2003) states that "by any measure, the large public company audit market is a tight oligopoly" (p. 16). Using data from *Who Audits America* for public companies (1988–2002), the United States Government Accountability Office (2003) computes a CR_4 of 63% for 1988 (based on the sales being audited). During that time, the four largest audit firms had four significant competitors who audited 35% of the public company sales (i.e., the U.S. audit market was dominated by the Big 8). In 1997, the CR_4 increased to 71%, and the two remaining significant competitors had a combined market share

⁵ Schiff and Fried (1976) and Dopuch and Simunic (1980) use an approach similar to that of Zeff and Fossum (1967) for data of 1973 and 1975, respectively.

of only 28%. Finally, in 2002, the four dominant firms further increased their combined market share to 99%, which left no room for significant competitors. The values for the CR_4 based on the number of public company clients are lower, but still increased from 51% in 1988 to 65% in 1997 and to 78% in 2002. In a follow-up report, the United States Government Accountability Office (2008) uses SEC-filings of public companies to calculate the values for the CR_4 based on audit fees.⁶ From the observed decrease in the CR_4 from 96% in 2002 to 94% in 2006, the United States Government Accountability Office (2008) concludes that—although concentration has slightly decreased—the market segment still is a tight oligopoly. In 2006, the HHI based on audit fees was 0.23. However, the United States Government Accountability Office (2008) observes a negative association between the degree of market concentration and client size. Interestingly, the proportion of smaller public companies hiring one of the Big 4 audit firms sharply decreased between 2002 and 2006. Since smaller public companies hired smaller audit firms as successors to the Big 4, concentration in this market segment has significantly lessened: For example, the HHI based on audit fees for the market segment of audits of companies with revenues of less than USD 100 million decreased from 0.14 in 2002 to 0.08 in 2006.

II.4. Reasons for why today's level of audit market concentration is high

From the overview above, it becomes apparent that today, the market segment of statutory audits for listed companies—both at the national level of European countries and in the U.S.—is highly concentrated. The values observed for various concentration measures exceeded critical thresholds already in the 1960s. However, during the last decades, audit market concentration has further increased (for the UK, see Oxera Consulting Ltd. (2006) and Abidin et al. (2010), p. 191; for the U.S., see United States Government Accountability Office (2003), p. 15ff). Several factors have led to the currently high degree of concentration in the audit market:

II.4.1. Supply-side effects

Audit firm mergers in the 1980s and 1990s have decreased the number of the major audit networks from eight to four (see United States Government Accountability Office (2003), p. 10f; Feldman (2006), p. 194; United States Department of the Treasury (2008), p. V:4 ff; UK Competition Commission (2013), p. 24f). In 1987, the Big 8 audit firm Peat Marwick Mitchell and the non-Big 8 audit firm KMG Main Hurdman formed KPMG Peat Marwick. In 1989, the merger between Ernst & Whinney and Arthur Young, both Big 8 audit firms, resulted in the creation of Ernst & Young. In the same year, the Big 8 audit firms Touche Ross and Deloitte Haskins & Sells merged to form Deloitte & Touche. These mergers reduced the market to the Big 6. In 1998, the Big 6 firms Coopers & Lybrand and Price Waterhouse merged to form PricewaterhouseCoopers, so that the Big 5 remained.

Sullivan (2002) discusses four merger theories that explain audit firms' motivations to merge. First, the effect of a merger could be the reduction of marginal costs for the merged firm. Sullivan (2002) lists several channels through which audit firms with a larger client base can achieve marginal cost

⁶ FRR No. 56 requires SEC registrants to publicly disclose audit fees for the latest fiscal year in proxy statements filed with the SEC on or after February 5, 2001 (Securities and Exchange Commission (SEC) (2000)). FRR No. 68 requires fee disclosure for two fiscal years (Securities and Exchange Commission (SEC) (2003)).

reductions (e.g., more areas of specialized knowledge about clients' industries, tax laws, and accounting standards; scale economies through greater division of labor and thus increased labor productivity; increased number of geographic locations, etc.). Second, marginal cost reductions could be stronger for large clients than for small, regional clients. Third, since mergers reduce the number of suppliers, mergers could facilitate collusion among rivals, for example, the coordination of pricing strategies. Forth, mergers could lead to unilateral price increases if a firm merges with a rival that had previously constrained its price. If the first two effects are the rationale behind a merger, the merger enhances efficiency, whereas the merger could be regarded as anticompetitive if the last two arguments are its main driver.

Sullivan (2002) tests these merger theories by using a sample of observations from 1,978 publicly owned firms, spanning the period from 1985 to 1997. Sullivan (2002) concludes that the Big 8 mergers between Ernst & Whinney and Arthur Young to form Ernst & Young and between Touche Ross and Deloitte Haskins & Sells to form Deloitte & Touche reduced the merged firms' marginal costs of auditing large clients who switched their statutory auditor after the mergers. This finding is in line with the argument that these mergers were mainly driven by the quest for synergies and economies of scale (see Ewert and London Economics (2006), p. 33f; United States Government Accountability Office (2003)): In order to improve their audit technology, infrastructure, and staff training and development, audit firms required large amounts of investment capital. However, due to their partnership structure, audit firms were mainly dependent on the financial resources that their partners provided (for an analysis of European audit markets, see Oxera Consulting Ltd. (2007)). Thus, it was essential to enlarge the network in order to spread the investment costs across more partners. Moreover, it was necessary for audit firms to build up expertise to meet the needs of their clients, which were growing in size and global reach. In addition to expanding the number of offices available internationally, audit firms believed that network affiliation made it easier to keep up to date with country-specific accounting and tax issues. Since each of the former Big 8 audit firms had a specific country and/or industry specialization, the mergers led to the bundling of capacities. Another goal pursued with the mergers was to achieve economies of scope, that is, to be able to offer to clients a broader range of management consulting services.

Sullivan (2002) also finds that while the share of large clients acquired by the merged firms increased after the merger, the share of small clients won by the merged firms decreased. Put differently, the merged firms restructured their client portfolio. Therefore, it is reasonable to assume that the mergers have increased the level of concentration. Several studies have analyzed the mergers' effect on market structure. In line with the conclusion of Sullivan (2002) that the mergers were efficiency-enhancing instead of anticompetitive, the general impression from these studies is that the mergers increased concentration, but did not negatively affect competition:

Using data from the period 1983–1988, Minyard and Tabor (1991) calculate values for the adjusted *HHI* that corrects the *HHI* for the expected market shares (based on the square root of the clients' revenues) in case the *n* largest audit firms share the market equally (i.e., $HHI_{adj} = HHI - (1/n)$). The authors examine the potential impact of the mergers occurring in 1989 (Ernst & Whinney and Arthur Young, and Touche Ross and Deloitte Haskins & Sells) and of the proposed combination of Arthur Andersen and Price Waterhouse (which had finally not been conducted) on audit market concentration in the U.S. They conclude that the consummated mergers “had little, if any, impact on competition within the market structure for auditing services provided by large firms” (Minyard and Tabor (1991), p. 88). In contrast, the proposed merger of Arthur Andersen and Price Waterhouse would have increased relative concentration. However, Minyard and Tabor (1991) interpret

only an increase in the *HHI* above the threshold $(1/N_{pre-merger}) - (1/N_{post-merger})$ as an indication of a higher level of concentration, irrespective of the fact that the number of suppliers has decreased.

Tonge and Wootton (1991) examine the impact of the Big 8 mergers conducted in 1989 on concentration in the market segment of audits provided to large companies listed on the New York Stock Exchange (NYSE) or on the American Stock Exchange (ASEX) or traded on the U.S. Over the Counter Market (OTC). Based on data from 1988, Tonge and Wootton (1991) calculate audit firms' pro forma market shares based on (1) their clients' market value (outstanding shares times the closing April 27, 1989 market price), (2) the number of clients, and (3) their clients' revenues. Tonge and Wootton (1991) compare the market shares of the Big 8 and the four largest audit firms, respectively, under the assumption that no mergers had occurred, with the market shares of the new largest eight and four firms, respectively. They conclude that the mergers did not decrease competition among the resulting Big 6 audit firms. However, Tonge and Wootton (1991) find that concentration had increased over time. Wootton et al. (1994) also analyze the effects of the mergers on concentration in the U.S. audit market and conclude that—although concentration ratios had increased—competition within the Big 4 became more balanced.

Hogan and Jeter (1999) analyze data from the period 1976–1993 to examine the effect of the mergers that in 1989 formed the Big 6 on the structure of the U.S. audit market. The authors find that the CR_3 at the industry level (based on total assets) had significantly increased during the 18-year period studied. Moreover, Hogan and Jeter (1999) document significant increases in industry concentration levels for non-regulated industries; the concentration levels of regulated industries constantly remain at a high level. Hogan and Jeter (1999) also find that the CR_3 is significantly higher in industries with greater client-firm concentration and in rapidly growing industries but lower in industries with a greater litigation risk. Hogan and Jeter (1999) also provide evidence that the market leaders continue to increase their market shares, whereas the Big 6 audit firms with comparatively smaller industry market shares lose market shares over time.

Francis et al. (1999) examine market leadership and industry expertise at the city-level. Based on data for 3,777 publicly listed companies from 145 cities for 1988 (before the Ernst & Young and the Deloitte & Touche merges) and 3,125 observations from 148 cities for 1990 (after the mergers), the authors document that the Big 8 had a combined market share of 80.5% of clients before the merger, whereas the Big 6 had 81.9% after the merger. Although concentration at the national level remained quite stable, the dominant audit firm changed. The city-level analysis shows that the Ernst & Young merger can be described as a “leadership merger”: The primary effect was to increase market share in cities where Ernst & Whinney and Arthur Young already operated, which, in turn, increased the number of cities in which Ernst & Young dominated the market. In contrast, the Deloitte Touche merger can be seen as a “coverage merger” that increased the total number of city markets in which the firm operates.

The United States Government Accountability Office (2003) concludes from the trend of the *HHI* (based on the number of public company clients) that has been constructed from data published by *Who Audits America* (1988-2002) that the mergers of 1989 and 1998 have increased concentration.

Choi and Zéghal (1999) extend their analysis beyond the U.S. market. For Canada, Denmark, France, Germany, Italy, the Netherlands, Sweden, Switzerland, the United Kingdom, and the United States, they compare the values obtained for the CR_4 , the CR_6 , the CR_8 , and the *HHI* between 1986 (pre-merger period) and 1991 (post-merger period). Since the authors consider 1986 as the pre-merger period, they take into account also the effect of the merger between Peat Marwick

Mitchell and KMG Main Hurdman. Choi and Zéghal (1999) use data from 229 (for 1986) and 214 (for 1991) audit firms and use their total revenues as a proxy for their market shares. Thus, Choi and Zéghal (1999) analyze the effect of the mergers on the aggregate audit market instead of on a sub-segment. The results indicate that the large audit firms dominated the market before the mergers in ten countries, and that the mergers contributed to a further increase in absolute concentration. This effect was particularly noticeable in the European market (excluding the United Kingdom). However, in France, Italy, Switzerland, and in the U.S., the mergers led to a more balanced market share distribution among the largest audit firms. In Canada, Denmark, Germany, Sweden, and in the United Kingdom, in contrast, the market share distribution was more imbalanced after the mergers.

The latter result for the United Kingdom is confirmed by Oxera Consulting Ltd. (2006), who document that the *HHI* based on audit fees increased from 0.18 before the merger of Coopers & Lybrand and Price Waterhouse in 1998 to 0.26 after the merger. McMeeking et al. (2007) calculate the *CR*₈ (1985–1989), the *CR*₆ (1990–1996), the *CR*₅ (1997–1999), the *CR*₄ (2000–2002), and the *HHI*, based on the number of clients and on audit fees, before and after the mergers of Arthur Young and Ernst and Whinney (1989), Coopers and Lybrand and Deloitte, Haskins and Sells (1990), Price Waterhouse and Coopers and Lybrand (1997), and the demise of Arthur Andersen (2002). They find that the merger activity is associated with more intense concentration: For example, between 1985 and 2002, the *CR*₄ based on the number of clients (based on audit fees) increased from 45% to 80% (from 59% to 88%), and the correspondig *HHI* increased from 0.13 to 0.22. (0.13 to 0.23).⁷

II.4.2. The demise of Arthur Andersen

In June 2002, the Big 5 audit firm Arthur Andersen was convicted of obstruction of justice for shredding documents related to the Enron scandal occurring in 2001. Consequently, Arthur Andersen lost its auditing license in the U.S. The disappearance of Arthur Andersen from the market reduced the number of dominant players to the “Final Four”. Several studies have analyzed the effect of the demise of Arthur Andersen on the structure of the audit market:

Directly after Arthur Andersen’s exit from the market, Beattie et al. (2003) study its impact on audit market concentration in the United Kingdom, where Deloitte & Touche acquired Andersen UK. Based on a sample of all companies listed on the London Stock Exchange at April 2002, Beattie et al. (2003) document values for the *CR*₄ based on audit fees (based on audit clients) of 89.6% (66.6%). Assuming that Deloitte & Touche would be able to take over all of the former Andersen UK clients, Beattie et al. (2003) calculate the *CR*₄ for 2003, based on audit fees (based on audit clients), to 96.3% (72.8%). The authors conclude that the acquisition of Andersen UK would have a significant impact on (absolute) concentration. However, the timely study of Beattie et al. (2003) is based on pro-forma figures and covers a period that is too short for the acquisition’s effect on concentration to completely unfold. In a later study, Abidin et al. (2010) consider a period that covers the actual effects of both the merger of Coopers & Lybrand and Price Waterhouse and the demise of Andersen UK. For a sample of 9,006 domestic companies listed on both the main and AIM markets of the London Stock Exchange for the period 1998–2003, Abidin et al. (2010) calculate the *CR*₄, the *HHI*, and the Gini coefficient based on audit fees and on the number of audit

⁷ Pong (1999) also presents a study on the effect of increased consolidation on concentration in the audit market in the United Kingdom.

clients, respectively. They find that the CR_4 (based on audit fees and on the number of clients) increased over the six-year period, and that the increase in the CR_4 based on audit fees is statistically significant at the 1% level. The HHI based on audit fees is above 0.25 in every year studied, indicating “a highly concentrated audit market with potential for significant market power” (Abidin et al. (2010), p. 196). The values for the Gini coefficient are also very high over the six-year period. However, the values for the HHI and the Gini coefficient for the whole market indicate a slight decline in the relative concentration between 1998 and 2003. Since Deloitte & Touche was able to increase its market share considerably (both in terms of audit fees and the number of audit clients), the market share distribution among the “Final Four” was more balanced after Deloitte’s acquisition of Andersen UK than before. Oxera Consulting Ltd. (2006), in contrast, finds an only temporary effect of the dissolution of Arthur Andersen on the HHI based on audit fees. However, the CR_4 based on audit fees permanently increased from 87.8% in 2001 to 97% in 2002.

Extending the number of audit markets studied, Ballas and Fafaliou (2008) compare the market shares of the four largest audit firms (i.e., the CR_4 based on the number of audit clients) for 15 EU Member States (i.e., Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom) before and after the demise of Arthur Andersen (1998–2001 and 2002–2004, respectively). Their results indicate that the average concentration had increased in 12 but decreased in three countries. The concentration ratio for the aggregate sample increased from 62.0% before to 70.6% after Arthur Andersen’s dissolution.

In the U.S., Arthur Andersen’s business was dissolved. KPMG Peat Marwick, Ernst & Young, and Deloitte & Touche each acquired some of Arthur Andersen’s offices, and all of the large audit firms faced significant competition for the former Arthur Andersen clients (Kohlbeck et al. (2010)). Particularly for the U.S. audit market, it is difficult to disentangle the effects resulting from the collapse of Arthur Andersen and those resulting from the passage of the Sarbanes Oxley Act (United States House of Representatives (2002), SOX hereafter). SOX might have an effect on concentration (see Paragraph II.4.4) since it raised the costs incurred by audit firms by increasing regulatory scrutiny, tightening the rules regarding auditor independence (e.g., by banning the provision of a number of non-audit services to audit clients), requiring stricter compliance with auditing standards, and increasing the sanctions for auditor misconduct.

Using data from *Who Audits America* (1988–2002), the United States Government Accountability Office (2003) document that in 2002 the HHI (based on the number of public clients) increased steeply to 0.26. Comunale and Sexton (2003) delve into the switching patterns of the former Arthur Andersen clients. The authors compare the market shares of the remaining Big 4 audit firms (measured as the percentage number of S&P 500 clients) observed after the decline of Arthur Andersen with those estimated by a Markov model. Using U.S. data from 1995–1999 as an input, the Markov model takes into account audit firms’ probabilities to retain their existing clients and to attract new clients as well as the clients’ probabilities to switch among the large audit firms. The results indicate that Deloitte & Touche (PricewaterhouseCoopers) attracted significantly more (fewer) of the 73 Arthur Andersen S&P 500 clients than expected. Ernst & Young and KPMG Peat Marwick, in contrast, were able to acquire roughly the predicted number of clients. Comunale and Sexton (2003) assign the differences between the estimated and the observed market shares to the reputational effects resulting from the fact that the remaining Big 4 audit firms were also facing investigations. However, although the demise of Arthur Andersen had increased the absolute concentration, it did not result in an excessive increase in relative concentration. Dunn et al. (2011) compare the market

share distribution at the national-industry level, the city level, and the city-industry level among the Big 5 prior to the collapse of Arthur Andersen to the market share distribution among the Big 4 as established in 2007. For a sample of 47 industry-observations from 2001 and 2007, Dunn et al. (2011) determine the Gini coefficient and the adjusted $HHI_{adj} = HHI - (1/n)$ as proposed by Minyard and Tabor (1991) to measure relative concentration. The authors conclude that changes in both the Gini coefficient and the adjusted HHI between 2001 and 2007 indicate that the market share distribution among the remaining Big 4 audit firms became more balanced at both the national-industry level and the city-industry level. The Gini measure suggests more equality at the city level. These findings are in contrast to those of Feldman (2006), who analyzes data from 1,071 publicly traded U.S. companies for the years 2000–2002 and documents a substantial increase in relative concentration as measured by the HHI based on audit fees. In addition, Dunn et al. (2011) propose a measure of the commonality of auditors among the largest four clients in each industry. $COMMON_4$ takes on the value of one if each of the four largest firms in the industry uses a different auditor, two if the four firms use three different auditors, three if the four firms use two different auditors, and four if each of the four firms has hired the same auditor. The authors find an increase in the commonality of auditors at both the industry and city-industry level, suggesting an increased frequency of the largest four clients to hire the same auditor(s).

II.4.3. Demand-side effects

As regards the demand-side, clients seem to have preferences for the leading international audit networks (see Ewert and London Economics (2006), p. 33f; Oxera Consulting Ltd. (2006); UK Competition and Markets Authority (2019), p. 89ff). These preferences can be explained with the leading audit networks' capability to audit geographically dispersed companies in a globalized economy, their higher expertise in the clients' characteristics, their reputation with external addressees, and their liability. Moreover, audit committees are likely to hire one of the Big 4, partly because they risk criticism for hiring smaller audit firms in case of audit failures, partly because audit committee chairs are often alumni of one of the Big 4. For example, Smith (2008) documents for the United Kingdom that almost two thirds of the FTSE 100's audit committee chairs are alumni of the Big 4, whereas exactly none of these positions are filled with alumni of the mid-tier audit firms.

Empirical studies find strong evidence for a price premium of the Big 8/6/5/4 audit firms (see the meta-analyses of Hay et al. (2006) and Hay (2013)). Moreover, various studies document the existence of a price premium for industry specialists (Craswell et al. (1995); DeFond et al. (2000); Ferguson and Stokes (2002); Ferguson et al. (2003); Casterella et al. (2004); Francis et al. (2005); Basioudis and Francis (2007); Carson (2009); Zerni (2012); Goodwin and Wu (2014); Hay (2013)) and for audit firms that are differentiated from their closest competitors (Mayhew and Wilkins (2003); Numan and Willekens (2012)). Although these price premiums might partly result from the increased market power of the dominant, specialized, and differentiated audit firms, they certainly also reflect demand-side factors, at least to a certain degree.

Additional evidence for demand-side effects comes from the literature on voluntary auditor switching that documents that voluntary switches occur infrequently, and if so, mainly between the Big 4. For a sample of the S&P 500 clients during the period 1995–1999, Comunale and Sexton (2003) find that the retention probabilities of the large audit firms are uniformly high (98.37% to 99.32%).

Thus, clients tend to stay persistently with their incumbent audit firm. However, in case of an auditor change, clients seem to prefer certain audit firms to the competing audit firms (the large audit firms' attractiveness parameters range from 0.107 to 0.371).

However, recent evidence suggests that market share mobility has increased due to the regulators' attempts undertaken to increase competition in the audit market. Willekens et al. (2019) find that market share mobility has increased after the EU Reform Act (i.e., Directive 2014/56/EU and Regulation 537/2014). Similarly, the UK Competition and Markets Authority (2019) notes that switching rates in the United Kingdom (temporarily) increased after the implementation of an Order prescribing the mandatory tendering of audit contracts by the FTSE 350 companies at least every ten years (UK Competition and Markets Authority (2013)). A similar effect was observed after the implementation of the mandatory audit firm rotation at the EU-level at least every 20 years (UK Competition and Markets Authority (2019)). However, the switches occurred almost entirely between the Big 4 audit firms.

II.4.4. Audit market regulation

Decreasing the level of concentration is among regulators' goals (see Chapter IV). However, there is evidence that the introduction of new regulations and requirements itself can have an impact on the market structure:⁸

DeFond and Lennox (2011) argue that the implementation of SOX imposes proportionally higher costs on small and low-quality audit firms. In line with this view, DeFond and Lennox (2011) document that 607 (49%) of the 1,233 small audit firms with fewer than 100 SEC registrants as clients contained in their sample exited the market during the period 2001–2008.⁹ The majority of the exits took place between 2002 and 2004, that is, after passage of SOX in 2002 and the beginning of PCAOB inspections in 2003 (Public Company Accounting Oversight Board (PCAOB) (2003)). Remarkably, the exiting small audit firms provided lower quality than those who remained in the market (i.e., they were more likely to avoid peer reviews and inspections, and more likely to receive unfavorable peer review or inspection reports). Moreover, the exiting small audit firms were less likely to issue a going concern opinion (GCO) than the successor small audit firms. Thus, DeFond and Lennox (2011) conclude that the introduction of PCAOB inspections resulted in an increase in concentration, which, however, increased audit quality. For a sample of 1,469 audit firms with fewer than 100 SEC registrants as clients (2001–2008), Fargher et al. (2018) confirm the results of DeFond and Lennox (2011) that the market exits of small audit firms peaked between 2002 and 2004, and that the small audit firms exiting the market were less likely than their successors to issue GCOs.¹⁰ However, Fargher et al. (2018) question the quality-effect resulting from the exits. The authors find no evidence that clients had higher absolute discretionary accruals or a higher likelihood of restating their financial statements in the period in which they had been audited by a small audit firm exiting the market than when being audited by a small audit firm that succeeded

⁸ We provide an overview of empirical studies addressing the effects of specific regulations like MAR, the prohibition on the joint supply of AS and NAS, and JAs in Chapter V.3.

⁹ „Market exit“ means that these audit firms did not longer audit SEC clients and were not registered with the Public Company Accounting Oversight Board (PCAOB) anymore.

¹⁰ However, Huang et al. (2009) find that the likelihood that clients will choose a Big 4 audit firm as a successor following an auditor change was lower in the post SOX (2005–2006) than in the pre-SOX (2001) era.

the former auditor. To sum up, the concentration-increasing effect of SOX documented both by DeFond and Lennox (2011) and Fargher et al. (2018) does not necessarily lead to an increase audit quality.

There is also evidence that the implementation of SOX increased audit fees in the U.S. Huang et al. (2009) report an initial-year audit fee discount of about 24% for Big 4 clients in the pre-SOX era (2001). However, they find that after the implementation of SOX (2005–2006), the discount had changed to a premium of about 16%. Ghosh and Lustgarten (2006) document that there is a discount for Big 4 initial audit engagements in 2002, but not in 2003. Ghosh and Pawlewicz (2009) also document that the fee discount for Big 4 clients disappeared after SOX. However, both Ghosh and Lustgarten (2006) and Ghosh and Pawlewicz (2009) find that non-Big 4 audit firms offered discounts on initial audit engagements in both the pre- and the post-SOX period. More generally, Ghosh and Pawlewicz (2009) find that audit fees increased by more than 74% between 2000 and 2005. Alali et al. (2019) analyze Big 4 audit fee setting in the period between 2000 and 2001 (pre-SOX period) and the effects of the supply-shocks occurring between 2002 and 2003 (SOX period), between 2004 and 2006 (PCAOB AS2 period during which more audit effort was necessary), and 2007 (PCAOB AS5 period where the efficiency of audits of internal control were improved), as well as of the demand-side shock occurring in the period 2008–2010 (Great Recession period where clients suffered financial constraints) on audit fees charged by the Big 4. For a large sample of 46,035 firm-year observations, Alali et al. (2019) find that Big 4 audit fees significantly increased from the pre-SOX to the PCAOB AS2 period, but then decreased until the Great Recession period. Potential reasons for the increase in audit fees and the disappearance of the discount for initial audit engagements in the post-SOX years are audit firms' greater exposure to legal liability, the prohibition on the joint supply of AS and NAS (i.e., AS are less likely seen as a "loss leader" to obtain more profitable NAS contracts), and increased audit effort.¹¹ Moreover, for a reduced sample of 34,051 firm-year observations, Alali et al. (2019) show that the Big 4's pricing for small clients depends on the degree of concentration as measured with the *HHI* at the MSA-level, based on audit fees: If competition is low (i.e., if the *HHI* is above the median), the Big 4 are more likely to charge small clients a premium in the SOX period, in the PCAOB AS5 period, and in the Great Recession period.

Using data on statutory audits of listed public interest entities in 28 EU Member States, Willekens et al. (2019) compare the degrees of concentration and competition before (2013–2015) and after (2017) the EU Audit Reform (i.e., Directive 2014/56/EU and Regulation 537/2014). Willekens et al. (2019) document that the aggregate *HHI* based on audit fees is rather stable, with a range from 0.27 (2013) to 0.26 (2017). The aggregate *CR*₄ based on audit fees slightly decreased from 91.2% (2013–2015) to 89.8% (2017), that is, the combined market share of the non-Big 4 audit firms increased slightly (by about 1.4%) after the EU Audit Reform. The fact that the average EU market share that changed between audit firms increased from 3.2% in 2013–2014 to 7.6% in 2016–2017 points to an increase in competition. Further analyses reveal that the *HHI* (the *CR*₄) decreased in 13 (14) Member States, and market share mobility increased in 16 Member States after the implementation of the EU Audit Reform. The explicit objectives of the EU Audit Reform, namely to reduce concentration and to increase competition, do not seem to have been achieved in all EU Member States, and if so, not to a great extent.

¹¹ However, note that the demise of Arthur Andersen, which also might have affected concentration and competition, occurred simultaneously to the implementation of SOX.

The observation that absolute concentration is rather resistant to regulatory action also seems to apply to the United Kingdom: In 2014, an Order by the Competition and Markets Authority was introduced (UK Competition and Markets Authority (2013)), which requires that FTSE 350 companies must put their statutory audit out to tender at least every 10 years. The maximum tenure of the statutory auditor is 20 years. However, these requirements had essentially no effect on the dominance of the Big 4. In 2016, the Big 4 audited 99% (97%) of the FTSE 100 (FTSE 250) companies (UK House of Commons (2018)).

II.5. Summary

The overview of studies investigating audit market concentration at the national level indicates that the segment of statutory audits for listed companies today is highly concentrated. This result is valid for nearly all of the European countries and for the U.S. Although the audit market was significantly concentrated already in the 1960s, the levels of absolute concentration (i.e., the combined market share of the largest audit firms in a market) and of relative concentration (i.e., the inequality in the market share distribution across audit firms) have further increased.

Among the potential reasons for this development are the mergers between the dominant audit firms occurring in the 1980s and 1990s, the demise of Arthur Andersen after the Enron accounting scandal in 2002 and demand-side effects, but also stricter regulations affecting the audit function. Whereas the findings are largely consistent in that the mergers and the exit of Arthur Andersen led to an increase in absolute concentration, there is some evidence that these events resulted in a more balanced market share distribution (although at a high level of relative concentration). Clients' preferences for international audit firm networks, which are attributable to a broad range of reasons, have led over time to an accumulation of market shares among the major audit firms. Since clients' preferences are obviously relatively stable, concentration seems to be driven largely by demand-side factors. Moreover, the evidence on the effects of regulations—like the SOX and the EU Audit Reform—on concentration does not seem to indicate that these regulations helped to significantly increase competition. Thus, whether the current regulation (e.g., the implementation of MAR, the prohibition on the joint supply of AS and NAS, and mandatory JAs) ultimately will achieve these goals remains an empirical question.

III. POTENTIAL EFFECTS OF AUDIT MARKET CONCENTRATION

III.1. Introduction

Today, the national audit markets worldwide can be characterized as tight oligopolies where severe barriers to market entry exist for smaller audit firms. Regulators are increasingly concerned about the negative effects that a high level of concentration (and, consequentially, an assumed low degree of competition) could have on the efficient functioning of the audit market. New regulations are therefore often proposed with a view to the market structure.

In this chapter, we first present the regulators' objections to the fact that not even a handful of audit firms dominate the market. Among the concerns are low audit quality at excessive audit fees, market barriers to entry for smaller audit firms, and a systemic risk arising from the possibility that one of the Big 4 audit firms could exit the market. We then give an overview of empirical studies addressing the association between market concentration and both audit fees and audit quality. We provide this overview to help assess the regulator's concerns.

III.2. Regulators' concerns about audit market concentration

III.2.1. The assessment until the turn of the century

During the last decades, the assessment of both the connection between concentration and competition and the desirability of competition have been subject to change in the regulatory debate. When the Big 8 audit firms dominated the market, regulators were not concerned that increased concentration would soften competition in the audit market. On the contrary, the opinion was that competition between the Big 8 audit firms was more intense in the 1980s than ever before (Tonge and Wootton (1991)). Several authors agreed in this assessment (Hanson (1977), Bernstein (1978), Benston (1979-1980), Dopuch and Simunic (1980), Weston (1980), Hermanson et al. (1987), and Palmer (1989)). In particular, the concern was that concentration would lead to strong price competition, which was expected to have the following effects:

Audit firms apply a low-balling strategy to acquire new clients, that is, offer an initial audit fee that is significantly below the total expected costs the auditor would incur for auditing a new client. Once an audit firm has acquired a new mandate, it is able to increase the audit fees above the expected costs incurred for auditing an existing client, that is, to earn (quasi-)rents from an ongoing audit engagement. Among the reasons for the emergence of (quasi-)rents, the analytic audit literature discusses transaction costs (DeAngelo (1981a); DeAngelo (1981b)), an incumbent's private client-specific information about the recurring costs for auditing that client (Kanodia and Mukherji (1994)), asymmetric information about future audit costs and quality (Schatzberg and Sevcik (1994)), asymmetric information concerning the auditor's reporting behavior (Schatzberg (1994)), and cost differences between audit firms (Gigler and Penno (1995)). Low-balling is seen as the consequence of competitive pressure, since the present value of an audit engagement cannot be positive in a competitive environment.

Low-balling (i.e., pricing below cost) cannot be directly tested empirically, since information on audit costs is not available. However, the empirical literature finds (mixed) evidence for audit fee price-cutting, that is, a fee discount granted during the first period(s) of an audit engagement (for an overview, see Hay et al. (2006), Hay (2013), and DeFond and Zhang (2014)). Pricing initial engagements below costs raises the concern that audit quality will be lower in the first year of the auditor-client contractual relationship. Moreover, the assumption that the auditor views the discount as an investment to earn future returns leads to concerns about auditor independence, since an auditor who does not issue a clean opinion risks losing the client.

However, since the audit fee is sunk when auditors issue their audit opinion, there is—at least from a theoretical perspective—no reason to assume that a price discount would threaten independence and thus audit quality. However, there are circumstances where the existence of (quasi-)rents can cause independence issues. Magee and Tseng (1990), Dye (1991), Lee and Gu (1998), Zhang (1999) provide analytic models on this topic.

III.2.2. The assessment today

Today, there is exactly the opposite concern that concentration might actually *reduce* competition (Oxera Consulting Ltd. (2006); United States Department of the Treasury (2006); United States Department of the Treasury (2008); European Commission (2010); UK House of Lords (2010); European Commission (2011c); UK House of Lords Select Committee on Economic Affairs (2011); UK Competition Commission (2013); UK Competition and Markets Authority (2019)). Thus, regulators and policy makers in Europe, in the United Kingdom, and in the U.S. had requested high-level inquiries into the effects of market structure on the effectiveness of statutory audits. The resulting reports list a number of reasons why a high level of concentration might be a concern (United States Government Accountability Office (2003); Oxera Consulting Ltd. (2006); United States Department of the Treasury (2006); United States Department of the Treasury (2008); United States Government Accountability Office (2008)).

These reports did not find direct evidence that the observed level of concentration would exclude price competition (United States Government Accountability Office (2003); United States Department of the Treasury (2008); United States Government Accountability Office (2008)).¹² But the fact that only a few large audit firms are capable of auditing large public companies still raises the concern that the market leaders could exert their market power to earn excessive fees (European Commission (2010); UK Office of Fair Trading (2011)).¹³

Moreover, regulators discuss whether a high degree of concentration could lead to a decline in audit quality.¹⁴ This issue came up especially after the financial market crisis, where critical voices questioned the performance of the Big 4 audit firms. Regulators noted that the possibly low audit quality could be the result of a high degree of concentration, particularly in the financial sector (United States Government Accountability Office (2003); Oxera Consulting Ltd. (2006); Oxera Consulting Ltd. (2007); United States Department of the Treasury (2008); UK Competition Commission (2013)). However, the arguments leading to the concern that audit quality might be insufficient differ: On the one hand, the reasoning is that concentration results in a high degree of competition, so that audit firms would focus on cutting costs instead of on providing high quality (UK Competition and Markets Authority (2019), p. 78). On the other hand, the concern is that the market leaders would rely on the assessment that they are “too big to fail”, which decreases the incentive to exert sufficient audit effort (UK Competition Commission (2013)). As a consequence, audit regulation and tendering are considered necessary to ensure competition in quality.

Another aspect is that clients face the problem of a limited number of auditor alternatives (United States Government Accountability Office (2003); Oxera Consulting Ltd. (2006); United States Department of the Treasury (2006); United States Department of the Treasury (2008); United States Government Accountability Office (2008); European Commission (2010); UK House of Lords (2010); European Commission (2011c); UK House of Lords Select Committee on Economic

¹² For the United Kingdom, Oxera Consulting Ltd. (2006) find that the observed high level of market concentration has led to an increase in audit fees (see also UK Competition Commission (2013)).

¹³ Paragraph III.3.2 contains an overview of the empirical literature on the association between market structure and audit fees.

¹⁴ For an overview of studies addressing the association between market structure and audit quality, see Paragraph III.3.3.

Affairs (2011); UK House of Commons (2018)). Particularly large national and multinational public companies require audit firms with a sufficient number of audit staff, a high degree of industry-specific and technical expertise, a worldwide presence, and an international reputation (UK Competition and Markets Authority (2019), p. 77). Today, the options are thus restricted to the Big 4 audit firms. In jurisdictions where audit firm rotation is mandatory, the switching rule reduces the number of audit firms available to three, since the incumbent cannot participate in a tender. Potential conflicts of interest, the separation of AS and NAS, clients' preferences for appointing a different auditor than the closest competitor, and audit firms' decisions not to bid for audit contracts (e.g., in order to maintain or receive NAS contracts) can further reduce the number of alternatives (UK Competition and Markets Authority (2019), p. 84ff). In fact, the UK Competition and Markets Authority (2019) concludes from the observation that the audit committees of 25% of the 250 FTSE 350 companies had fewer than three credible competing bidders for an audit tender that "competition is, in these circumstances, fragile" (p. 76).

Further, smaller audit firms face severe barriers to entry into the market segment of audits for large national and multinational public companies (United States Government Accountability Office (2003); Oxera Consulting Ltd. (2007); United States Department of the Treasury (2008); United States Government Accountability Office (2008); European Commission (2010); European Commission (2011b); European Commission (2011c); UK Competition Commission (2013); UK Competition and Markets Authority (2019)). These barriers include a lack of staff, insufficient industry and technical expertise, shortage of capital to build the necessary infrastructure, restricted breadth of their networks, high litigation risks combined with a limited professional insurance availability or excessive insurance costs, lack of international reputation, and Big 4 clauses in some credit agreements. Accordingly, the United States Government Accountability Office (2003) concludes from simulations that a new audit firm resulting from mergers among smaller audit firms would not be able to effectively compete with the Big 4 for large national and multinational public companies. Thus, it seems rather unlikely that a rival to the Big 4 will emerge in the near future (Oxera Consulting Ltd. (2006)).

Finally, regulators are particularly concerned about the systemic risk arising from the failure of one of the Big 4 audit firms. The market exit of one of the Big 4 would decrease the stability of capital markets and harm investors' confidence (United States Department of the Treasury (2008); European Commission (2010); UK House of Lords (2010); European Commission (2011c); European Parliament and Council of the European Union (2011); UK House of Lords Select Committee on Economic Affairs (2011); UK Competition and Markets Authority (2019), p. 95ff). Using a discrete choice approach, Gerakos and Syverson (2015) find that the exit by one of the Big 4 audit firms in the U.S. would result in a loss of consumer surplus of USD 1.4–1.8 billion. These potential problems, in turn, might create an incentive for the regulator not to sanction a Big 4 audit firm should it perform poorly, as appropriate action might lead to the demise of the audit firm affected. However, the fact that the market leaders anticipate this strategy generates additional moral hazard problems in providing high audit quality (European Parliament and Council of the European Union (2011); UK Competition Commission (2013)). This argument applies even more as (potential) clients also do not seem to sanction the market leaders for poor performance. For example, the UK Competition and Markets Authority (2019), p. 80, observes that KPMG's market share (based on audit fees) in the FTSE 350 segment had remained fairly constant at around 20% between 2011 and 2017. In 2018, when KPMG announced its strongest growth in a decade, its market share increased to 25%. Concurrently, in its 2018 report, the UK Financial Reporting

Council (2018) reported “a deterioration in the quality of the audits that we inspected to an unacceptable level at one firm, KPMG” (p. 4).¹⁵

III.3. Empirical studies on the effects of audit market concentration

III.3.1. Structuralist view vs. efficiency view

The structure-conduct-performance paradigm, which dominated the traditional industrial organization literature until the 1970s, assumes that market structure (e.g., the number of competing firms and customers, supply and demand concentration, barriers to market entry, etc.) directly determines suppliers’ economic conduct (i.e., firms’ strategic behavior with respect to their investment activity, collusion, expansion, etc.). Conduct then has a *causal* effect on performance (i.e., the nature of product or service provided; product price, quantity, and quality; production efficiency; etc.). Conduct is not directly observed, but is inferred from performance. Performance, in turn, is assumed to indicate various degrees of competition. However, the structure-conduct-performance paradigm assumes that the level of concentration is *exogenous* to conduct.

The arguments put forward by the regulators are mainly in line with this structuralist view. According to the structure-conduct-performance hypothesis, an increase in audit market concentration would amplify the market power of the surviving audit firms. This would enable them to set higher prices for potentially lower-quality audits and to obtain higher profits (Oxera Consulting Ltd. (2006); European Commission (2010)), which would be regarded as a lack of competition. This view is consistent with the audit market functioning as a Cournot oligopoly (Ciconte et al. (2015)) where clients regard audits as a *homogenous product* and suppliers compete on *quantity*.

Research in the 1970s has shifted from the analysis of how market structure affects performance to the simultaneous analysis of market structure, conduct, and performance. The modern theory of industrial organization uses (non-cooperative) game theory to model firms’ strategic interactions. Since, in equilibrium, conduct, market structure, and performance are simultaneously determined, a clear prediction regarding the impact of concentration on competition is not feasible.

Applied to the audit market, the efficiency view could be regarded as the opposite position to the structuralist view (Pearson and Trompeter (1994); Danos and Eichenseher (1986); Numan and Willekens (2012)): Audit firms under competitive pressure aim at obtaining economies of scale or scope to be able to efficiently fulfill clients’ demand for high-quality audits. If only a limited number of audit firms is able to make the investments that are necessary to build specialist knowledge and/or to implement an efficient audit technology, concentration arises *endogenously* as a response to client demand. In this setting, the level of concentration cannot be regarded as a causal determinant of audit quality or audit fees. Thus, while concentration measures are good proxies for specific facets of market structure, their connection to competition and performance is far from straightforward (Dedman and Lennox (2009); Numan and Willekens (2012)).

Under the efficiency view, the effect of concentration on audit fees could be either negative (if audit firms pass on to their clients the cost savings) or positive (if clients are willing to pay higher fees for higher audit effort and quality). The efficiency view is in line with the assumption that the

¹⁵ Up to this point, the Financial Reporting Council had launched investigations into KPMG’s audit of Quindell (August 2015), Rolls Royce (May 2017), Carillion (January 2018), and Conviviality (July 2018).

audit market is a Bertrand oligopoly if audit firms are price-takers in a competitive market (Ciconte et al. (2015)). In line with this view, Dekeyser et al. (2019) and Willekens et al. (2020) argue that the audit market resembles a product-differentiated oligopoly with competition on *audit quality* and *audit fees*. Thus, the finding of a positive association between concentration (or audit firms' market shares) and audit fees could be either due to market power of the leading firms (which would be in line with both the structuralist view and the efficiency view) or due to product differentiation based on quality (which would be in line only with the efficiency view).

In the following paragraphs, we summarize the main findings of the empirical studies on the effects of concentration on audit fees (see Paragraph III.3.2) and audit quality (see Paragraph III.3.3). As can be seen from the overview, the focus has gradually shifted over time from the traditional industrial organization view to analyses that are more in line with the modern theory of industrial organization.

III.3.2. The association between concentration and audit fees

Some empirical studies confirm the hypothesis of a positive association between concentration and audit fees:

Menon and Williams (2001) use an U.S. sample of 1,330 firm-year observations from 249 Big 6 (Big 8) clients that voluntarily disclosed audit fees between 1980 and 1997. Menon and Williams (2001) find that audit fees were significantly higher in the period between 1983 and 1989 than in 1980, but that audit fees in the 1990s were not significantly different from audit fees in 1980. Moreover, Menon and Williams (2001) document a short-lived increase in audit fees after the mergers that in 1989 reduced the Big 8 to the Big 6. The authors obtain this result from including a dummy variable that takes the value of one if the auditor is Deloitte & Touche or Ernst & Young or one of the predecessors of these two firms in the audit fee regressions for the respective years.

Based on 7,255 firm-year observations covering the period 1985–2002, McMeeking et al. (2007) investigate audit fees in the United Kingdom before and after the mergers of Arthur Young and Ernst and Whinney (1989), Coopers and Lybrand and Deloitte, Haskins and Sells (1990), and Price Waterhouse and Coopers and Lybrand (1997), and the demise of Arthur Andersen (2002).¹⁶ More precisely, McMeeking et al. (2007) examine the price premiums that clients paid to the audit firms involved in the merger before and after the merger. As the focus is rather on the audit firm level than on the market level, McMeeking et al. (2007) do not consider concentration measures in their audit fee regression (although they report the values for various metrics). McMeeking et al. (2007) conclude that there is a positive association between concentration and audit fees. Further, McMeeking et al. (2007) find that the brand name reputation of the smaller audit firms increased after the merger with a larger audit firm. Thus, the authors assign the fee premiums more to product differentiation than to anti-competitive pricing.

The literature generally assumes that, due to a low degree of concentration, there is price competition in the small-client segment of the audit market (Dopuch and Simunic (1980)). Willekens and Achmadi (2003) use Belgian data on 59 (from 1989) and 93 (from 1997) privately owned companies to test this assumption. Willekens and Achmadi (2003) measure concentration with the CR_4 ,

¹⁶ In the United Kingdom, companies have to report audit fees since the implementation of the Companies Act of 1967.

the CR_6 , the CR_8 , and the HHI , based on the number of qualified professionals per audit firm and on the personnel cost per audit firm (as reported in the audit firms' financial statements), respectively. They find that, although concentration in the market segment studied is not significant both in 1989 and in 1997, the increase in concentration between these years is significant. Willekens and Achmadi (2003) also investigate whether, due to an increase in concentration, the extant audit-pricing model in this segment changed between 1989 and 1997:

$$(5) \quad LNAF = \alpha + \beta_1 \cdot MSHARE + \gamma' [Controls] + \varepsilon .$$

The authors collected data on audit fees (AF) through a survey. $LNAF$ is the natural logarithm of the audit fees, and $MSHARE$ is an auditor's market share based on either the audit firm's personnel cost or on the number of qualified professionals per audit firm, or a Big 8/6 dummy. The coefficient on $MSHARE$ is positive and significant both in the regressions for 1989 and 1997 and statistically significant at the 1% level. This finding suggests that audit firms exert market power also in the small-client segment of the audit market. However, the impact of $MSHARE$ decreased between 1989 and 1997, suggesting an increase in price competition.

Carson et al. (2012) make use of an Australian sample of 11,593 client-years representing 2,467 distinct publicly listed companies during the period 1996–2007. The advantage of this sample is that, different from other countries, the disclosure of audit fees was mandatory in Australia during the whole sample period. Moreover, the time span studied is sufficient to reflect a change in actual concentration. Carson et al. (2012) analyze the change in the Big N audit fee premium over the Big 6 (1996–1998), Big 5 (1999–2001), and Big 4 (2002–2007) periods:

$$(6) \quad BIGN_PREM = \alpha + \beta_1 \cdot PERIOD_{BIG5} + \beta_2 \cdot PERIOD_{BIG4} + \gamma' [Controls] + \varepsilon .$$

Carson et al. (2012) define the Big N premium ($BIGN_PREM$) as the difference between the natural logarithm of the actual audit fee paid to the Big N audit firm and the predicted audit fee in case the client had hired a non-Big N audit firm instead of the Big N (estimated separately for each Big N period). $PERIOD_{BIG5}$ ($PERIOD_{BIG4}$) is an indicator variable equal to one for audit engagements that occurred during the Big 5 (Big 4) period; the focus is thus more on the audit fee time-trend of the market as opposed to that of an audit firm. Carson et al. (2012) find that the Big N premium has increased during the Big 4 and Big 5 periods compared to the Big 6 period (the difference is significant at least at the 1% level). Although the premium is highest during the Big 4 period, the difference between the Big 5 and the Big 4 premium is not statistically significant. However, the growth in the Big N premium is not uniform across different client segments considered in the analysis. From the observation that the premiums paid to the industry leader declined as the number of Big N audit firms decreased, Carson et al. (2012) conclude that concentration diminished the economic advantage derived from industry leadership.¹⁷

Ciconte et al. (2015) analyze proprietary data about fees, costs, and profits from 125 individual audit engagements that a (then) international Big 6 audit firm had conducted in 1997 in the Netherlands. The research question is whether higher market concentration allows audit firms to earn superior profits:

¹⁷ Analyzing a proprietary data set consisting of the audit fees that 653 U.S. publicly held companies that were audited by the Big 6 had paid in 1993, Casterella et al. (2013) also find that specialists charge lower audit fees when there is concentration.

$$(7) \quad LNAF = \alpha + \beta_1 \cdot LNCONCEN + \gamma' [Controls] + \varepsilon,$$

$$(8) \quad LNAC = \alpha + \beta_1 \cdot LNCONCEN + \gamma' [Controls] + \varepsilon, \text{ and}$$

$$(9) \quad LNPROF = \alpha + \beta_1 \cdot LNCONCEN + \gamma' [Controls] + \varepsilon.$$

AF is the actual fees that clients paid to the audit firm. *AC* is audit costs, estimated based on the actual number of audit hours spent per staff level, times the individual internal hourly cost rate for each staff person, summed over all staff levels, and out-of-pocket costs. *PROF* is a profitability measure (i.e., *LNPROF* is defined as the natural logarithm of one plus the ratio of the audit fee to actual engagement costs). *CONCEN* indicates the *CR*₄, the *CR*₆, the *CR*₈, the *HHI*, or the audit firm's market share (computed using the number of auditors per firm) for the local markets "Randstad" and "the rest of the Netherlands". For the Randstad market, Ciconte et al. (2015) find that the concentration and market share measures are positively associated with the level of fees, but not with the level of auditor effort. *CR*₆ is positively associated with profitability. Ciconte et al. (2015) conclude that a Cournot oligopoly (Bertrand oligopoly) describes conduct in the audit market for large clients (for small clients).

Feldman (2006) analyzes data from 1,071 publicly traded U.S. companies for the years 2000–2002 and documents an increase in market concentration since the demise of Arthur Andersen. To test for an association between concentration and audit fees, Feldman (2006) uses the following stylized regression model

$$(10) \quad \% \Delta AF = \alpha + \beta_1 \cdot \% \Delta HHI + \beta_2 \cdot \% \Delta HHI \times HHI_{2001} + \gamma' [Controls] + \varepsilon,$$

where $\% \Delta AF$ is the percentage change in a client's audit fees between 2001 and 2002, and $\% \Delta HHI$ is the percentage change in the *HHI* in each audit market (defined by a 4-Digit SIC code) between 2001 and 2002. In line with the structure-performance hypothesis, Feldman (2006) finds a positive coefficient on $\% \Delta HHI$ that is statistically significant at the 5% level. However, the coefficient on $\% \Delta HHI \times HHI_{2001}$ (where HHI_{2001} is the 2001 value for the *HHI* of each market) is negative and statistically significant at the 10% level. Thus, audit fees decreased for clients in markets that were already highly concentrated in 2001, and in markets that experienced a large increase in concentration. This finding is in contrast to the structure-performance hypothesis. Moreover, the relatively short period examined was one of unprecedented turmoil, that is, equilibrium strategies eventually had not yet evolved.

Huang et al. (2016) analyze a sample of 12,334 firm-year observations from China for the period 2001–2011. The audit market in China is characterized by a low dominance of the Big 4, the presence of many small-sized audit firms, and intense price competition. Moreover, the regulatory environment and investor protection are comparatively weak. With the aim of improving audit quality, regulators have thus proposed regulations that were expected to increase concentration. Huang et al. (2016) estimate the association between concentration and audit fees with the following stylized regression model:

$$(11) \quad LNAF = \alpha + \beta_1 \cdot CONCEN + \beta_2 \cdot BIG4 + \gamma' [Controls] + \varepsilon.$$

AF is the audit fees. *CONCEN* is either the market share of the local top four audit firms in a city (as a group), based on audit fees (*MSHARE*_{top4}), the *HHI* based on the audit fees paid from listed clients to the local top four audit firms in a city-year (*HHI*_{top4}), or the *HHI* based on audit fees paid

from listed clients to all audit firms in a city-year (HHI). $BIG4$ is a dummy variable for the Big 4 audit firms. As the coefficient on $MSHARE_{top4}$ (HHI_{top4}) [HHI] is positive and significant at the 5% (1%) [1%] level, Huang et al. (2016) document a positive association between concentration and audit fees. In addition, the Big 4 and industry specialists earn a fee premium.

Based on an U.S. sample of Big 4 clients with 28,627 national-industry observations from 45 markets and 18,510 city-industry observations from 3,329 markets spanning the period 2004–2017, Dunn et al. (2019) examine the association between audit fees and the inequality in the Big 4 market share distribution both at the national-industry and the city-industry level. Dunn et al. (2019) hypothesize a U-shaped association between the inequality in the market share distribution and audit fees at the national-industry level: Consistent with tacit collusion, audit fees should be high when audit firms have equal market shares. When the market share distribution gets more imbalanced, audit fees should decrease due to increased competition. When large audit firms have obtained dominance, audit fees should increase again, since smaller suppliers are—due to their capacity constraints—weak competitors. To include non-linearity, Dunn et al. (2019) use the following stylized regression model:

$$(12) \quad LNAF = \alpha + \beta_1 \cdot GINI_{nat_ind} + \beta_2 \cdot (GINI_{nat_ind})^2 + \beta_3 \cdot GINI_{city_ind} + \beta_4 \cdot (GINI_{city_ind})^2 + \gamma' [Controls] + \varepsilon.$$

$GINI_{nat_ind}$ ($GINI_{city_ind}$) is the Gini coefficient for the Big 4, based on audit fees at the national-industry (city-industry) level. Dunn et al. (2019) document a U-shaped association between the Gini coefficient and audit fees at the national-industry level (i.e., $\beta_1 < 0$, $\beta_2 > 0$, both significant at the 1% level). At the city-industry level, where capacity constraints are less binding, results are directionally different (i.e., $\beta_3 > 0$, $\beta_4 < 0$, both significant at the 1% level).

For a sample of 39,255 client-year observations covering 90 U.S. MSAs for the period 2000–2013, Eshleman and Lawson (2017) estimate audit fees with the stylized regression model

$$(13) \quad LNAF = \alpha + \beta_1 \cdot CONCEN + \beta_2 \cdot CHANGE + \beta_3 \cdot BIG4 + \beta_4 \cdot SPEC_{nat} + \beta_5 \cdot SPEC_{city} + \beta_6 \cdot SPEC_{nat} \times SPEC_{city} + \gamma' [Controls] + \varepsilon.$$

$CONCEN$ is the MSA-level HHI based on audit fees, calculated separately for Big 4 and non-Big 4 audit firms. $CHANGE$ is an indicator variable that takes the value of one for clients that switch auditors (switching sample) and zero for clients with an ongoing auditor-client relationship (non-switching sample). $BIG4$, $SPEC_{nat}$, $SPEC_{city}$, and $SPEC_{nat} \times SPEC_{city}$ are indicator variables that take the value of one if the auditor is a Big 4 audit firm and has national-level specialization, city-level specialization, or both national- and city-level specialization, respectively. For the non-switching sub-sample, Eshleman and Lawson (2017) find that concentration is associated with significantly higher audit fees (but only for clients who do not need a SOX 404 audit). For the switching sub-sample, increases in concentration significantly reduce initial audit fee discounts (for the test, a changes model is used). As far as concentration decreases competition, this finding is in line with the argument that competition is a necessary condition for low-balling. Eshleman and Lawson (2017) also show that the positive effect of local audit market concentration on audit fees is more pronounced for smaller clients (e.g., for the clients of the non-Big 4 audit firms). Moreover, Eshleman and Lawson (2017) document that the difference between their findings and those of a

negative association between concentration and audit fees documented by Pearson and Trompeter (1994) and Numan and Willekens (2012) is driven by the consideration of MSA-level fixed-effects in the fee model. When these fixed-effects are included (not included), the association between concentration and audit fees is found to be positive (negative). This finding highlights the idea that the failure to account for factors that jointly determine concentration and audit fees might partly explain why the results on the association between concentration and audit fees are ambiguous.

Chang et al. (2019) examine the effect of changes in market concentration on the adjustment of audit fees to changes in audit costs. More precisely, Chang et al. (2019) expect upward stickiness of audit fees to be lower than downward stickiness, since auditors are assumed to quickly adjust audit fees upwards if audit costs increase, but to be reluctant to pass on decreases in audit costs to their clients. Chang et al. (2019) measure audit fee stickiness with the following regression:

$$(14) \quad \Delta LNAF = \alpha + \beta_1 \cdot \Delta LNE[AF] + \beta_2 \cdot I_{\Delta LNE[AF] < 0} \times \Delta LNE[AF] + \varepsilon .$$

$\Delta LNAF$ is the change between years $t-1$ and t in the logarithm of actual audit fees, and $\Delta LNE[AF]$ is the change between years $t-1$ and t in the logarithm of expected actual audit fees (as estimated with a standard audit fee model). $I_{\Delta LNE[AF] < 0}$ takes the value of one if $\Delta LNE[AF]$ is negative. A negative (positive) coefficient on β_2 then implies that audit fees are more (less) sticky downwards than upwards. Furthermore, Chang et al. (2019) predict a decline in upward stickiness (higher β_1) and an increase in downward stickiness (lower $\beta_1 + \beta_2$) as a response to increased concentration at the regional level. To test this hypothesis, Chang et al. (2019) run regression (14) separately for the periods 2002–2007 (period of lower concentration) and 2008–2016 (period of higher concentration) on a sample of 21,633 observations from Chinese listed companies, and compare β_1 and $\beta_1 + \beta_2$ across regressions. The results indicate that increased concentration is connected to faster upward adjustments of audit fees, as the difference in β_1 is significant at 1% (i.e., reduced upward stickiness), but to slower downwards fee adjustments as the difference in $\beta_1 + \beta_2$ is significant at 5% (i.e., increased downward stickiness). To test whether stickiness varies with regional concentration, Chang et al. (2019) estimate the regression model on the sub-samples of above- and below-median HHI_{10} (HHI for the top 10 domestic audit firms in each region-year, based on audit fees), each for the periods 2002–2007 and 2008–2016, respectively. Chang et al. (2019) find that the asymmetry between upward and downward audit fee stickiness is more pronounced in regions with a larger HHI_{10} .

Under the structuralist view, concentration gives audit firms substantial market power, which they can use to set excessive prices for potentially low-quality audits. The efficiency view, in contrast, assumes that demand factors like the complexity of an audit drive concentration. Clients, in turn, are willing to pay higher audit fees for the additional audit effort required. Van Raak et al. (2020) aim at disentangling the structuralist and the efficiency views of concentration. They argue that audit complexity in the small and medium-sized enterprise (SME) client segment of the audit market is low, and therefore concentration is exogenous. For a sample of 15,775 client-year observations from 8,122 private companies in Belgium (2006–2011), Van Raak et al. (2020) test the association between concentration and audit fees with the following stylized regression model:

$$(15) \quad LNAF = \alpha + \beta_1 \cdot CONCEN + \beta_2 \cdot COMPETITION + \gamma' [Controls] + \varepsilon .$$

Van Raak et al. (2020) define audit market segments by geographical area (i.e., all auditor-client combinations within a radius of 50 km of the client) and by client size (i.e., clients in the same quartile of total assets), which is a measure of audit complexity. Their measure of concentration is the average of the *HHI* and the size of individual audit partners' client portfolios (both based on the natural logarithm of total assets being audited). To measure *COMPETITION*, Van Raak et al. (2020) use client mobility (i.e., the sum of the absolute values of the annual percentage-point changes in market shares). The results of separate tests for the SME-clients and the large clients indicate a positive association between concentration and audit fees in both sub-samples (significant at 1%).

The results of Gunn et al. (2019) are contradictory to those of Van Raak et al. (2020), since they are in line with the structuralist view in particular for the segment of audits of large and complex clients. More precisely, Gunn et al. (2019) argue that concentration is most likely to be associated with higher audit fees (and lower audit quality) in the group of the Big 4 audit firms if clients' choice options are in fact limited. Gunn et al. (2019) use a sample of 29,179 firm-year observations from 6,981 Big 4 audit clients from 28 countries (2007–2013) to analyze concentration within the group of the Big 4 audit firms:

$$(16) \quad LNAF = \alpha + \beta_1 \cdot CONCEN_{BIG4} + \beta_2 \cdot SIZE + \beta_3 \cdot INT_OPERATIONS + \beta_4 \cdot IFRS_USE + \gamma [Controls] + \varepsilon.$$

AF is either the total audit fees charged to a client firm or the total audit fees, scaled by the square root of total assets audited. $CONCEN_{BIG4}$ is the *HHI*, based on the total assets audited by one of the Big 4 audit firms in a country-industry-year group. *SIZE* is an indicator variable that takes the value of one when the total assets audited exceed the 25th percentile value for all observations within the same country-industry-year grouping, and zero otherwise. *INT_OPERATIONS* is a dummy variable that is equal to one when the client has assets located in at least one country outside its home country, and zero otherwise. *IFRS_USE* is a dummy for a client's use of IFRS. In separate analyses, Gunn et al. (2019) find that the coefficients on $CONCEN_{BIG4} + CONCEN_{BIG4} \times SIZE$, $CONCEN_{BIG4} + CONCEN_{BIG4} \times INT_OPERATIONS$, and $CONCEN_{BIG4} + CONCEN_{BIG4} \times IFRS_USE$ are significantly positive, that is, there is a positive association between concentration among the Big 4 and audit fees for large clients, clients with international operations, and clients that use IFRS. For these clients, there is a negative association between concentration and audit quality (see equation (28) below).

Numan and Willekens (2012) hypothesize (and find) that there is (1) a positive association between their “auditor-client-alignment” measure and audit fees (because audit firms that differentiate their products are likely to be able to charge fees that exceed their marginal costs) and (2) a positive association between their “incumbent-competitor-distance” measure and audit fees (since equilibrium prices will be closer to marginal cost when the closest competitor has a similar degree of specialization).

$$(17) \quad LNAF = \alpha + \beta_1 \cdot CLIENT_ALIGNMENT + \beta_2 \cdot COMPETITOR_DISTANCE + \beta_3 \cdot HHI + \gamma [Controls] + \varepsilon.$$

CLIENT_ALIGNMENT is the revenue share the audit firm generates in a 2-digit SIC industry, relative to the total revenue generated by the audit firms in a MSA. *COMPETITOR_DISTANCE*

is the absolute difference between the incumbent audit firm’s market share in the client’s industry and the market share of the incumbent audit firm’s closest competitor (in terms of market share). *HHI* is calculated at the level of a two-digit SIC industry in an U.S. MSA, based on audit fees. The authors use U.S. data on Big 4 audit fees and client characteristics of relatively large public companies. Their sample includes 2,637 firm-year observations for the period 2005–2006 from 1,573 unique clients. The results are in line with models of spatial competition: Audit firms can mitigate price competition in the audit market by differentiation, because clients are willing to pay a premium for audit firms that are specialized towards their characteristics. The fee premium resulting from specialization, however, is determined by both an audit firm’s specialization and the specialization of its closest competitors.

Chu et al. (2018) extend the idea proposed by Numan and Willekens (2012) that price competition in the audit market is local and both client- and auditor-specific. More precisely, Chu et al. (2018) refer to the quasi-rent model of DeAngelo (1981a) and assume that transaction costs related to auditor switching result in audit firms’ pricing power. Thus, Chu et al. (2018) consider both client size (relative to the size of the audit firms active in a market) and relative auditor size differences as determinants of audit fees. They assume a positive relation between transaction costs and client size and an inverse relation between transaction costs and auditor size, relative to the size of competing audit firms:

$$(18) \quad LNAF = \alpha + \beta_1 \cdot BIG4 + \beta_2 \cdot COMPETITION + \gamma' [Controls] + \varepsilon .$$

BIG4 is an indicator variable that equals one for Big 4 auditors and zero otherwise. An audit market is defined as a two-digit client SIC industry in an U.S. metropolitan statistical area. Chu et al. (2018) use two measures for *COMPETITION*: The first measure is a client’s number of potentially efficient audit firms. Chu et al. (2018) consider an auditor as a potential supplier if the auditor’s total audit fees earned in the client’s market are at least as high as the audit fees the client pays to its current auditor. For the *COMPETITION* measure, seven dummy variables for the number of potential suppliers (between one and seven) a client has are used. The second measure is the auditor size difference, that is, the sum of the largest auditor’s fees in a market minus the sum of the client’s auditor’s fees in a market, divided by the total audit fees in a market. Chu et al. (2018) analyze a sample of 26,876 firm-year observations of audit fees from U.S. public companies across standard metropolitan areas (SMAs) by client 2-digit SIC industries (2000–2011). When the number of potentially efficient audit firms is used as the *COMPETITION* measure, the coefficients on the dummy variables for the number of potential suppliers are positive and statistically significant at 1% (except for the coefficients on the dummy for seven potential suppliers, which is significant at 10%). Moreover, the coefficients virtually monotonically decrease from the dummy for one supplier to the dummy for seven suppliers. The authors conclude that audit fees paid to the incumbent audit firm increase as the client’s number of potentially efficient audit firms in a local market decreases. The larger audit firms drive audit pricing. Moreover, when the auditor size difference is used as a *COMPETITION* measure, Chu et al. (2018) report a negative coefficient on this variable that is significant at 1%. Thus, audit fees decrease as the auditor size difference increases, that is, smaller audit firms obtain lower fees due to their competitive disadvantage. Interestingly, Chu et al. (2018) show that the effect of *COMPETITOR_DISTANCE* as defined by Numan and Willekens (2012) disappears after controlling for the number of suppliers to each client in a local market and auditor size differences.

There is also limited evidence of a negative association between concentration and audit fees:

For a sample of 78 publicly traded U.S. companies, Maher et al. (1992) find that inflation-adjusted audit fees declined significantly over the period 1977–1981 in which competition was assumed to increase. Sanders and Allen (1995) also document a real decrease in audit fees for U.S. public-sector audits during the period 1985–1989 with more intense competition. Pong (2004) analyzes the audit fees paid by 708 quoted companies that had hired the same audit firm during the sample period and finds that inflation-adjusted audit fees in the United Kingdom decreased by 9.7% over the period between 1991 and 1995. However, all these studies do not directly measure concentration or competition: In the first-differences design of Maher et al. (1992), the fee development that cannot be explained by changes in the independent variables are contained in the intercept of the regression with the difference in audit fees as the dependent variable. Sanders and Allen (1995) compare predicted fees with actual fees, and Pong (2004) uses dummies for the years 1992–1995 as well as a Big 4 dummy.

Pearson and Trompeter (1994), in contrast, explicitly take into account concentration:

$$(19) \quad \begin{aligned} LNAF = & \alpha + \beta_1 \cdot CONCEN + \beta_2 \cdot YEAR1983 + \beta_3 \cdot YEAR1984 \\ & + \beta_4 \cdot YEAR1985 + \beta_5 \cdot YEAR1986 + \gamma' [Controls] + \varepsilon. \end{aligned}$$

The sample consists of 140 life and health insurance and of 101 property and casualty insurance companies operating in Wisconsin between 1982 and 1986, all of which were audited by a Big 6 audit firm and did not change their auditor. *CONCEN* is the CR_3 for both the health insurance industry and the property and casualty insurance industry, based on the square root of clients' assets, and *YEAR1983–YEAR1986* are indicator variables that take on the value of one for the years 1983–1986, respectively. From their finding that the absolute concentration at the national level is negatively associated with audit fees (significance at the 1% level), Pearson and Trompeter (1994) conclude that higher concentration at the national level is associated with increased price competition. Nevertheless, the indicator variables for 1983 and 1984 are non-significant, whereas the year-dummies for 1985 and 1986 are positive and significant at a level of significance of 10% and 5%, respectively. Thus, fees increased over the sample period. The validity of this study, however, is limited, as only the insurance industry is included in the sample. Moreover, the sample period covers a relatively short time.

For an U.S. sample with 771 firms and 2,313 firm-year observations from 2000 to 2002, Asthana et al. (2009) find that the Big 4 premium and audit fees increased significantly in 2002 after the Enron scandal, the demise of Arthur Andersen, and the implementation of SOX. Asthana et al. (2009) use the following stylized regression model:

$$(20) \quad \begin{aligned} LNTF = & \alpha + \beta_1 \cdot MSHARE + \beta_2 \cdot AA \times YEAR2000 + \beta_3 \cdot BIG4 \times YEAR2000 \\ & + \beta_5 \cdot YEAR2001 + \beta_6 \cdot AA \times YEAR2001 + \beta_7 \cdot BIG4 \times YEAR2001 \\ & + \beta_8 \cdot YEAR2002 + \beta_9 \cdot AA \times YEAR2002 + \beta_{10} \cdot BIG4 \times YEAR2002 + \gamma' [Controls] + \varepsilon. \end{aligned}$$

LNTF is the natural logarithm of the total of audit and audit-related fees. *MSHARE* is the square root of the assets of the auditor's clients, divided by the square root of the assets of all auditors in two-digit SIC codes. *BIG4 (AA)* are dummy variables for Big 4 clients (clients of Arthur Andersen in 2000 or 2001, or its former clients that switched to a Big 4 audit firm in 2002), and *YEAR2000–YEAR2002* are year-dummies. The coefficient on *YEAR2002* is positive and significant at 5%; the coefficients on *AA×YEAR2002* and *BIG4×YEAR2002* are larger than both the coefficients on *AA×YEAR2001* and *BIG4×YEAR2001* and *AA×YEAR2000* and *BIG4×YEAR2000*, respectively, and

the difference is statistically significant. $BIG4 \times YEAR2000$, $BIG4 \times YEAR2001$, and $BIG4 \times YEAR2002$ are all significantly positive at 1%, indicating a Big 4 premium. The coefficient on $MSHARE$ is negative and significant at 1%; Asthana et al. (2009) conclude from this finding that auditors seem to pass along the reductions in audit costs to their clients, but exert their market power to increase audit fees if they become dominant in a market.

As a control, Numan and Willekens (2012) include in their fee regression the HHI (based on the audit fees of an audit office) in addition to their “auditor-client-alignment” and “incumbent-competitor-distance” measures (see regression model (17) above).¹⁸ Numan and Willekens (2012) find that the HHI has a significantly negative association with audit fees. This result is in line with the argument that competition is more intense if relative concentration is higher.

Finally, there are also studies that do not find a significant association between concentration and audit fees or document mixed results:

Using a sample of U.K. domestic listed companies spanning the period 1998–2003, Abidin et al. (2010) report descriptive evidence of significant upward pressure on audit fees since 2001, but only for smaller clients.

Based on a sample of 270 listed companies that were audited by a Big 8 audit firm, Iyer and Iyer (1996) investigate the effect of the Big 8 mergers on audit fees in the United Kingdom. More precisely, Iyer and Iyer (1996) test whether the extant audit fee model differs between the Big 6 audit firms in 1991 and the Big 8 audit firms in 1987 by performing the following stylized regression on the pre-merger and the post-merger samples:

$$(21) \quad LNAF = \alpha + \beta_1 \cdot MERGER + \gamma' [Controls] + \varepsilon.$$

The coefficient on $MERGER$ (a dummy variable indicating whether the audit firm was involved in a merger) is non-significant in both samples. Using the first-differences design (Maher et al. (1992)), Iyer and Iyer (1996) find that there is no evidence of an increase in audit fees. During the same period, the CR_8 for the Big 8 (based on audit revenues) had increased from 0.71 to 0.78, and the HHI for the top 20 audit firms had increased from 0.08 to 0.11.

Bandyopadhyay and Kao (2004) use data from 257 Ontario municipalities in 11 local audit markets (1995) to analyze how local audit offices determine audit fees. Bandyopadhyay and Kao (2004) take into account the market power of the auditor and the influence exerted by the client:

$$(22) \quad LNAF = \alpha + \beta_1 \cdot CONCEN + \beta_2 \cdot INF \\ + \beta_3 \cdot CONCEN \times INF + \gamma' [Controls] + \varepsilon.$$

$CONCEN$ is measured with the HHI for the local Big 6/non-Big 6 audit market, based on the square root of municipalities’ operating revenues, and INF is a proxy for the clients’ influence. INF is measured by (1) the relation between a municipality’s operating revenues and the total of all municipalities’ operating revenues ($RATIO$); (2) a municipal client’s percentile rank of municipal operating revenues at the level of a local audit office ($RANK$), or (3) the number of local audit offices operating within a 60 kilometer radius of a municipality ($RIVAL$). When estimating audit fees for the Big 6 and the non-Big 6 audit markets separately, Bandyopadhyay and Kao (2004) find

¹⁸ For an explanation of the “auditor-client-alignment” measure and the “incumbent-competitor-distance” measure, see Paragraph II.2.4.

a positive association between concentration and audit fees in the non-Big 6 sub-sample; however, concentration is unrelated to audit fees in the Big 6 sub-sample. Interestingly, the coefficient value on *HHI* is consistently larger for the non-Big 6 sub-sample than for the Big 6 sub-sample. The results regarding the effect of client influence, in contrast, are mixed. When *RIVAL* is used to measure the client's influence, Bandyopadhyay and Kao (2004) document a negative association between client influence and audit fees for both sub-samples. In contrast, when *RATIO* and *RANK* are used, the results are mixed.

Bills and Stephen (2016) take into account that there is an intersection of the Big 4 audit firm market and the small audit firm market in which small suppliers compete for public clients at the local (MSA) level. For a Big 4 audit firm sample with 16,073 firm-year observations and a sample with 11,938 firm-year observations from small audit firms for the period 2004–2013, Bills and Stephen (2016) document a positive association between audit fees and the distance between a small audit firm and its closest competing small audit firm. The intuition behind this result is that a small audit firm can charge higher fees when it increases its market power vis-à-vis another small audit firm. However, Bills and Stephen (2016) find a negative association between audit fees and the distance between a small audit firm and its closest competing Big 4 audit firm: When a small audit firm reduces its distance to a Big 4 audit firm, market participants perceive the small audit firm as being more similar to the Big 4 audit firm, which enables the small audit firm to increase its fees. But Big 4 audit firms are harmed when a small audit firm gets closer, as they incur a decrease in audit fees. The results indicate the necessity to separately take into account market share distances between small and Big 4 audit firms and those within the group of small and Big 4 competitors, respectively.

III.3.3. The association between concentration and audit quality

Theoretical results show that the relation between concentration and audit quality is ambiguous: Higher levels of concentration can either deteriorate or improve audit quality (Chaney et al. (2003)). High-level reports indicate that increased concentration does not necessarily lead to lower audit quality (United States Government Accountability Office (2003); United States Government Accountability Office (2008)). In fact, there are empirical findings indicating that there is even a positive association between concentration and audit quality:¹⁹

Kallapur et al. (2010) analyze the relation between audit quality and concentration based on a sample of 27,756 firm-year observations from 179 MSAs for the period from 2000 to 2006:

$$(23) \quad AQ = \alpha + \beta_1 \cdot CONCEN + \gamma' [Controls] + \varepsilon.$$

Audit quality (*AQ*) is either the absolute positive and negative discretionary accruals estimated by using the Jones (1991) model as modified by Ball and Shivakumar (2006), performance-adjusted discretionary accruals as proposed by Kothari et al. (2005), or the accruals quality measure developed by Dechow and Dichev (2002). *CONCEN* is the *HHI* based on audit fees and is measured at the MSA-level. Kallapur et al. (2010) find a positive association between the *HHI* based on audit

¹⁹ In our overview, we neglect studies that analyze changes in audit quality over time, during crisis periods or after mergers, or as a response to increased litigation and higher insurance costs, more intense legislative and media scrutiny, and more rigorous regulatory reviews of the auditing profession (see, among others, Geiger et al. (2005); Fargher and Jiang (2008); Chan and Wu (2011)).

fees and audit quality, which is significant at the 1%-level for all audit quality measures used. This finding is robust to alternative specifications of *CONCEN* (the *HHI* based on the number of clients, the *HHI* based on total client assets, separate *HHIs* for large and small clients in each MSA, and transformed functional forms of the *HHI*). Interestingly, Kallapur et al. (2010) take into account that concentration and audit quality could be endogenously determined (i.e., clients could have preferences for high-quality auditors). When controlling for endogeneity by using a 2SLS instrumental variables approach with exogenous instruments for concentration, Kallapur et al. (2010) still find a positive association between concentration and audit quality.

Newton et al. (2013) analyse a sample of 27,043 firm-year observations from the U.S. for the period 2000–2009 (excluding the year 2002). Newton et al. (2013) investigate the association between audit quality and competition with the following stylized logistic regression model:

$$(24) \quad AQ = \alpha + \beta_1 \cdot COMPETITION + \gamma' [Controls] + \varepsilon .$$

To measure audit quality (*AQ*), Newton et al. (2013) use an indicator variable that takes the value of one if there is a financial statement restatement for which the identification of misstatement indicates that the incumbent performed a lower-quality audit (i.e., a client's failure in the application of generally accepted accounting principles). Thus, Newton et al. (2013) consider a measure of audit quality that is more clear-cut than accruals. To measure *COMPETITION* within a MSA, Newton et al. (2013) determine the *HHI* at the MSA-level, based on audit fees, and then rank the observations into quintiles based on descending values of the *HHI* (i.e., the *HHI* is an inverse measure of competition). Newton et al. (2013) thus assume a direct link between concentration and competition. The authors find that higher competition (i.e., a lower value for the *HHI*) is associated with a higher likelihood of restatements and of restatements that have a negative net effect on the financial statements; thus, higher concentration levels are related to higher audit quality. Newton et al. (2013) find no significant relation between competition and the likelihood of restatements that have a positive net effect on the financial statements. These results are qualitatively identical if the sample is divided into Big 4 and non-Big 4 audits, but the effect is stronger for non-Big 4 audits.

Newton et al. (2016) investigate whether audit market competition facilitates clients' internal control opinion shopping. The sample consists of 11,846 firm-year observations from Big 4 clients for the period 2005–2011. Newton et al. (2016) consider the measures *DISTANCE_{MSA}* and *DISTANCE_{ind}*. *DISTANCE_{MSA}* is the absolute difference between the incumbent audit office's fee market share within its MSA and the fee market share of the audit office within that MSA that is closest to the incumbent auditor (in terms of market share). *DISTANCE_{ind}* is similar to *DISTANCE_{MSA}*, but defined at the MSA-industry. The *HHI* is based on audit fees. Newton et al. (2016) assume a direct relation between concentration and competition; thus, they decile-rank the concentration measures based on decreasing values, that is, higher values represent more intense competition (a lower degree of concentration). The results indicate that internal control opinion shopping occurs mainly in competitive audit markets.

For a Chinese sample of 12,334 firm-year observations for the period 2001–2011, Huang et al. (2016) investigate the effect of concentration on audit quality:

$$(25) \quad AQ = \alpha + \beta_1 \cdot CONCEN + \gamma' [Controls] + \varepsilon .$$

Audit quality is measured with the absolute value of discretionary accruals (*DACC*) as estimated with the modified Jones (1991) model and adjusted by Kothari et al. (2005). As noted for equation (11), *CONCEN* is either the market share of the local top four audit firms (*MSHARE_{top4}*), the *HHI* for the local top four audit firms (*HHI_{top4}*), or the *HHI* for all audit firms (*HHI*). The concentration measures are calculated based on audit fees. As the coefficients on *MSHARE_{top4}*, *HHI_{top4}*, and *HHI* are non-significant, there is no direct effect of concentration on earnings quality. Thus, Huang et al. (2016) employ path analysis to examine the indirect effects of concentration on audit quality through audit fees. The results indicate that concentration increases audit fees, which, in turn, improves audit quality. However, Huang et al. (2016) find that modified audit opinions are less likely in concentrated audit markets. From the result that concentration reduces the likelihood that executives and auditors are sanctioned by regulators for audit failures, the authors conclude that the reduced likelihood for modified audit opinions in more concentrated markets does not stem from reduced auditor independence. Instead, higher audit fees indicate higher audit effort, which increases clients' earnings quality and decreases the need for auditors to issue modified audit opinions. Taken together, the results suggest that concentration improves audit quality indirectly through increased audit fees, and this positive indirect effect offsets the negative direct effect of concentration on audit quality so that the overall effect is non-significant. This explanation is consistent with the efficiency view outlined above.

Similar to Huang et al. (2016), Eshleman and Lawson (2017) test the direct association between concentration and audit quality, and the indirect effect of concentration on audit quality via higher audit fees:

$$(26) \quad AQ = \alpha + \beta_1 \cdot CONCEN + \beta_2 \cdot \% \Delta AF + \gamma' [Controls] + \varepsilon.$$

The results are based on a sample of 35,428 client-year observations from 90 U.S. MSAs for the period 2000–2013. For *CONCEN*, Eshleman and Lawson (2017) use a proxy similar to the rank measure proposed by Newton et al. (2013) (i.e., the values for the *HHI* at the MSA-level, based on audit fees, ranked into quintiles in descending order). *%ΔAF* is the percentage change in audit fees. Eshleman and Lawson (2017) find that concentration is associated with higher audit quality as proxied by the absolute value of performance-adjusted abnormal accruals (Kothari et al. (2005)) (i.e., the coefficient on *CONCEN* is negative and significant at the 1% level). The coefficient on *%ΔAF* is significantly positive, indicating that audit quality is lower when audit fees are higher. The results of Eshleman and Lawson (2017) also indicate that the positive association between concentration and audit quality extends to first year audit engagements for those firms that change their auditor, but only if the auditor does not low-ball. Thus, Eshleman and Lawson (2017) confirm the result of Huang et al. (2016) that one channel through which concentration increases audit quality is increases in audit fees.

In this vein, Chang et al. (2019) investigate the impact of audit fee stickiness on audit quality. More precisely, Chang et al. (2019) predict that upward stickiness of audit fees (i.e., the reluctance of auditors to increase audit fees sufficiently to cover additional audit costs) results in lower audit quality. Downward stickiness (i.e., the reluctance of auditors to pass on costs savings to clients), in contrast, is expected to increase audit quality. Audit quality is operationalized with the absolute and signed abnormal accruals (Dechow and Dichev (2002)), the abnormal working capital accruals, and an auditor's propensity to issue modified audit opinions. In line with their predictions, Chang et al. (2019) find for a sample of 21,633 observations from Chinese listed companies (2002–2016) that less upward stickiness is associated with less earnings management and more auditor reporting

conservatism, and quick downward price adjustments are related to lower audit quality. As outlined in Paragraph III.3.2, Chang et al. (2019) find that fee stickiness is conditional on concentration (i.e., increased concentration is connected to faster upward adjustments of audit fees, but to slower downward adjustments).

Francis et al. (2013) present the results of a cross-country study on the relation between concentration at the national level and the quality of audited earnings. Francis et al. (2013) analyze a sample of 55,408 firm-year observations from 42 countries for the period 1999 through 2007:

$$(27) \quad AQ = \alpha + \beta_1 \cdot CR_4 + \beta_2 \cdot HHI + \gamma' [Controls] + \varepsilon.$$

The measure for absolute concentration is the CR_4 based on the number of clients audited by the Big 4 within country-industry-year groupings. The measure for relative concentration is the HHI based on total client sales audited by each Big 4 audit firm in a country-industry-year. Industries are defined using 2-digit SIC codes. Audit quality (AQ) is measured by total accruals (i.e., net income before extraordinary items, less cash flow from operations, scaled by lagged total assets), abnormal accruals as estimated with the modified Jones (1991) model (Dechow et al. (1995)), the likelihood of reporting a profit or avoiding a loss (a dummy variable coded one if the firm reports a bottom-line positive net income and zero if the firm reports a loss), and timely loss recognition (Ball and Shivakumar (2005); Bushman and Piotroski (2006)). For the likelihood of reporting a profit, an adapted version of the regression model is used. Francis et al. (2013) find a significantly negative association between CR_4 and the total accruals (5%), the abnormal accruals (5%), and the probability of reporting a profit (1%) both for Big 4 audits and for non-Big 4 audits. This finding indicates that audit quality is higher when the Big 4, as a group, have a larger combined market share. In contrast, there is a significantly *positive* association between the HHI and the total accruals (1%), the abnormal accruals (1%), and the probability of reporting a profit (10%), but only for Big 4 audits. Thus, earnings quality is lower in countries where the market share distribution across the Big 4 is more imbalanced. If audit quality is measured by timely loss recognition, audit quality is also higher (lower) in countries both with a higher CR_4 (HHI). At first glance, the result of a negative association between the HHI and audit quality is in contrast to the findings of Kallapur et al. (2010) and Newton et al. (2013). However, Kallapur et al. (2010) and Newton et al. (2013) measure concentration at the MSA-level, whereas Francis et al. (2013) measures concentration at the country-level. If audit fees as a channel for the effects of concentration on audit quality are taken into account, the result of Francis et al. (2013) also contradict those of Huang et al. (2016), Eshleman and Lawson (2017), and Chang et al. (2019) (who also measure concentration at the regional level). However, Gunn et al. (2019) and Boone et al. (2012) confirm the negative association between relative concentration and audit quality for country-level and MSA-level concentration measures, respectively:

For a sample of 29,179 firm-year observations from 6,981 Big 4 audit clients from 28 countries (2007–2013), Gunn et al. (2019) find evidence for a negative association between Big 4 market concentration and audit quality for large clients (as well as clients with international operations and clients that use IFRS). More precisely, Gunn et al. (2019) use the following stylized regression model:

$$(28) \quad LNAF = \alpha + \beta_1 \cdot CONCEN_{BIG4} + \beta_2 \cdot SIZE \\ + \beta_3 \cdot INT_OPERATIONS + \beta_4 \cdot IFRS_USE + \gamma' [Controls] + \varepsilon.$$

AQ is either the absolute abnormal accruals determined by using the modified Jones model (Jones (1991); Dechow et al. (1995)), the income-increasing accruals, or the probability of reporting a profit. $CONCEN_{BIG4}$ is the HHI , based on Big 4 clients' total assets. $SIZE$ is a dummy variable for large clients (i.e., the total assets audited exceed the 25th percentile value), $INT_OPERATIONS$ is a dummy variable for foreign assets, and $IFRS_USE$ is a dummy variable for the use of the IFRS. In line with the results of Francis et al. (2013), Gunn et al. (2019) find a negative association between concentration among the Big 4 and audit quality for large (and complex) clients. Combined with the finding of higher audit fees for these clients, Gunn et al. (2019) provide evidence in favor of the structuralist view of concentration for the market segment of Big 4 audits for large (and complex) clients.

Boone et al. (2012) use an U.S. sample of 4,779 firm-year observations for which the client's earnings per share before discretionary accruals fell short of the analysts' consensus earnings forecast (2003–2009). For these clients, Boone et al. (2012) investigate the relation between concentration and the likelihood that income-increasing discretionary accruals (as estimated by using the Jones (1991) model as modified by Ball and Shivakumar (2006)) are used to meet or beat the analysts' consensus earnings forecast. When the HHI for the MSA, based on audit fees, is used as a measure for concentration, Boone et al. (2012) find that higher concentration at the local level is associated with greater auditor tolerance for earnings management (i.e., lower audit quality). The results remain unchanged if the HHI is calculated for all audit firms or for the Big 4 audit firms only, and if market shares are determined by audit fees, client size (book value of assets or revenues), or number of clients. Taking into account the possibility that concentration affects audit fees and audit fees impact audit quality (Huang et al. (2016); Eshleman and Lawson (2017)) and the potential endogeneity of concentration (consistent with Kallapur et al. (2010)) also do not affect the results. However, Boone et al. (2012) do not detect an association between the CR_4 and earnings management.

The findings of Willekens et al. (2020) are relevant in explaining the mixed results with regard to the connection between the HHI and audit quality. Willekens et al. (2020) use 11,211 (13,819) U.S. firm-year observations from relatively large public companies for the period 2009–2017 to investigate the explanatory power of the HHI as compared to the auditor's market share distance from the closest competitor (a measure developed by Numan and Willekens (2012)):

$$(29) \quad \begin{aligned} AQ = & \alpha + \beta_1 \cdot HHI + \beta_2 \cdot COMPETITOR_DISTANCE \\ & + \beta_3 \cdot SPEC_{office} + \beta_4 \cdot SPEC_{nat} + \gamma' [Controls] + \varepsilon. \end{aligned}$$

The authors define audit markets at the (local) audit office level, using two-digit SIC code industries. Audit quality (AQ) is measured either with the level of performance-adjusted absolute abnormal accruals as estimated using the cross-sectional Jones (1991) model, or with the incidence of restatements due to probably intentional misstatements with a positive effect on the financial statements. The HHI is calculated based on audit fees. $COMPETITOR_DISTANCE$ is the absolute difference between the incumbent audit office's market share in the client's industry and the market share of the incumbent's closest competitor (in terms of market share). $SPEC_{office}$ ($SPEC_{nat}$) is a dummy variable for industry leadership that takes the value of one if the incumbent has the highest industry market share in the MSA (national) audit market, and zero otherwise. Willekens et al. (2020) find that $COMPETITOR_DISTANCE$ is significantly negatively related to the likelihood of a misstatement (5%) and absolute abnormal accruals (1%). The positive association between market share distance and audit quality is given only when the incumbent is the market

leader; industry leadership itself does not have a significant association with audit quality. Thus, Willekens et al. (2020) conclude that a market leader's industry market share dominance has a more prominent effect on audit quality than industry specialization *per se*. The coefficient on *HHI*, in contrast, is non-significant.

Van Raak et al. (2020) also examine the association between concentration and audit quality (*AQ*) for a sample of private companies in Belgium (2006–2011):

$$(30) \quad AQ = \alpha + \beta_1 \cdot CONCEN + \beta_2 \cdot COMPETITION + \gamma' [Controls] + \varepsilon.$$

Audit quality is measured with *DACC*, that is, the absolute value of abnormal accruals as estimated using the modified Jones model (Jones (1991); Dechow et al. (1995)). For the SME sub-sample, the coefficient on the concentration measure is positive and significant at the 5% level (i.e., concentration decreases audit quality), whereas it is non-significant for the large clients sub-sample. Van Raak et al. (2020) interpret this finding as evidence for the structuralist view in the SME sub-sample (i.e., market concentration impairs price and quality), but for the efficiency view in the large clients sub-sample (i.e., concentration is unrelated to audit quality). Moreover, Van Raak et al. (2020) argue that there is still price and quality competition in the large clients sub-sample: The coefficients on client mobility in the audit fee regression (see equation (15)) are negative and statistically significant at the 5% level for both sub-samples, and the difference in the coefficients is not statistically significant. Moreover, the coefficient on client mobility in the accruals regression is negative (i.e., client mobility improves audit quality) and statistically significant at the 1% level only for the large client sub-sample. Van Raak et al. (2020) conclude that in the large-client segment of the audit market, there is competition in price and quality although the market is highly concentrated. The recommendation to the regulator is that audit quality can be improved rather by enhancing client mobility than by decreasing concentration.

III.4. Summary

Regulators have always been concerned about the level of concentration in a national audit market. At present, the concern is that too high a concentration would endanger competition. A low intensity of competition, in turn, is expected to result in barriers to market entry for smaller audit firms, limited auditor selection options for certain clients, low audit quality at excessive prices, and a systemic risk resulting from the potential event that one of the Big 4 audit firms disappears from the market.

The arguments put forward by the regulators are mainly in line with the structuralist view, which assumes a direct causal link between concentration and competition: A high degree of concentration gives the dominant firms market power, which they then use to set high prices for audits of low quality. Since this outcome is undesirable from an economic perspective, regulators have proposed means to decrease concentration and to increase competition (see Chapter IV).

According to the efficiency view, in contrast, concentration is not exogenously given, but the result of clients' preferences for quality-differentiated audits. The increased investments that are necessary for the audit firms to realize economies of scale or scope in order to be able to satisfy clients' demand lead to an increase in concentration. From a regulatory perspective, this outcome is not necessarily disadvantageous. The final evaluation depends on whether the association between

concentration and audit fees is negative or positive, and on the importance of the remaining potentially adverse effects of concentration (e.g., systemic risks). In any case, a high concentration does not necessarily lead to a need for additional regulatory measures.

The effects of concentration on audit fees and audit quality ultimately remain an empirical question. Unfortunately, the results are mixed. As can be seen from the overview above, the empirical literature on this topic has evolved from using as a foundation the assumptions of the traditional industrial organization literature to taking into account spatial competition:

First, although concentration measures provide information about specific facets of the structure of the audit market, they do not have direct implications for conduct, performance, and competition. Thus, recent empirical studies use not only concentration metrics, but also competition measures as explanatory variables in their audit fee and audit quality regressions. For example, Numan and Willekens (2012), Bills and Stephen (2016), Chu et al. (2018), and Willekens et al. (2020) apply metrics based on spatial competition models, and Van Raak et al. (2020) use the mobility of market shares to proxy for competition. In contrast to the structuralist view, which assumes that all audit firms in a market have similar market power, these studies take into account that competition is local and depends on the competitive advantage of an audit firm over its closest competitor. Interestingly, there are also approaches that take into account multimarket contacts of auditors (Dekeyser et al. (2019) and Deméré et al. (2019)). Spatial competition metrics should thus be considered in addition to the traditional measures for industry leadership and auditor specialization. Moreover, the empirical literature has started to take into account that audit fees and audit quality also depend on the client's relative bargaining power (e.g., Bandyopadhyay and Kao (2004) or Chu et al. (2018)). The application of the metrics developed in these studies would be a fruitful extension to studies investigating the association between concentration and audit fees and audit quality, respectively.

Second, while cross-country studies measure audit firms' market shares mainly at the level of the audit firm, single-country (or single-market segment) studies tend to measure market shares at a more granular level. For example, the audit market is often defined at the city- or MSA-level (if competition is regional), at the level of an industry-MSA (if competition is between audit firms within the same geographic region for clients from a specific industry), or at the audit firms' office level (since this is where most of the decisions in an audit firm are actually made) (see Wallman (1996); Francis et al. (1999); Reynolds and Francis (2001); Chaney and Philipich (2002); Ferguson et al. (2003); Francis et al. (2005); Francis and Yu (2009)). This approach considers a more direct link between concentration and conduct.

Third, to empirically differentiate the structuralist view from the efficiency view, a simultaneous investigation of audit fees and audit quality is necessary. The finding of a positive association between concentration and audit fees does not imply a low degree of competition if there is also a positive link between concentration and audit quality. As can be seen from the overview above, there are some studies that test both, audit fees and audit quality (e.g., Huang et al. (2016); Eshleman and Lawson (2017); Chang et al. (2019); Gunn et al. (2019); Van Raak et al. (2020)).

Forth, empirical analyses should take into account that concentration might be endogenous. Today, there are only few studies that implicitly (Eshleman and Lawson (2017); Huang et al. (2016)) or explicitly (Kallapur et al. (2010); Boone et al. (2012)) address this issue. However, extended sample periods are necessary to capture the potential effects of audit fees and audit quality, respectively,

on concentration, since these effects need time to unfold (e.g., through mergers or the growth of audit firms).

IV. AUDIT REGULATIONS

IV.1. Introduction

In 2002, the legislator in the U.S. had reacted to the accounting scandal of Enron with the implementation of the Sarbanes-Oxley Act (United States House of Representatives (2002)). However, in the aftermath of the global financial crisis beginning in 2007, regulators in Europe, in the United Kingdom, and in the U.S. have resumed their discussion regarding the advantageousness of different audit market regulations in increasing audit quality. In particular, the audit firms had been criticized for failing to raise a red flag on troubled banks.

Consequently, on April 16, 2014, the European Parliament and the Council of the European Union signed Directive 2014/56/EU and Regulation (EU) No 537/2014, which became applicable by June, 17, 2016. Directive 2014/56/EU sets out a framework for all statutory audits conducted in the EU and lays down the framework for auditor oversight in the EU Member States (European Parliament and Council of the European Union (2014a)). Regulation (EU) No 537/2014 defines the requirements for carrying out statutory audits of public-interest entities' financial statements in the EU (European Parliament and Council of the European Union (2014b)). By offering Member States some flexibility with respect to the specific design of some regulations,²⁰ the legislator intended to limit the additional costs that clients would have to incur and to prevent unnecessary additional audit procedures. Despite all the efforts of the regulator, however, serious accounting scandals continue to occur (e.g., Carillion in the United Kingdom and Wirecard in Germany). Thus, the accusations against auditors are not lessening, and the statutory audit function is still critically discussed in a number of high-level inquiries and reports on the findings of the regular oversight of the respective national audit market.

As a response to the insolvencies of BHS in 2016, of Carillion in 2018, and of Thomas Cook in 2019, on March 18, 2021, the Government of the United Kingdom published its White Paper "Restoring trust in audit and corporate governance" (UK Government, Department for Business, Energy & Industrial Strategy (2021)). The White Paper contains far-reaching proposals for the reform of the auditing, corporate reporting, and corporate governance systems in the United Kingdom. With respect to auditing, the White Paper proposes the creation of a new, stand-alone audit profession, including changes to the current audit practices and the extension of the audit's scope from financial statement auditing to corporate auditing. Audits would have a clear focus on the public interest, that is, the definition of public interest entities would be extended. A new regulator (the Audit, Reporting and Governance Authority (ARGA)) would be responsible for the oversight of the auditing profession. In addition, the White Paper suggests regulatory measures to increase competition and improve audit quality. In particular, UK-registered FTSE 350 companies would be required to hire a smaller "challenger" audit firm for conducting a meaningful portion of their audit

²⁰ Examples are the expansion of the definition of public-interest entities, a maximum audit tenure under MAR that falls below the tenure laid down in the regulation, or the extension of the list of prohibited NAS. Willekens et al. (2019) give an overview of the EU Audit Reform's implementation status for the EU Member States.

(mandatory managed shared audit requirement). If competition in the sector of FTSE 350 audits should not improve, the Big 4 audit firms could even face a cap on their market shares. Moreover, the ARGA could impose an operational split between the audit and non-audit functions of audit firms.

The primary objective of the measures that have already been implemented or are currently being discussed is to improve the quality of statutory audits and thus to restore investors', creditors', and the public's confidence in the integrity of financial statements. More precisely, regulators aim at increasing the probability that auditors will find errors and irregularities in their clients' financial statements (audit efficiency). Above all, regulators attempt to strengthen auditors' incentives to report truthfully the results of their audits to the addressees of the financial reports (independence). Since regulators consider the high degree of concentration that is observed in most of the national audit markets *per se* as disadvantageous (see Paragraph III.2.2), a second goal of regulators is to reduce concentration in audit markets (European Parliament and Council of the European Union (2014b); UK Government, Department for Business, Energy & Industrial Strategy (2021)). This goal is considered important also because there is the concern that a high concentration is associated with low audit quality.

Although the relative importance of these targets differs both between the individual regulatory measures and across jurisdictions, the objectives of an increase in audit quality and a decrease in concentration are at the top of the agenda in the legislators' pronouncements. For example, the recent European Regulation No. 537/2014 explicitly states improved audit quality, less concentration, and more intense competition in the audit market as objectives (see numbers (5), (25), and (30) in European Parliament and Council of the European Union (2014b)). In discussing whether (and how) the goals of an increase in audit quality and a decrease in concentration are related, it seems that the regulator is making the structure-conduct-performance paradigm the basis of consideration. In particular, it is assumed that a high degree of concentration *causes* lower audit quality. If this assumption were true, regulatory measures that lead to a reduction in concentration would simultaneously improve audit quality.

However, there are arguments that the causal linkages are not as clear-cut as the regulator assumes. First, from a historical perspective, regulators have not been effective in preventing accounting scandals (Hail et al. (2018)). This observation raises the question of whether the already implemented regulatory measures are having the intended effects, and if so, whether the benefits of regulations outweigh their costs (DeFond and Zhang (2014)). Second, the empirical evidence for a negative association between concentration and audit quality is mixed (see Paragraph III.3.3). Third, there are empirical findings supporting the assertion that audit regulation itself has contributed to the currently observed high level of concentration (see Paragraph II.4.4). For these reasons, a more detailed analysis of the effects of regulatory measures seems necessary. In particular, such an analysis would have to take into account that there is no one-sided causal effect of concentration on audit quality, but that concentration and audit quality are interconnected.

In this chapter, we give an overview of the regulatory landscape. In doing so, we have selected those measures that we believe can have an impact both on concentration and audit quality. Some of these measures are already effective in some countries or must be applied by the statutory auditor of a client from a specific segment of a national audit market (e.g., financial institutions, public interest entities, etc.). Other measures have been critically discussed during the last decades, but

have not (yet) been implemented. To highlight the benefits resulting from a simultaneous consideration of concentration and audit quality, we do not present measures that are likely to have at most a weak effect on concentration (such as the disclosure of audit fees, the mandatory rotation of the audit partner, the composition of the audit committee, auditor reporting, or oversight of the audit profession).

In the following paragraphs, we thus discuss the potential incentive effects—both those that the regulator envisages and the potentially occurring unintended side effects—of the mandatory audit firm rotation, of the prohibition on the joint supply of audit services and non-audit services, and of joint audits. Moreover, we also discuss how these regulations can affect the market share distribution among audit firms. These considerations serve as a basis for the discussion of the empirical studies and analytical models presented in the following chapters.

IV.2. Selected audit market regulations

IV.2.1. The mandatory audit firm rotation

The introduction of the mandatory rotation of the audit firm after a certain period (MAR) has been controversial for decades (United States Senate (1976); American Institute of Certified Public Accountants (AICPA) (1978); European Commission (1996); Public Company Accounting Oversight Board (PCAOB) (2011); European Commission (2010); United States House of Representatives (2013); European Parliament and Council of the European Union (2014b)). Several countries that had introduced MAR later repealed it. Austria, for example, abolished MAR in the 1990s; in Spain, MAR was effective between 1988 and 1995; in South Korea, MAR was applicable from 2006 to 2010 (Kwon et al. (2014)); and in Turkey, MAR was effective between 2006 and 2010. In the European Union, MAR after ten years (plus an additional ten years if a public tendering is conducted) with a “cooling-off” period of four years is mandatory since 2016 (European Parliament and Council of the European Union (2014b), Article 17).²¹ However, in Italy, MAR is effective already since 1975 (Cameran et al. 2016). In the U.S., the Public Company Accounting Oversight Board (PCAOB) had favored the implementation of MAR for years. However, in 2013, the Congress decided not to implement MAR (United States House of Representatives (2013)), because the trade-off between additional costs and an increase in independence was regarded as disadvantageous (United States General Accounting Office (GAO) (2003); Roush et al. (2011); Edwards (2014)). More precisely, the Audit Integrity and Job Protection Act amended the Sarbanes-Oxley Act of 2002 (SOX) to deny the PCAOB any authority to require MAR for audits conducted for a particular issuer of securities in accordance with SOX standards.

Advocates of MAR emphasize that auditors would risk losing the economic benefits derived from a client if they issued a qualified, or even adverse, opinion on the client’s financial statements. Thus, restricting the number of periods in which an auditor can provide statutory audits to a client is expected to strengthen auditor independence. Moreover, proponents of MAR argue that auditors might become too familiar with their clients and be blinded by routine, such that audit quality would decline over potentially unrestricted tenures. Opponents, in contrast, argue that MAR would

²¹ In the United Kingdom, the market investigation conducted by the Competition Commission between 2011 and 2013 resulted in an Order with effective date January, 1, 2015 that prescribes, among others, the mandatory tendering of audit contracts by the FTSE 350 companies at least every ten years (UK Competition and Markets Authority (2013)).

be inefficient because of the start-up costs auditors incur to become familiar with a client's business. Thus, a change in the audit firm would lead to a loss of client-specific knowledge. As a consequence, audit quality could be lower during the first year(s) of an engagement (e.g., Geiger and Raghunandan (2002); Myers et al. (2003); United States General Accounting Office (GAO) (2003); Carcello and Nagy (2004); Knechel and Vanstraelen (2007); Stanley and DeZoort (2007); Gul et al. (2009)), and audit fees could increase. Moreover, there is also the concern that MAR would facilitate opinion shopping during an auditor change.

With regard to the market structure effects of MAR, the proponents of this regulation expect that MAR would improve audit quality, as it should increase the dynamism of the audit market and decrease concentration (European Commission (2011c)). Note that this argument relies on the assumption of a negative association between concentration and audit quality (Gunn et al. (2019); Boone et al. (2012)). However, MAR could also increase concentration if clients tend to choose as a successor a larger rather than a smaller audit firm. Moreover, if MAR is implemented in a highly concentrated audit market, clients will face the problem of finding a sufficiently specialized successor, in particular if MAR is combined with the prohibition on single-provider auditing and consulting.

IV.2.2. The prohibition on the joint provision of audit and non-audit services

The joint supply of audit services (AS) and non-audit services (NAS) has been criticized for decades. In particular, there is the concern that the economic benefit earned by an auditor from the provision of consulting services threatens the auditor's independence. Thus, most jurisdictions have restricted the scope of NAS that auditors are allowed to provide to their audit clients. However, the scope of the restriction varies greatly between countries. In some jurisdictions, the limitation only affects certain consulting services.

For example, whereas SOX does not restrict the provision of audit-related or tax services, audit firms are prohibited from providing public companies with any design or implementation services for financial information systems, internal AS, and "certain other services" (United States House of Representatives (2002), SOX, Title II, §201 (g)). However, SOX prescribes that the audit committee of the registrant approves any NAS allowed by law (SOX, Title II, §202). Moreover, SOX demands the separate disclosure of audit fees and various types of NAS fees. In the EU, Regulation 537/2014 of the European Union defines a blacklist of NAS that statutory auditors are not allowed to offer to their public interest entity audit clients (European Parliament and Council of the European Union (2014b), Art. 5).²² Expert services unrelated to the audit, a number of tax services, and other advisory services are excluded from the prohibition. In addition, there is a cap on the fees earned from providing NAS of 70% of the average fees paid in the last three consecutive financial years for carrying out the statutory audit(s) of the client's financial statements (European Parliament and Council of the European Union (2014b), Article 4). In other countries, the joint

²² The blacklist contains tax services; services that involve playing any part in the management or decision-making of the audited entity; bookkeeping and preparing accounting records and financial statements; payroll services; designing and implementing internal control or risk management procedures related to the preparation and/or control of financial information or designing and implementing financial information technology systems; valuation services; selected legal services; internal audit services; services linked to financing, capital structure and allocation and investment strategy; promoting, dealing in or underwriting shares in the audited entity; and some human resources services.

supply of AS and NAS is (or will eventually be) totally banned. For example, in the United Kingdom, the UK Competition and Markets Authority (2019) observes that the fees earned for NAS are well below the 70% cap. However, after the insolvency of Carillion in January 2018, the critical arguments against the Big 4 audit firms' market dominance have once again reached a climax. As a consequence, committees of the British parliament have asked the Competition and Markets Authority (CMA) to examine whether breaking up the Big 4 into separate audit and consulting parts would increase competition (UK House of Commons (2018)). On July 6, 2020, the Financial Reporting Council (2020) asked the Big 4 audit firms in the United Kingdom to implement on a voluntary basis an operational split of their audit practices from the rest of the firm by June 30, 2024. The UK Government, Department for Business, Energy & Industrial Strategy (2021) in its recently published White Paper argues in favor of an operational separation between the audit and non-audit practices of audit firms.

Opponents of a prohibition on the joint supply of AS and NAS give consideration to the fact that NAS can generate knowledge spillovers that can improve the effectiveness of the audit (Simunic (1984); Beck et al. (1988); Knechel and Sharma (2012)). Thus, the advantageousness of a ban on single-provider auditing and consulting depends on the trade-off between an eventually lower probability to detect errors or irregularities in a client's financial statements (effectiveness) and the increased probability to report detected findings to the addressees of the financial report (independence).

In addition to the incentive effects, a restriction of the joint supply of AS and NAS can affect the market structure. On the one hand, the possibility to jointly provide AS and NAS gives the Big 4 audit firms a competitive advantage over the non-Big 4 audit firms that lack the capacities to offer an increased scope of services. Thus, a ban on single-provider auditing and consulting would at least partly remove the barriers to market entry for the non-Big 4 audit firms. Moreover, the loss of knowledge spillovers can eliminate the comparative cost advantage of the Big 4 audit firms and thus increase competition. On the other hand, the Big 4 audit firms lose a large share of their profits if the scope of services they are allowed to provide is restricted. Thus, the prohibition on the joint supply of AS and NAS could further increase concentration, since additional mergers would be a possible way to cover a given amount of fixed costs. The total effect of this regulation on concentration therefore depends on the relative effects on the cost structures of the Big 4 and the non-Big 4 audit firms, which are, unfortunately, empirically not observable. Moreover, the overall effect is likely to depend on the type of NAS put on the blacklist, since the types of NAS differ in their profitability and their intensity of knowledge spillovers flowing from NAS to AS.

IV.2.3. Joint audits

Ratzinger-Sakel et al. (2013), p. 176, define a joint audit (JA) as "an audit in which financial statements are audited by two or more independent auditors in a way that involves: coordination of the audit planning; shared audit effort; cross reviews and mutual quality controls; and issuance of one single auditor's report signed by the auditors who are jointly liable." Regulation in the EU encourages JAs by extending the maximum tenure under rotation to twenty-four years if JAs are carried out, without the necessity to conduct a tender (European Parliament and Council of the European Union (2014b), Article 17). However, JAs have not become mandatory in the European Union, and thus JAs today are required only in France. In Denmark, JAs audits had been mandatory from 1930 until 2005 (Ratzinger-Sakel et al. (2012); Holm and Thinggaard (2014); Holm and Thinggaard

(2016); Holm and Thinggaard (2018)). Currently, regulators again discuss the advantages and disadvantages of JAs (The Dutch Authority for the Financial Markets (AFM) (2018); UK Competition and Markets Authority (2019)).

Proponents of JAs argue that there is the potential for synergies being realized during joint work. Thus, JAs would lead to an increased efficiency of audit effort. Moreover, the advocates of JAs are of the opinion that JAs would improve independence: First, the probability that two auditors would agree to errors and irregularities in the client's financial statements is arguably lower than for one auditor in a single audit. Second, since auditors share the audit fee, the economic dependence on a single client is reduced. Opponents of JAs, in contrast, argue that audit effort is lower in JAs than in SAs because of the free-riding problem. However, if free riding occurs or not, arguably depends on the size of the audit firms that are involved in the consortium.

The effect of the implementation of JAs on concentration depends on the composition of the JA consortium. The JA rules in Denmark and in France, for example, do not contain requirements regarding the composition of the consortium. If the consortium consists of two Big 4 audit firms, JAs will not have the desired effect on concentration (European Commission (2010); European Commission (2011a)). In fact, there are some reasons to assume that two Big 4 audit firms will form the consortium. First, the fact that audit firms are jointly liable implies that both audit firms must possess sufficient capacities to plan and conduct the audit. Second, the coordination costs are higher if the consortium consists of a Big 4 and a smaller audit firm (Gonthier-Besacier and Schatt (2007); Thinggaard and Kiertzner (2008)). If, however, an equal allocation of the workload between the auditors is not required, non-Big 4 audit firms could gain market shares in a mandatory JA setting (Guo et al. (2017)). In this vein, Piot (2007) argues that mandatory JAs would allow the largest non-Big 4 audit firms (e.g., Mazars in France) to challenge the Big 4 firms. This case could be advantageous for clients since larger audit firms cannot charge the Big 4 price premium, but arguably have the capacities that are necessary to audit large clients.

Recently, the UK Government, Department for Business, Energy & Industrial Strategy (2021) has proposed in its White Paper the implementation of mandatory managed shared audits for FTSE 350 companies. Under shared audits, companies would have to appoint an audit firm to lead the group audit. This audit firm would bear the overall liability. When a tender for the statutory audits of entities within the group occurs, companies would need to hire a challenger audit firm to conduct a meaningful proportion of the statutory audits. A challenger firm is a firm that provides statutory audits to Public Interest Entities, but does not generate audit revenues that exceed 15% of the FTSE 350 statutory audit market by fees in either of the prior two years. In contrast to a JA regime, the challenger audit firm would be liable for its audit work, but would not bear joint and several liability for the group audit. Whereas this regulation certainly reduces concentration in the audit market, the effect on audit quality could be negative because of the challenger's incentive to free ride on the effort of the larger audit firm.

IV.3. Summary

Regulators worldwide have taken action to improve the quality of statutory audits: In the European Union, the European Parliament and Council of the European Union (2014b) have introduced new regulations, which came into force in June 2016. Among other measures, the European Parliament implemented MAR and a prohibition on the joint supply of AS and NAS, but decided not to require mandatory JAs. In the United States, the Sarbanes-Oxley Act (2002) was implemented in 2002.

SOX includes regulations to improve auditor independence (e.g., audit partner rotation and a prohibition on the joint supply of AS and NAS), and the basis for the creation of the PCAOB. In the U.S., the regulator has decided not to implement MAR and does not require mandatory JAs.

As outlined above, the incentive effects of MAR, of a ban on single-provider auditing and consulting, and of JAs are ambiguous. Thus, from a theoretical perspective, it is, *ex ante*, not clear whether these measures indeed will improve the efficiency of audits and auditor independence. Moreover, in addition to increasing audit quality, the regulator aims at decreasing concentration and at intensifying competition. Unfortunately, the prediction regarding the effect of the audit regulations mentioned above on market structure are also indeterminate. An aggravating factor in predicting the effects of regulation is that market structure and audit quality are closely interconnected. Thus, it does not come as a surprise that the empirical findings regarding the association between audit regulations and audit quality and concentration, respectively, are mixed. We give an overview of empirical studies on these issues in the next chapter.

V. EMPIRICAL RESULTS ON THE EFFECTS OF REGULATIONS ON AUDIT QUALITY AND MARKET STRUCTURE

V.1. Introduction

As outlined in Figure 1, audit market regulations have both (intended and unintended) direct incentive effects and market structure effects. The introduction of MAR, for example, decreases the auditor's economic advantage derived from the auditor-client relationship. The intended direct incentive effect of MAR is then an increase in the auditor's incentive to remain independent. An unintended direct incentive effect of MAR, in contrast, is the loss of client-specific knowledge, which could result in a lower probability to detect errors and irregularities in the client's financial statements during the first periods of an audit engagement. However, the introduction of MAR also could have market structure effects. The effect of an increased dynamism of the audit market is intended, whereas the effect that concentration increases if clients choose one of the Big 4 audit firms as a successor to a mid-tier audit firm is unintended.

However, the empirical finding of an association between market structure and audit fees (see Paragraph III.3.2) could indicate that concentration determines audit firms' market power, but also that audit effort and/or auditor independence are contingent on the audit firm's market share. If the latter interpretation—which is supported by the empirical evidence for an association between concentration and audit quality (see Paragraph III.3.3)—is correct, then researchers have good reason to assume that audit market regulations also have indirect effects on incentives through their effect on the market structure (indirect incentive effect). Moreover, regulations can have indirect market structure effects, that is, changes in incentives caused by a regulation can influence market structure. For example, in the long run, the market structure is expected to adjust to the profits that audit firms can earn in a market that is shaped by a specific regulatory environment (see Paragraph II.4.4).

Consequently, to assess the overall effect of a regulation on audit quality, both the incentive effect and the market structure effect have to be considered.

In this chapter, we first provide a synopsis of the empirical evidence on whether MAR, the prohibition on the joint supply of AS and NAS, and JAs have the desired effects on audit quality. Note that audit quality as observed in the empirical literature is the combined result of the effects outlined above. Not surprisingly, the empirical findings on the effects of audit regulations on audit quality are mostly inconclusive. We thus highlight the main differences between the empirical studies to enhance the understanding of the contradictory results. One approach to understanding why empirically measured effects of regulations on audit quality are inconsistent is to investigate the direct market structure effect of regulations. In the next step, we thus give an overview of the empirical studies that address the effects of MAR and JAs on market structure. To the best of our knowledge, there is no such study on the effects of the prohibition on the joint supply of AS and NAS.

V.2. The effect of audit regulations on audit quality

V.2.1. The mandatory audit firm rotation

Lennox (2014) provides an overview of the arguments for and against MAR.²³ The arguments in favor of MAR are (1) the decrease in the *ex-ante* expected economic benefit an audit firm derives from a single client, and thus the reduction in the audit firm's economic dependence; (2) the successor's "fresh look" at the client's financial statements; (3) the prevention of close personal relationships and misplaced trust; and (4) an increase in competition. The potential disadvantages of MAR are (5) the reduction in audit firms' incentives to build up client-specific knowledge; (6) the loss of client-specific knowledge at the time of audit firm turnover; (7) transaction costs both for the audit firm and the client; and (8) limited incentives to exert audit effort during the final year of the auditor-client relationship. These arguments can be grouped into two categories: Arguments related to a change of the statutory auditor *per se* (i.e., (2), (6), and (7) from above) and arguments related to the effects of an *ex ante* limited tenure (i.e., (1), (3), (4), (5), and (8) from above). In line with this categorization, the empirical literature on the effects of MAR can roughly be divided into (1) studies investigating the effects of audit firm tenure and voluntary auditor changes, and (2) studies on the effects of MAR.

The literature on audit firm tenure and voluntary auditor changes is extensive. Ewelt-Knauer et al. (2012) provide a comprehensive chronological overview of archival studies from 1984 to 2009 that analyze the effect of audit firm tenure on audit quality.²⁴ These studies use data from 1960 to 2007, mainly from the U.S., but also from Australia, Belgium, and Taiwan. A vast majority of the studies document that long tenures improve (or at least do not impair) audit quality (e.g., Geiger and Raghunandan (2002); Myers et al. (2003); Carcello and Nagy (2004); Knechel and Vanstraelen (2007); Stanley and DeZoort (2007); Gul et al. (2009)). Overall, the evidence seems to indicate

²³ In his review, Lennox (2014) distinguishes between audit firm tenure, audit firm rotation, audit partner tenure, and audit partner rotation. We focus on mandatory audit firm rotation, as this type of rotation is most likely to have both incentive and market structure effects.

²⁴ Ewelt-Knauer et al. (2012) additionally provide overviews of analytical studies, experimental work, and survey research on the effects of MAR.

that the implementation of MAR would have a negative effect on audit quality. One of the exceptions is Davis et al. (2009), who find a non-linear relationship between audit firm tenure and earnings quality (i.e., both short and long tenures are positively associated with discretionary accruals, which are used as a proxy for (lower) audit quality). This result points to the problem of defining the optimal maximum tenure in case MAR is implemented.

However, studies on voluntary auditor changes fail to account for the potential direct incentive effects of MAR. Thus, the results from studies addressing voluntary auditor changes cannot be transferred without restrictions to a MAR setting: First, clients who voluntarily change their auditor might have an incentive to do so (e.g., opinion shopping, auditor-client disagreements, hiring a brand-name auditor in an IPO-setting, etc.). Second, the fact that both the auditor and the client anticipate an auditor turnover under MAR might affect both their reporting and audit effort strategies during their ongoing contractual relationship. Thus, comparisons of audit quality before and after a voluntary auditor change might not be the best prediction for the effect that a mandated turnover will have on audit quality. We thus focus on empirical studies conducted in settings where some form of MAR regulation was actually effective, that is, on studies using Italian, South Korean, or Spanish data.²⁵ However, the findings of these studies are mixed. There is some evidence confirming the findings from samples of voluntary auditor changes that the implementation of MAR would be disadvantageous since it would decrease audit quality:

Ruiz-Barbadillo et al. (2009) analyze Spanish data from 1991 to 2000 (3,119 observations) and use the likelihood that the auditor will issue a going-concern opinion (*GCO*) as a proxy for audit quality. The stylized logistic regression equation is

$$(31) \quad GCO = \alpha + \beta_1 \cdot MAR + \beta_2 \cdot INF + \beta_3 \cdot BIG6 \\ + \beta_4 \cdot INF \times MAR + \beta_5 \cdot BIG6 \times MAR + \gamma' [Controls] + \varepsilon.$$

MAR is a dummy for the years 1991–1994 when MAR was effective in Spain. At the country-level, Ruiz-Barbadillo et al. (2009) find a negative coefficient on *MAR* that is significant at the 5% level, indicating that audit quality was lower during the period when MAR was effective than in the period when MAR was abolished again. Additional analyses show that the coefficients on *INF* (i.e., the logarithm of a client's sales, divided by the sum of the logarithms of the sales of the auditor's whole clientele) and on the interaction term *INF*×*MAR* are not statistically significant; thus, the relative importance of a client is not connected to the likelihood that the client receives a *GCO*. The coefficient on *BIG6* is positive and significant at the 1% level, and the coefficient on the interaction term *BIG6*×*MAR* is negative and significant at the 5% level, suggesting that MAR mitigates the effect of the Big 6 reputation on the auditor's propensity to issue a *GCO*.

Using Italian data from 204 publicly listed companies audited by a Big 4 audit firm from the years 2006–2009 (667 firm-year observations), Cameran et al. (2015) find that abnormal working capital accruals (*AWCA*) are higher in the first three years following a mandatory rotation than in later years. *AWCA* are calculated as the difference between actual accruals and expected accruals based on the prior-year relation between a client firm's sales and its working capital accruals as in DeFond and Park (2001). The main conclusion of the study is derived from the stylized regression equation

²⁵ Most of these studies are also part of the literature reviews in Ewelt-Knauer et al. (2012) and Lennox (2014). However, they mainly discuss early working paper versions.

$$(32) \quad AWCA = \alpha + \beta_1 \cdot PERIOD_{Years1-3} + \gamma' [Controls] + \varepsilon,$$

where $PERIOD_{Years1-3}$ is an indicator variable that takes the value of one for the first three engagement years, and zero otherwise (during the sample period, auditors in Italy needed to be appointed for three years, and the appointment was renewable twice at most). From their finding of a positive coefficient on $PERIOD_{Years1-3}$ that is statistically significant at the 5% level, Cameran et al. (2015) conclude that shorter auditor tenure and thus MAR is associated with lower audit quality at the client-level. Further, Cameran et al. (2015) analyze the effects of mandatory and voluntary audit firm changes with the stylized regression equation

$$(33) \quad AWCA = \alpha + \beta_1 \cdot CHANGE_{vol} + \beta_2 \cdot CHANGE_{man} + \gamma' [Controls] + \varepsilon,$$

where the indicator variables $CHANGE_{vol}$ and $CHANGE_{man}$ take the value of one in case of a voluntary auditor change and the mandatory rotation, respectively. Cameran et al. (2015) find that the coefficients on both variables are non-significant.

Mali and Lim (2018) extend the reverse regression model suggested by Basu (1997) and the accrual-based model proposed by Ball and Shivakumar (2005) to investigate the effects of MAR in South Korea. They use data from 2000 to 2009 with 334 observations from the MAR sample spanning from 2006 to 2009 (out of 3,607 total observations):

$$(34) \quad TACC = \alpha + \beta_1 \cdot CC_{BS} + \beta_2 \cdot CHANGE_{man} + \beta_3 \cdot CC_{BS} \times CHANGE_{man} + \gamma' [Controls] + \varepsilon \text{ and}$$

$$(35) \quad EARN = \alpha + \beta_1 \cdot CC_{Basu} + \beta_2 \cdot CHANGE_{man} + \beta_3 \cdot CC_{Basu} \times CHANGE_{man} + \gamma' [Controls] + \varepsilon,$$

where CC_{BS} is a proxy for conditional conservatism defined as the product of cash flows from operations, divided by prior year total assets, and a dummy variable equal to one if cash flows from operations are negative. The conservatism proxy CC_{Basu} is the product of the cumulative stock returns for 12 months and a dummy variable equal to one if cumulative stock returns are negative. $TACC$ are total accruals, divided by prior year total assets, and $EARN$ are earnings, divided by prior year total assets. $CHANGE_{man}$ denotes an indicator variable equal to one in case of a mandatory audit firm rotation and zero in case of mandatory partner rotation or a voluntary auditor change, respectively. Mali and Lim (2018) find significantly (1%) negative coefficients on the interaction terms $CC_{BS} \times CHANGE_{man}$ and $CC_{Basu} \times CHANGE_{man}$, respectively, both when $CHANGE_{man}$ is compared to the mandatory partner rotation and to a voluntary auditor change. These results suggest that MAR decreases accounting conservatism, that is, lowers audit quality.²⁶

However, there are also findings that MAR increases audit quality:

Using Italian data from 1998 to 2011 (1,583 firm-year observations), Corbella et al. (2015) document that abnormal working capital accruals ($AWCA$) (as calculated in DeFond and Park (2001) and Francis and Wang (2008)) do not change significantly in the first year following a mandatory (or voluntary) auditor change between the Big 4 audit firms. For the stylized regression equation

$$(36) \quad AWCA = \alpha + \beta_1 \cdot CHANGE_{vol} + \beta_2 \cdot CHANGE_{man} + \gamma' [Controls] + \varepsilon,$$

the coefficient on the indicator variable $CHANGE_{man}$ (which takes the value of one for the year following a mandatory auditor change) is non-significant for the full sample and the Big 4 sub-

²⁶ Note that the conservatism proxy CC_{Basu} is always negative.

sample. This result is in line with the findings of Cameran et al. (2015) for Big 4 audit firms (regression equation (33)). For the non-Big 4 sub-sample, however, the coefficient on $CHANGE_{man}$ in the study of Corbella et al. (2015) is negative and significant at the 5% level. Thus, MAR seems to increase audit quality at least in the non-Big 4 market segment.

In line with the empirical result of Cameran et al. (2015), Cameran et al. (2016) document lower abnormal working capital accruals ($AWCA$) as calculated in DeFond and Park (2001) for Big 4 audit firms in the last three years before a mandatory rotation than in earlier periods. Cameran et al. (2016) use the following stylized regression model:

$$(37) \quad AWCA = \alpha + \beta_1 \cdot PERIOD_{Years4-6} + \beta_2 \cdot PERIOD_{Years7-9} + \gamma' [Controls] + \varepsilon.$$

For an Italian sample with 1,184 observations from the period 1985–2004, Cameran et al. (2016) find a significantly negative coefficient on $PERIOD_{Years7-9}$, an indicator variable that takes the value of one for audits in the last three years of the engagement. In contrast to Cameran et al. (2015), however, Cameran et al. (2016) interpret their result as an overall beneficial effect of MAR, as audit quality improves when the final engagement period gets closer. The underlying reasoning is that the auditor is more independent as an immediate reappointment is not possible anymore.

There is also the result that MAR does not affect audit quality:

Based on South Korean data from 2000 to 2009, Kwon et al. (2014) conclude that MAR does not have an effect on audit quality. For a sample of 6,710 firm-year observations including both Big 4 and non-Big 4 audit firms, neither in the first year nor in subsequent years after an enforced auditor change do Kwon et al. (2014) find changes in performance-adjusted discretionary accruals ($DACC$) calculated as in Kothari et al. (2005). To be more precise, Kwon et al. (2014) use the stylized regression equation

$$(38) \quad DACC = \alpha + \beta_1 \cdot MAR + \gamma' [Controls] + \varepsilon,$$

where MAR is a dummy variable for the years 2006–2009 when MAR was effective in South Korea. Kwon et al. (2014) find the coefficient on MAR to be non-significant, which indicates that audit quality during the MAR period is not different from the audit quality observed in the years before the MAR regulation became effective. Further analysis where Kwon et al. (2014) replace the MAR variable by indicator variables for continuing engagements, voluntary audit firm changes, and actual mandatory audit firm changes during the MAR period, respectively, shows that these variables also do not have a significant effect on $DACC$.

Even though studies from countries in which MAR was effective have an obvious advantage over studies that consider voluntary auditor changes, there are still a few drawbacks. In Italy, MAR was implemented in 1975 and was effective ever since (Cameran et al. (2016)). Thus, Italian data for the period after 1975 does not allow for an investigation of the effect of the implementation of MAR, but is eventually useful for investigating long-term effects like the adjustment of the market structure because of the new regulation. In South Korea, MAR was effective only between 2006 and 2010 (Kwon et al. (2014)). Potential long-term effects can thus not be investigated based on South Korean data. In Spain, MAR was effective from 1988 to 1995, and the maximum duration of the audit engagement was nine years. Thus, an audit firm change was actually never enforced (Ruiz-Barbadillo et al. (2009)). Researchers might soon overcome these drawbacks when more data from the EU will be available. The implementation of MAR in the EU Member States in 2016 (see European Parliament and Council of the European Union (2014b), Article 17) might provide

a good data source for future research on MAR. Using this data would help to more precisely differentiate between tenure-driven efficiency effects and regulation-driven incentive effects, which would allow for a better understanding of the effects of MAR on audit quality.

V.2.2. The prohibition on the joint provision of audit and non-audit services

Proponents of the prohibition on a joint supply of AS and NAS are concerned that the joint provision of both services could impair auditor independence—and thus audit quality—by making auditors financially dependent on their clients (economic bonding). Opponents of the prohibition, however, argue that the joint provision of AS and NAS leads to desirable “knowledge spillovers” that improve the auditor’s competency and efficiency (DeFond and Zhang (2014)).

The data basis for empirical research on the effects of the joint provision of AS and NAS is quite rich. Sharma (2014) gives a comprehensive overview of the literature on NAS and auditor independence that has been published between 2001 and 2012. This overview includes mainly studies from the U.S., but also from Australia, Italy, New Zealand, Norway, and the United Kingdom, using data from 1978 to 2007. Sharma (2014) structures his overview by differentiating between (1) auditor opinion studies, (2) restatement studies, (3) earnings quality studies, (4) studies on the role of good governance, (5) studies on the costs and benefits of the joint provision of AS and NAS, and (6) investor perception studies.

However, even though the literature is quite extensive, it does not show a clear tendency with regard to the advantageousness or disadvantageousness of a ban on the joint provision of AS and NAS. As the studies differ in their measures for the relevance of NAS, their proxies for audit quality, and their model specifications, the results lead to partially contradictory conclusions (Sharma (2014)). In the following, we present studies on this topic that are more recent and try to synthesize the main drivers for the contradictory findings.

There are studies suggesting that the prohibition on the joint supply of AS and NAS would be disadvantageous since the provision of NAS is connected to higher audit quality:

Using U.S. data from 1978 to 1980, Koh et al. (2013) investigate whether NAS fees lagged by one year (NAF_{-1}) are associated with lower earnings quality.²⁷ NAS fees are calculated either as the ratio between the total NAS fees and the total fees paid to the auditor or as the ratio between the fees paid for information services and the total fees. Audit quality (AQ) is either proxied by the absolute discretionary accruals ($DACC$) calculated using the cross-sectional version of the modified Jones (1991) model; 1,260 observations) or by the probability of meeting or beating earnings benchmarks (the indicator variable $I_{EARN_SURPR>0}$ takes the value of one for firms reporting a small positive earnings surprise; 1,266 observations). For the analysis, the following stylized regression equation is used (logistic regression when $I_{EARN_SURPR>0}$ is the dependent variable):

$$(39) \quad AQ = \alpha + \beta_1 \cdot NAF_{-1} + \gamma' [Controls] + \varepsilon .$$

If earnings quality is proxied by $DACC$, Koh et al. (2013) find the coefficient on NAF_{-1} to be non-significant when NAF_{-1} captures the total NAS fees. However, the coefficient is significantly negative at the 10% level when NAF_{-1} contains only information service fees. If earnings quality is

²⁷ Starting September 1978, U.S. companies had to report NAS fees as a percentage of AS fees; this regulation was however withdrawn in 1982 again (Koh et al. (2013)).

proxied by $I_{EAR_NSURPR>0}$, the coefficients on NAF_{-1} are significantly negative both for total NAS fees (10%) and for information service fees (5%). Further, to investigate perceived earnings quality, Koh et al. (2013) run an additional regression with the earnings response coefficient as the dependent variable (434 observations). Koh et al. (2013) find a significantly positive association between information service fees (5%) and the earnings response coefficient. As these results indicate a quality-increasing effect of the joint provision of NAS (especially for information services), the prohibition on the joint supply of AS and NAS would be disadvantageous.

Bell et al. (2015) use U.S. data from internal audit quality assessments made in 2003 in a Big 4 audit firm (265 observations). In their analysis, Bell et al. (2015) differentiate between public and private client firms and find that total NAS fees are positively associated with audit quality for SEC registrants, but negatively associated with audit quality for private client firms. In the stylized regression equation

$$(40) \quad AQ = \alpha + \beta_1 \cdot (NAF/AF) + \beta_2 \cdot PUB + \beta_3 \cdot PUB \times (NAF/AF) + \gamma' [Controls] + \varepsilon,$$

Bell et al. (2015) consider (1) an indicator variable that takes the value of one for engagements receiving an “unqualified satisfactory” assessment for overall audit quality, and (2) a continuous variable counting the total number of assessed audit deficiencies as proxies for the dependent variable audit quality (AQ). NAF/AF is the ratio of total NAS fees (NAF) to audit fees (AF), and PUB is an indicator variable that takes the value of one if the client has publicly listed securities (equity, debt, or both). Bell et al. (2015) find a positive coefficient on $PUB \times (NAF/AF)$ for the discrete measure that is significant at the 1% level; higher NAS fees for public clients thus increase the probability of a satisfactory assessment for audit quality. In a one-tailed test for the continuous measure of the assessed audit deficiencies, the authors find a negative coefficient; higher NAS fees for public clients thus decrease the number of audit deficiencies. The results indicate that audit quality is more likely to be higher when NAS fees increase if the client is a SEC registrant than when it is a private client. Bell et al. (2015) find no association between total NAS fees and audit quality in the full sample, though.

However, there are also findings that the joint provision of AS and NAS actually leads to lower audit quality, that is, a ban on the joint supply of both services would be advantageous:

Blay and Geiger (2013) find a negative association between NAS fees and GCO decisions. For the analysis, U.S. data from 2004 to 2006 with 180 observations where clients received a GCO and 1,299 observations of financially distressed clients that did not receive a GCO are used:

$$(41) \quad GCO = \alpha + \beta_1 \cdot LNAF + \beta_2 \cdot LNNAF + \gamma' [Controls] + \varepsilon.$$

GCO is an indicator variable that takes the value of one if the audit firm issues a GCO. $LNAF$ and $LNNAF$ are the natural logarithms of the current audit fees and NAS fees, respectively. Blay and Geiger (2013) find a negative coefficient that is significant at the 5% level on $LNNAF$ (whereas the coefficient on $LNAF$ is non-significant). Further, for the stylized regression equation

$$(42) \quad GCO = \alpha + \beta \cdot LNFEF_{YEAR+1,2} + \gamma' [Controls] + \varepsilon,$$

Blay and Geiger (2013) find a significantly (5%) negative coefficient on $LNFEF_{Year+1,2}$, that is, on the natural logarithm of the sum of the audit fees and NAS fees paid to the incumbent auditor in the subsequent two years. The results suggest that providing NAS to audit clients can impair auditor independence, especially when the clients are in financial distress.

Markelevich and Rosner (2013) show that both higher NAS fees and higher total fees are positively associated with the likelihood that clients would be sanctioned for issuing materially misstated or fraudulent financial statements. For their analysis, Markelevich and Rosner (2013) use U.S. data from 2000 to 2010 including 286 fraud firm-year observations and a control sample consisting of 14,326 firm-year observations. They consider different fee variables in their fraud prediction model. The stylized logistic regression equation is given by

$$(43) \quad FRAUD = \alpha + \beta_1 \cdot FEE + \gamma' [Fraud\ predictors] + \delta' [Controls] + \varepsilon.$$

FRAUD is a dummy variable that takes the value of one if the SEC had sanctioned the client for fraud. In the main analysis, *FEE* either captures the logarithm of total fees (*LNTF*) or the logarithms of audit fees (*LNAF*) and NAS fees (*LNNAF*) separately. Markelevich and Rosner (2013) find significantly positive coefficients on *LNNAF* (10%) and on *LNTF* (1%) (the coefficient on *LNAF* only gets significantly positive if governance variables are excluded). These findings indicate that clients with higher NAS fees are more likely to be sanctioned for issuing misstated or fraudulent financial statements, which is an indication of lower audit quality.

Lisic et al. (2019) examine the relation between an audit firm's U.S.-wide proportion of total NAS revenue in total revenue, and audit quality (46,864 observations from the years 2000–2013). In the stylized logistic regression equation

$$(44) \quad MISSTATE = \alpha + \beta_1 \cdot \%NAF + \beta_2 \cdot NAF + \beta_3 \cdot TAXF + \gamma' [Controls] + \varepsilon,$$

MISSTATE is an indicator variable that takes the value of one if the client's annual financial statements were misstated (as revealed through a subsequent restatement prior to the year 2016). *%NAF* is the proportion of the NAS fees an audit firm earns in the U.S. (i.e., the proportion of management advisory and other (non-tax) consulting revenues) in total U.S. revenue (i.e., audit, tax, management advisory and other (non-tax) consulting revenues), calculated at the audit-firm level. *NAF* are the management advisory and other (non-tax) NAS fees at the client level; *TAXF* are the tax fees paid to the auditor, also at the client level. Lisic et al. (2019) find a significantly (1%) positive coefficient on *%NAF* for the full sample and for the pre-SOX observations. For the post-SOX period, however, the coefficient is not statistically significant (the coefficient on *NAF* is significant for the full sample (the post-SOX period) at the 1% level (10% level), but non-significant for the pre-SOX period; the coefficient on *TAXF* is never statistically significant). The results suggest that pre-SOX higher proportions of NAS fees negatively affected audit quality, whereas this is not the case post-SOX.

Using a U.S. sample with 2,126 observations from 2005 to 2015, Carcello et al. (2020) examine the relation between NAS fees and the outcomes of goodwill impairment decisions:

$$(45) \quad IMP = \alpha + \beta_1 \cdot NAS + \gamma' [Controls] + \varepsilon.$$

IMP is an indicator variable that takes the value of one if the client recorded a material goodwill impairment (i.e., an impairment exceeding 0.5 percent of revenue). To capture the provision of NAS, either the natural logarithm of current NAS fees (*LNNAF*) or the sum of the current NAS fees divided by total fees paid to the auditor (*NAF/TF*) is used. Carcello et al. (2020) find a significantly negative coefficient on both *LNNAF* (1%) and *NAF/TF* (5%), indicating that goodwill impairment is less likely when NAS fees are larger.

Finally, there are also studies documenting mixed or non-significant results:

Lennox (2016) focuses on the restrictions on auditor-provided tax services that the PCAOB adopted on July 26, 2005. In the stylized logistic regression equation

$$(46) \quad AQ = \alpha + \beta_1 \cdot I_{Reduction\ TAXF} + \beta_2 \cdot I_{Reduction\ TAXF} \times POST + \beta_3 \cdot POST + \gamma' [Controls] + \varepsilon,$$

audit quality (AQ) is either proxied by an indicator variable equal to one if the client's audited financial statements are subsequently restated ($MISSTATE$); if the client's audited financial statements are restated due to tax issues ($MISSTATE_{Tax}$); or if the client receives a GCO from its auditor (GCO). $I_{Reduction\ TAXF}$ is an indicator variable equal to one if the client substantially reduced its auditor-provided tax service fees between July 26, 2005 and October 31, 2006 (i.e., in the transition period between the announcement of the restrictions and their implementation); $POST$ is an indicator variable equal to one for dates after October 31, 2006. For a sample of 24,859 observations (of which 5,992 are observations with reduced tax service fees), Lennox (2016) finds significantly positive coefficients on $I_{Reduction\ TAXF}$ for the audit quality proxies $MISSTATE$ and $MISSTATE_{Tax}$ at the 1% level (but not for GCO). He concludes that clients who had substantially reduced their auditor-provided tax services are more likely to misstate their financial statements during the pre-event window than clients who did not reduce the services to such a high extent. However, the coefficients on $I_{Reduction\ TAXF} \times POST$ are not statistically significant for the quality proxies $MISSTATE$ and $MISSTATE_{Tax}$; for the quality proxy GCO , the coefficient is significantly positive at the 10% level, though. The findings thus suggest that the restrictions on auditor-provided tax services did not result in higher audit quality.

Beardsley et al. (2019) find a positive association between audit fee pressure and the provision of NAS. The authors then investigate both the effect of an increased focus on providing NAS due to higher fee pressure and the combined effect of audit fee pressure and increased NAS provision on audit quality, using U.S. data from 2004 to 2013 (3,029 observations):

$$(47) \quad \Delta MISSTATE_RATE = \alpha + \beta_1 \cdot I_{Increase\ NAF} + \beta_2 \cdot I_{Increase\ NAF} \times PRESSURE + \beta_3 \cdot PRESSURE + \gamma' [Controlss] + \varepsilon.$$

The dependent audit quality metric $\Delta MISSTATE_RATE$ is the change in audit offices' client misstatement rates (identified through subsequent restatements) from the previous year to the present year. $I_{Increase\ NAF}$ is an indicator variable equal to one in case of an unexpected NAS fee increase; $PRESSURE$ is an indicator variable that takes the value of one if the average unexpected audit fees are lower in the present year than in the previous year. The coefficients on $I_{Increase\ NAF}$ and $PRESSURE$ are not significant. However, Beardsley et al. (2019) find a positive coefficient on $I_{Increase\ NAF} \times PRESSURE$ that is significant at the 5% level. Thus, an increased focus on NAS is positively associated with higher rates of client misstatements for audit offices under audit fee pressure than for audit offices that do not face fee pressure.

For the analysis of the German audit market (data from 2005 to 2009), which is characterized by a comparatively low litigation risk, Ratzinger-Sakel (2013) applies the stylized logistic regression equation

$$(48) \quad GCO = \alpha + \beta_1 \cdot NAF + \beta_2 \cdot AF + \gamma' [Controls] + \varepsilon.$$

GCO is an indicator variable that takes the value of one if the auditor's report contains a first time going concern emphasis-of-matter paragraph, and NAF (AF) is the natural logarithm of the NAS fees (audit fees). The sample includes 60 observations of client firms receiving a first-time GCO

and a (“strict”) control sample of (107) 648 financially stressed client firms that received a clean audit opinion. Ratzinger-Sakel (2013) finds that the coefficient on *NAF* (and *AF*) is not statistically significant, indicating that high NAS fees do neither impair nor enhance audit quality.

Using Spanish data from 2005 to 2013 with 813 firm-year observations, Garcia-Blandon et al. (2017) investigate whether absolute discretionary accruals (*DACC*) are comparably low when the NAS fees paid to the auditor are high in relation to the audit fees:

$$(49) \quad DACC = \alpha + \beta_1 \cdot NAF70\% + \gamma' [Controls] + \varepsilon.$$

DACC are calculated either using the modified Jones (1991) model (Dechow et al. (1995)) or as performance-matched discretionary accruals as suggested by Kothari et al. (2005). *NAF70%* is an indicator variable that takes the value of one when the NAS fees paid to the auditor exceed 70% of the audit fees. Garcia-Blandon et al. (2017) do not find a significant effect of *NAF70%* on absolute discretionary accruals. In their analysis, Garcia-Blandon et al. (2017) further differentiate between audit-related NAS, tax-related NAS, and NAS other than those related to audit or tax. However, the association between the provision of the respective NAS components and absolute discretionary accruals is also not statistically significant.

Based on a sample from South Korea for the periods 2002–2016 with 15,837 firm year observations in total (and 4,511 observations where the client received NAS from the auditor), Kang et al. (2019) investigate whether the effect of NAS on the discretionary accruals (*DACC*) derived from the modified Jones (1991) model (Dechow et al. (1995)) varies with client performance:

$$(50) \quad DACC = \alpha + \beta_1 \cdot NAF + \beta_2 \cdot PERF + \beta_3 \cdot NAS \times PERF + \gamma' [Controls] + \varepsilon.$$

NAF is either the NAS fees divided by the total fees (*NAF/AF*) or the natural logarithm of the NAS fees (*LNNAF*). *PERF* is a placeholder for an indicator variable that takes the value of one if the client’s return on assets or operating cash flow exceeds the respective (industry-year) median (*ROA* or *OCF*, respectively). Kang et al. (2019) find coefficients that are significantly positive at the 5% level on the interaction terms for all four possible NAS and performance proxy combinations, and conclude that the joint provision of AS and NAS reduces audit quality only for low-performing clients.

To sum up, the evidence on the effects of the joint provision of AS and NAS on audit quality is mixed. However, in addition to the sample, the studies differ in a multitude of dimensions, for example, in the proxies for audit quality, in the way the provision of NAS is measured, and in the interaction terms considered. These differences complicate a rather general assessment of a regulation prohibiting the provision of NAS.

V.2.3. Joint audits

Proponents of JAs frequently claim that JAs would enhance auditor independence and reinforce professional skepticism, resulting in audit quality that is higher in JAs than in single audits (SAs). Further, advocates of JAs argue that synergy effects would increase audit quality. Opponents of

JAs, however, argue that JAs can lead to free riding on audit effort as well as to coordination frictions, which would decrease audit quality.²⁸

Comparable to the situation for empirical research on the effects of MAR, data on actually required JAs is scarce. The majority of empirical research thus uses either data from Denmark, where JAs were required for all listed and state-owned companies from 1930 to 2004, or from France, where JAs are mandatory since 1966 for all listed companies and for non-listed companies with a share capital value exceeding a certain threshold (Ratzinger-Sakel et al. (2013)).²⁹ Ratzinger-Sakel et al. (2012) provide an overview of archival studies from 2010 to 2012, analyzing the effect of JAs on audit quality based on data from 2000 to 2010.³⁰ In addition to the studies from France and Denmark, there are also studies investigating the effect of JAs on audit quality in settings with voluntary joint audits. In the following, we extend and update this overview and present the main findings in a stylized but comparable way.

To the best of our knowledge, there is only one empirical study suggesting that audit quality in JAs is lower than in SAs:

Using French data from 2009 to 2012 (532 observations), Haak et al. (2018) report that a less balanced audit work allocation in a JA is associated with lower absolute abnormal working capital accruals (*AWCA*) calculated as in DeFond and Park (2001). To be more specific, for the stylized regression equation

$$(51) \quad AWCA = \alpha + \beta \cdot \%AF_{main} + \gamma' [Controls] + \varepsilon,$$

Haak et al. (2018) find a negative coefficient on $\%AF_{main}$ that is significant at the 10% level. $\%AF_{main}$ captures the share of the audit fees paid to the auditor who receives the largest share of the fees. Alternative settings where dummy variables indicating that the main auditor receives more than 70%, 75%, or 80% of the audit fees are used lead to comparable findings (i.e., significantly (1%) negative coefficients on the respective dummy variables). When total fees instead of audit fees are used, the coefficient β is non-significant, however. Haak et al. (2018) conclude that a more balanced audit work allocation reduces audit quality. As unbalanced JAs have parallels to SAs, Haak et al. (2018) follow that the results suggest that SAs may lead to higher audit quality than JAs.

On the contrary, there are studies indicating that the implementation of mandatory JAs would increase audit quality:

Zerni et al. (2012) use Swedish data from 2001 to 2007 (consisting of an initial sample of 1,667 firm-year observations including 973 JAs) to investigate whether voluntary JAs lead to accounting earnings recognizing bad news on a timelier basis than good news. To be more precise, Zerni et al.

²⁸ Opponents of JAs also frequently argue that JAs would lead to additional costs. The empirical evidence on this claim is, however, inconclusive. For example, André et al. (2016) and Lesage et al. (2017) find higher fees for JAs than for SAs. Holm and Thinggaard (2014) and Holm and Thinggaard (2016), in contrast, find that audit fees for JAs do not differ significantly between JAs and SAs.

²⁹ Several other countries have or had JA requirements for certain industries (mostly for banks and financial institutions) or allow for voluntary JAs (see Ratzinger-Sakel et al. (2012)).

³⁰ Ratzinger-Sakel et al. (2012) additionally provide overviews of studies on the effects of JAs on audit costs and audit market concentration, on the effects of auditor choice on audit costs and quality in JA settings, and on the determinants of the auditor-pair choice. Quite a few of the reviewed studies are working papers that might have changed before publication.

(2012) extend the Basu (1997) model by including the indicator variable JA , which takes the value of one if the client employs a JA:

$$(52) \quad EARN = \alpha + \beta_1 \cdot JA + \beta_2 \cdot JA \times RET + \beta_3 \cdot JA \times I_{RET < 0} \\ + \beta_4 \cdot JA \times I_{RET < 0} \times RET + \gamma' [Controls] + \varepsilon.$$

$EARN$ are the earnings per share before extraordinary items, scaled by the stock price at the beginning of the period; RET is the annual raw stock return; and $I_{RET < 0}$ is an indicator variable that takes the value of one if RET is negative. Zerni et al. (2012) find a significantly (5%) positive coefficient $JA \times I_{RET < 0} \times RET$ and conclude that JAs are associated with more conservative earnings. Further, Zerni et al. (2012) investigate the effect of voluntary JAs on abnormal working capital accruals ($AWCA$) based on DeFond and Park (2001). To do so, they use a regression model that is comparable to that used by Lesage et al. (2017), that is,

$$(53) \quad AWAC = \alpha + \beta_1 \cdot JA + \gamma' [Controls] + \varepsilon.$$

When income-increasing abnormal working capital accruals are considered, Zerni et al. (2012) find a negative coefficient on JA that is significant at the 10% level.

Using data from Gulf Cooperation Council countries from 2005 to 2013 with 1,372 observations in total, Al-Hadi et al. (2017) investigate the effect of voluntary JAs on cost of debt (COD):

$$(54) \quad COD = \alpha + \beta_1 \cdot JA + \gamma' [Controls] + \varepsilon.$$

COD is calculated as total interest expenses, scaled by total interest-bearing liabilities. Al-Hadi et al. (2017) find a negative coefficient on JA (an indicator variable that takes the value of one in case of a JA) that is significant at the 5% level.

Moreover, there is evidence that the advantageousness of JAs depends on the size of the audit firms forming the JA consortium:

Francis et al. (2009) use French data for mandatory JAs from 2003 (468 observations) to investigate the determinants of auditor-pair choice and its effect on the absolute value of abnormal working capital accruals ($AWCA$) based on DeFond and Park (2001), scaled by lagged assets, income-increasing abnormal working capital accruals, and income-decreasing abnormal working capital accruals.

$$(55) \quad AWCA = \alpha + \beta \cdot AUDITOR_PAIR + \gamma' [Controls] + \varepsilon.$$

$AUDITOR_PAIR$ is a placeholder for indicator variables that take the value of one if the auditor-pair consists of two Big 4 audit firms ($BIG4_BIG4$), a Big 4 and a non-Big 4 audit firm ($BIG4_SMALL$), or two large French audit firms and/or a large French audit firm paired with a non-Big 4 audit firm (LF_SMALL). When income-increasing abnormal working capital accruals are chosen as the dependent variable, Francis et al. (2009) find negative coefficients on $BIG4_BIG4$ that are significant at the 1% (5%) level, when compared to all other JA auditor pairs (to Big 4/non-Big 4 pairs). They further find significantly negative coefficients on $BIG4_SMALL$ (10%), when compared to JAs with non-Big 4/non-Big 4 auditor-pairs. However, the coefficients

on LF_SMALL (compared to JAs with non-Big 4/non-Big 4 auditor-pairs) are significantly negative at the 5% level for income-decreasing abnormal working capital accruals as the dependent variable.

Lobo et al. (2017) use French data from 2006 to 2009 to investigate the effect of the auditor-pair on goodwill impairment decisions:

$$(56) \quad \begin{aligned} IMP = & \alpha + \beta_1 \cdot BIG4_SMALL + \beta_2 \cdot PERF_{low} + \beta_3 \cdot PERF_{low} \times BIG4_SMALL \\ & + \gamma' [Controls] + \varepsilon, \end{aligned}$$

where IMP is a placeholder for either $IMP>0$ (an indicator variable that takes the value of one if the firm recognizes goodwill impairment (logistic regression)) or $\%IMP$ (the impairment loss (if any), divided by the beginning-of-the-year goodwill). $PERF_{low}$ is a low-performance indicator based on return on assets, operating cash flows, or market-to-book ratio. $BIG4_SMALL$ is an indicator variable that takes the value of one if the JA consortium consists of a Big 4 and a non-Big 4 audit firm. For both $IMP>0$ and $\%IMP$, Lobo et al. (2017) find that $\beta_1 + \beta_3$ is significantly positive for each of the low-performance indicators (at the 1% or 5% level, depending on the basis of the low-performance measure). This indicates that firms audited by a Big 4/non-Big 4 auditor-pair are more likely to recognize an impairment and book a larger impairment than firms audited by a Big 4/Big 4 auditor-pair when low-performance indicators suggest a higher likelihood of impairment.

Finally, there are also results indicating that the implementation of JAs would not significantly affect audit quality:

André et al. (2016) compare audit fees between France, Italy, and the United Kingdom for the years 2007–2011 (3,155 firm year-firm observations). They find that, despite the higher audit fees in France (where JAs are mandatory), abnormal accruals do not differ significantly between the countries. For the analysis of the abnormal accruals, the stylized regression equation

$$(57) \quad AWCA = \alpha + \beta_1 \cdot UK + \beta_2 \cdot IT + \beta_3 \cdot BIG4 + \gamma' [Controls] + \varepsilon$$

is used, where $AWCA$ is either the value of abnormal working capital accruals scaled by sales or the abnormal accruals. UK and IT are indicator variables that take the value of one for British and Italian companies, respectively. $BIG4$ is an indicator variable that takes the value of one if at least one Big 4 takes part in a French JA or if the SA in the United Kingdom or in Italy is conducted by a Big 4 audit firm. André et al. (2016) find that the coefficients on UK , IT , and $BIG4$ are non-significant, irrespective of the choice of the dependent variable. Thus, André et al. (2016) conclude that JAs in France are not associated with higher audit quality than Big 4 SAs in the United Kingdom and in Italy. A more detailed analysis where André et al. (2016) consider different auditor-pairs in France (i.e., Big 4/Big 4 or Big 4/non-Big 4) and the choice of Big 4 or non-Big 4 audit firms in the United Kingdom and in Italy does not change this finding.

Using Danish data from 2002 to 2010, Lesage et al. (2017) exploit the fact that the mandatory JA regime in Denmark was abandoned in 2005. Their dataset used for a cross-time comparison includes 358 JA and 208 SA observations. To investigate the effects of JAs on audit quality, Lesage et al. (2017) use the following regression equation:

$$(58) \quad DACC = \alpha + \beta_1 \cdot JA + \gamma' [Controls] + \varepsilon,$$

where JA is an indicator variable that equals one if two different audit firms sign the audit report. $DACC$ is a placeholder for the four different accrual measures “signed value of abnormal accruals”; “absolute value of abnormal accruals”; “positive value of abnormal accruals”; and “negative value of abnormal accruals” used in the analysis. Lesage et al. (2017) find non-significant coefficients on JA for all abnormal accrual versions. Further analyses also show that the change from JA to SA is not associated with a change in the signed value of abnormal accruals.

Holm and Thinggaard (2018) use Danish data from 2005 to 2008 (with 286 observations in total) to investigate whether abnormal accruals ($DACC$) differ between Big 4 SAs and JAs with either one or two Big 4 audit firms:

$$(59) \quad DACC = \alpha + \beta_1 \cdot BIG4_BIG4 + \beta_2 \cdot BIG4_SMALL + \gamma' [Controls] + \varepsilon.$$

$DACC$ are based either on DeFond and Park (2001) or on an adapted version of the Jones (1991) model as proposed by Kothari et al. (2005). $BIG4_BIG4$ ($BIG4_SMALL$) is an indicator variable that takes the value of one if the company is audited by two Big 4 audit firms (by one Big 4 and one non-Big 4 audit firm). Irrespective of the accrual measure and of whether total abnormal accruals or only income-increasing or income-decreasing abnormal accruals are used as the dependent variable, Holm and Thinggaard (2018) find that the coefficients on $BIG4_BIG4$ and $BIG4_SMALL$ are statistically non-significant.

To summarize, those studies using data from mandatory JA settings seem to find neither a positive nor a negative effect of JAs on audit quality. Those studies investigating data from voluntary JAs , however, find a positive association between JAs and audit quality. Even though there are undoubtedly differences between mandatory and voluntary JA settings, putting more weight on the potential drivers of such differences might be a fruitful path for future research.

V.3. The effect of audit regulations on market structure

In addition to the direct effects of audit regulations on audit quality, the regulations currently discussed (or recently implemented) might also have desired or undesired effects on the structure of the audit market. Investigating the market structure effects of audit regulations is important for at least three reasons: First, regulators aim directly at decreasing the currently high level of concentration. It therefore seems worth the effort to check whether the regulators’ goals of reducing concentration and increasing competition have actually been achieved. Second, market structure is associated with audit quality (see Paragraph III.3.3). Thus, the market structure effect of regulations can reinforce or dilute their direct incentive effects. Third, since the overall effect of a regulation might depend on the initial level of concentration that existed before the regulation went into effect, a monitoring of the development of the market structure seems necessary.

In this paragraph, we review the findings on the effects of audit market regulations on market structure. In contrast to the empirical literature on the effects of audit regulations on audit quality, the literature on the market structure effects is rather scarce. One obvious reason is a lack of data that would allow for such empirical investigations. In particular, the sample period would have to consider that the effects of regulations on the market structure need some time to unfold. Although this criterion is fulfilled for the prohibition on the joint supply of AS and NAS due to SOX, we are not aware of any study explicitly (or implicitly) investigating the effects of such a regulation on market structure. We therefore present studies on the market structure effects of MAR and JAs .

V.3.1. The mandatory audit firm rotation

Regulators expect that MAR increases the dynamism of the audit market and decreases the market shares of the Big 4 audit firms. Proponents of MAR assume that MAR can provide smaller audit firms the opportunity to enter the market segment of audits for listed companies. However, it is also possible that MAR leads to a further increase in market concentration, because larger clients tend to choose one of the Big 4 audit firms as successor if they are forced to change their auditor (Ewelt-Knauer et al. (2012)).

To the best of our knowledge, there is only one simulation on the effects of MAR on market structure. Comunale and Sexton (2005) construct a Markov model that depicts the audit firm changes among the Big 5 audit firms of S&P 500 clients between 1995 and 1999. Audit firm rotation is reflected in the transition probabilities, that is, in the probabilities that the client remains with the incumbent or switches to another audit firm. Comunale and Sexton (2005) examine the state probabilities after two, five, and nine years to evaluate the impacts of MAR. They find that MAR would have substantial effects on the market shares of the individual Big 5 audit firms that are active in the S&P 500 market, but also conclude that MAR would not create excessive market power for any of the Big 5 audit firms. However, Comunale and Sexton (2005) assume that clients continue their reliance on the Big 5 audit firms under MAR. Therefore, by assumption, the relation between the market shares of the Big 5 and the non-Big 5 audit firms remains stable. Further, the estimated transition probabilities are assumed to remain constant over time.

Gerakos and Syverson (2015) do not explicitly consider the effect of MAR on concentration, but use a discrete choice approach to estimate the losses in consumer surplus occurring from the implementation of MAR. Using U.S. data of publicly listed firms from 2001 to 2010, Gerakos and Syverson (2015) first identify clients' preferences for one of the Big 4 audit firms. The resulting demand model yields quantitative predictions about how audit firms' attributes (e.g., brand names, fees, and prior history with potential clients) and the match between the audit firm and the clients' characteristics (e.g., assets, industry segments, and foreign sales activity) affect the clients' audit firm choices. This demand model allows Gerakos and Syverson (2015) to determine the clients' willingness to pay for longer-term relationships with a particular audit firm, and the value clients would lose if forced to switch from their most preferred auditor to their best alternative auditor choice. Gerakos and Syverson (2015) estimate that the implementation of MAR would imply substantial consumer surplus losses for publicly traded U.S. firms of about USD 2.7 billion if MAR were required every ten years, and of up to USD 4.7–5.0 billion if MAR were required every four years. Moreover, Gerakos and Syverson (2015) calculate that MAR could result in an increase of audit fees of USD 0.75 to USD 1.3 billion per year.

In applying a dynamic discrete choice approach, Cheynel and Zhou (2020) extend the work of Gerakos and Syverson (2015) by considering both the client's current-period utility and the client's expected future utility derived from the auditor choice. Based on a sample of audit firm switching and misstatement decisions from 2003 to 2015, Cheynel and Zhou (2020) find that longer tenure is associated with lower utility from switching and greater utility from misstating. The increase in the switching rates under MAR can be explained with a lower expected future utility of the client if a maximum tenure is imposed. Moreover, misstatement rates modestly decrease from 7.6% to 5% (5.7%) if MAR after five years (10 years) is implemented.

V.3.2. Joint audits

Regulators expect that JAs can also help to decrease market concentration and to increase competition since a consortium of a Big 4 and a smaller audit firm would help the smaller audit firms to take root in the large listed companies segment. However, JAs might also lead to the undesired outcome that the audit market becomes “sticky” and that the number of audit firms to choose from further decreases (Ratzinger-Sakel et al. 2012).

Piot (2007) does not explicitly address the market structure effects of the implementation of a JA regime, but compares the market shares of the large audit networks for the years 1997 and 2003 in France where JAs are mandatory. Two external market structure shocks fall into this time span: (1) The merger between Coopers & Lybrand and Price Waterhouse to form PricewaterhouseCoopers in 1998, and (2) the collapse of Arthur Andersen, which resulted in the integration of the Arthur Andersen French correspondent Barbier Frinault into Ernst & Young in 2003. Thus, Piot (2007) does not explicitly consider the effect of JAs on the market structure, but rather the effects of external market structure shocks in a JA setting. The descriptive comparison shows that the PricewaterhouseCoopers merger in 1998 did not produce any gain in market share to the newly formed network, and that Barbier Frinault suffered an erosion of its audit portfolio resulting from the Enron case. However, the increased concentration due to the merger and the erosion of Barbier Frinault’s market share did not result in abnormally frequent collaborations between the main audit firms. Some national French audit networks have maintained significant market positions.

Audousset-Coulier (2015) does also not explicitly investigate the effects of JAs on market structure, but examines to what extent the number of Big 4 audit firms in a JA consortium (i.e., zero, one, or two Big 4 audit firms) affects audit fees. Using French data, she finds that hiring a combination of two Big 4 audit firms does not require paying a Big 4 premium that exceeds the fees for a Big 4/non-Big 4 auditor-pair. Audousset-Coulier (2015) thus concludes that the choice of two Big 4 auditors appears to be a rational economic choice for large and international clients. She argues that the requirement to hire a smaller audit firm paired with a larger one might lead to non-optimal situations, in particular for large, diversified, and international clients. In contrast to this argument, Francis et al. (2009) find for a sample of 467 French-listed companies from 2003 that only 11.6% of the companies were audited by Big 4/Big 4 auditor-pairs, whereas 51.6% of the companies were audited by Big 4/non-Big 4 combinations.

Even though Lesage et al. (2017) focus on the effects of JAs on audit fees and audit quality, they also document the effects of the abandonment of mandatory JAs in Denmark in 2005 on the Big 4 audit firms’ market shares. For the years 2002–2004, when JAs were mandatory in Denmark, the Big 4 audit firms had market shares of 73.7%, on average (based on the number of clients). In the years 2005–2010, the Big 4 audit firms’ market shares increased to 81.8%, on average. Thus, the argument that the implementation of mandatory JAs would decrease absolute concentration seems worth considering.

Similar to the MAR study of Comunale and Sexton (2005), Kermiche and Piot (2018) use a Markov model to estimate the relative attractiveness of different types of auditor-pairs in JAs in France. Kermiche and Piot (2018) simulate the long-term market structure based on two different market conjunctures: (1) A market concentration period during which the Big 6 developed into the Big 4 (i.e., 1997–2003); and (2) a stability period characterized by a Big 4 audit market (i.e., 2003–2009). Kermiche and Piot (2018) find that the JA system in France can mitigate a Big 4 audit market

dominance in the end. More specifically, they predict that Big 4/non-Big 4 auditor-pairs will remain the most common auditor-pairs, adopted by a majority of 54% of the audit clients.

Guo et al. (2017) use a structural application of the discrete choice model to analyze the effects of mandatory JAs on the structure of the audit market and on consumer surplus. To estimate clients' preferences for each individual audit firm and joint auditor pair, which are contingent on the audit firm's and the client's characteristics, Guo et al. (2017) use data from France (where JAs are mandatory). In the next step, Guo et al. (2017) apply their demand estimates to the single audit regime of the United Kingdom. The results indicate that the introduction of JAs in the United Kingdom would decrease the total consumer surplus, on average, by GBP 73.1 million per year. Guo et al. (2017) also find that the implementation of mandatory JAs would have significant effects on audit firms' market shares. More precisely, Guo et al. (2017) predict that small audit firms would gain clients, but would not be able to substantially increase their market shares (based on clients' assets). Two of the six largest audit firms, in contrast, would benefit in terms of substantial market share increases. Guo et al. (2017) also show that their results are sensitive to the specifications of the JA requirement. For example, Guo et al. (2017) predict that smaller audit firms will increase their market shares only if an equal split of the audit work between the auditors in the consortium is not required. The necessity to hire at least one non-Big 4 audit firm would mainly lead to a market share increase for the largest medium-sized audit firms, but would not help the smaller audit firms to significantly increase their market shares.

V.4. Summary

The review of the studies presented above shows that the effects of MAR, of the prohibition on the joint supply of AS and NAS, and of mandatory JAs on audit quality are not clear-cut. The currently available evidence does not allow for an unambiguous assessment of these regulatory measures. Further, even when the empirical results do not qualitatively differ across studies, they often can be interpreted in a way either against or in favor of a regulation (see, for example, Cameran et al. (2015) vs. Cameran et al. (2016) for the effects of MAR). The obvious reasons for the mixed findings are differences in the samples (both with respect to the country, the time span, and the market segment analyzed), in the measures used to proxy for audit quality, and in the explanatory variables.

Much more important, however, is the observation that controls for the auditor's market power, or, more generally, for the market structure, are missing. To the best of our knowledge, empirical studies frequently take into account aspects of the market structure only by using the Big 4/non-Big 4 dichotomy.³¹ A meaningful path for future research would thus be to use the traditional concentration measures (i.e., the CR_4 , the HHI , or the Gini coefficient) at the MSA-, the MSA-industry-, or the audit firm's office-level as an input to audit quality regressions. Moreover, metrics derived from spatial competition models (Numan and Willekens (2012); Bills and Stephen (2016); Chu et al. (2018); Willekens et al. (2020)) or proxies for competition (as the mobility of market shares; Van Raak et al. (2020)) could capture the effect of structure and conduct on performance. Inclusion of these controls seems necessary, as empirical evidence indicates that audit quality and market structure are connected.

³¹ An exception is Lisic et al. (2019), who consider the proportion of the NAS fees in total revenue, calculated at the audit-firm level.

Studies directly investigating the effect of regulations on market structure are scarce. In particular, there is a lack of studies addressing the effects of MAR and of a prohibition on the joint supply of AS and NAS on market structure. Thus, it is not possible to draw a meaningful conclusion with respect to the effectiveness of these regulations. One reason for the scarcity of research in this field is a lack of data. Conducting empirical studies on the market structure effects of MAR, however, will soon be possible, when data from European countries becomes available. As regards the effects of a prohibition on the joint supply of AS and NAS, data from the U.S. is already available. Empirical studies thus could analyze the effect of this regulation. However, the sample period would have to take into account that the market structure effect needs time to unfold. For research on the effects of JAs, the perspective is less promising, since JAs have not been made mandatory in the EU. The studies presented above seem to suggest that JAs tend to decrease market concentration. However, such a conclusion might also be premature, as most of the studies do not explicitly investigate the effects of JAs on market structure. Moreover, the studies rely on data from only two countries (i.e., Denmark and France).

VI. ANALYTICAL PAPERS THAT CONSIDER THE STRUCTURE OF THE AUDIT MARKET AS EXOGENOUS

VI.1. Introduction

In the following, we provide an overview of analytical studies that address the effects of MAR, the prohibition on the joint supply of AS and NAS, and JAs. The studies we present in this chapter do not consider interdependencies between incentive effects and market structure effects. We discuss such studies in Chapter VII. Compared to the empirical literature, the analytical literature on audit market regulations is rather scarce.

VI.2. The effect of audit regulations on audit quality

VI.2.1. The mandatory audit firm rotation

Arruñada and Paz-Ares (1997) analyze the direct effects of MAR on audit costs, market concentration, and audit quality. However, they do not explicitly solve a model of MAR, but mainly discuss the potential effects of MAR on the elements of their model. To be more specific, in a first step, Arruñada and Paz-Ares (1997) compare the net present value of total audit costs (TAC) in the case of voluntary rotation against the net present value arising under MAR. In the voluntary rotation setting, clients are assumed to change the auditor every T_{vol} years, and clients that are half-way through the auditor-client relationship are considered as a reference point. The next voluntary auditor change thus takes place in $T_{vol}/2$ years. In the MAR setting, the point of reference is the time of the first enforced auditor change; the next mandatory auditor change takes place in $T_{max} < T_{vol}$ years (i.e., T_{max} is the maximum tenure under MAR). The respective values for the total audit costs in case of a voluntary (mandatory) auditor change, TAC_{vol} (TAC_{MAR}), are given as

$$(60) \quad TAC_{vol} = c_{recurring} \cdot \frac{1+r}{r} + (c_{start-up} + c_{change}) \cdot \frac{(1+r)^{T_{vol}/2}}{(1+r)^{T_{vol}} - 1} \text{ and}$$

$$(61) \quad TAC_{MAR} = c_{recurring} \cdot \frac{1+r}{r} + (c_{start-up} + c_{change}) \cdot \frac{(1+r)^{T_{max}}}{(1+r)^{T_{max}} - 1}.$$

$c_{recurring}$ are the annual costs of a recurring audit; $c_{start-up}$ are start-up costs for the first audit of a specific client; c_{change} are the client's costs of changing the auditor (excluding possible increases in audit fees resulting from the auditor change); and r is the interest rate. Arruñada and Paz-Ares (1997) calculate the increase rate of the total audit costs for a switch from a voluntary to a mandatory auditor change scenario. More precisely, they show graphically how $[TAC_{MAR} - TAC_{vol}]/TAC_{vol}$ changes when different fractions between recurring costs and initial start-up and change costs ($c_{recurring}/(c_{start-up} + c_{change})$) are assumed, when T_{vol} changes, and when T_{max} is adjusted. Depending on the estimated relative costs for recurring and new audit engagements, Arruñada and Paz-Ares (1997) calculate that for a client who has to change the audit firm mandatorily every 9 years instead of voluntarily every 40 years, the present value of the total audit costs increases by between 7% and 20%.³² The general result that the net present value of total audit costs is higher under MAR is not surprising as TAC strictly increases in the frequency of auditor changes (i.e., TAC strictly decreases in T).

In the next step, Arruñada and Paz-Ares (1997) simulate changes in the market structure resulting from the implementation of MAR. Arruñada and Paz-Ares (1997) consider homogenous audit clients. Moreover, they assume that all clients simultaneously change their auditor and that auditors gain new clients in proportion to their initial market shares.³³ These assumptions lead to the following formula, which describes the market share $\alpha_{i,T_{max}+1}$ of a certain audit firm i in year $T_{max}+1$, conditional on the respective audit firm's market share and the $n-1$ competitors' market shares in T_{max} ($T_{max} = 0$ indicates the situation before MAR, $T_{max} = 1$ is the year of the first enforced auditor change, and so on):

$$(62) \quad \alpha_{i,T_{max}+1} = \sum_{i=1}^n \left(\alpha_{i,T_{max}} \cdot \frac{\alpha_{i,T_{max}}}{1 - \alpha_{i,T_{max}}} \right) - \alpha_{i,T_{max}} \cdot \frac{\alpha_{i,T_{max}}}{1 - \alpha_{i,T_{max}}}.$$

Based on the market shares of the Big 6 audit firms in the Spanish audit market in 1994, Arruñada and Paz-Ares (1997) graphically show how the initially unequal market shares converge. They further argue that this balancing reduces the auditor's incentives to actually compete with each other. The convergence directly results from the formula used and is not specific to the structure of the Spanish audit market.

Based on their assessment of the changes in the market structure resulting from the implementation of MAR, Arruñada and Paz-Ares (1997) discuss the effects of MAR on the auditor's professional competence, focusing on the two aspects of auditor tenure and industry specialization. Finally, Arruñada and Paz-Ares (1997) investigate the effect of MAR on auditor independence. They argue

³² Estimates for the relative costs are derived from survey data of Ridyard and De Bolle (1992).

³³ For this market share calculation, the audit firm that has to turn down the client is excluded.

that the auditor chooses the alternative leading to minimal costs; the alternatives are reporting and not reporting irregularities in the client's financial statements. In case of reporting, the auditor incurs costs of Q , which represent the value of the auditor-client relationship, or, to be more precise, the present value of future quasi-rents resulting from the start-up costs $c_{start-up}$ of a specific client:

$$(63) \quad Q_t = c_{start-up} \cdot \frac{(1+r)^{T_{max}-1} - (1+r)^{t-1}}{(1+r)^{T_{max}} - 1}.$$

Arruñada and Paz-Ares (1997) graphically illustrate how Q changes over time t , given different rotation periods T_{max} . The authors conclude that MAR leads to lower costs of independence, because the potential loss in quasi-rents from losing the client decreases with a higher rotation frequency (i.e., Q strictly increases in T_{max}). In case of non-reporting, Arruñada and Paz-Ares (1997) argue that the auditor incurs expected costs that include transaction costs of collusion, the probability that the auditor's misreporting will be detected, professional liability, the net present value earned from all other current contracts with the client (excluding the audit contract), and the value of potential future contracts. The authors then verbally discuss the effects of MAR on these variables.

Gietzmann and Sen (2002) analytically investigate the effect of MAR on auditor independence in a game-theoretical model with three risk-neutral players: An owner who has an investment project, a manager, and an auditor. Because of empire-building preferences, the manager always wants the project to continue. The owner, in contrast, wants the project to continue only if the economic state of the project is good, but to liquidate it if the state is bad. If an auditor is hired, the owner decides whether to continue the project or not after having received the audit report on the project's type.

There are two types of auditors. Nature assigns an auditor type to the project in case the owner wants to hire an auditor, but the owner cannot distinguish between the auditor types *ex ante*. Auditors always recognize a good project. Type *A* auditors make client-specific investments before conducting the audit, whereas type *B* auditors do not invest. The investment of a type *A* auditor increases the probability to detect a bad project. When hired, the auditor earns a fixed audit fee AF and has two strategies available: The auditor can either provide only minimum effort (i.e., $e = 0$ with $c(0) = 0$, which is interpreted as implicit collusion with the manager) or provide some fixed additional effort at a certain cost (i.e., $e > 0$ with $c(e) = e$, which is interpreted as maintaining independence). Effort costs $c(e)$ are independent of the auditor type. In case the actual state of the project is bad and the auditor does not detect the bad state, the project will get into financial distress with some given probability. In this case, the auditor faces legal liability L .

In the first part of their analysis, Gietzmann and Sen (2002) consider a one-period setting that maps the MAR situation in which the re-appointment of an auditor is not possible. Gietzmann and Sen (2002) first derive the condition that is necessary for a demand for audits to exist. Then, Gietzmann and Sen (2002) determine the conditions that need to be fulfilled for the existence of a "full compliance (FC)" equilibrium in which all auditors remain independent (i.e., exert additional audit effort $e > 0$), and of a "partial compliance (PC)" equilibrium, in which type *A* auditors remain independent, whereas type *B* auditors collude (i.e., exert only minimum audit effort $e = 0$).³⁴ To be more precise, Gietzmann and Sen (2002) derive a threshold of the legal liability in the MAR case,

³⁴ A "no-compliance (NC)" equilibrium where both types of auditors collude does not exist if the condition for a positive demand for audits hold.

L_{MAR} , that is necessary to end up in a FC or PC equilibrium, respectively. The threshold L_{MAR} for the PC equilibrium is lower than the threshold for the FC equilibrium. Thus, only if the legal liability L_{MAR} is comparably high, an auditor of type B will remain independent.

Gietzmann and Sen (2002) then extend the model to a two-period setting that describes the situation without MAR. There is a second period if in the first period (1) the project is good (regardless of the auditor's decision); (2) the project is bad and the auditor colludes, but the project survives anyhow; (3) the project is bad, the auditor remains independent, but nevertheless does not detect the true state of the project, and the project survives; and (4) the project is bad, the auditor does not collude, and the project is liquidated. In scenarios (1) to (3), the auditor keeps the client and thus the audit fee AF , and further earns the normal fee FEE (i.e., the fees from other auditor-client relationships) during the second period. In the last scenario (4), the auditor loses the current audit fee AF , but still earns the normal fee FEE during the second period. Only if auditors are caught for failing in the first period, they will face legal liability L and will not earn any fees (i.e., neither AF nor FEE) in the second period.

This two-period setting allows for Bayesian belief updating of the owner, which affects the owner's demand for audits. Gietzmann and Sen (2002) derive the necessary condition for such a positive demand. Moreover, Gietzmann and Sen (2002) determine the conditions both for FC equilibria to occur in both periods and for a PC (FC) equilibrium to occur in the first (second) period. The occurrence of these equilibria depends on the legal liability in the first (L_1) and second period (L_2).³⁵ Gietzmann and Sen (2002) then show that the potential future normal fees FEE can serve as a substitute for legal liability L if they are sufficiently high. The intuition behind this finding is that in case collusion is detected, not only one client, but also other clients and the respective fees will be lost. If future normal fees are too low to substitute for legal liability as a trigger for auditor independence, Gietzmann and Sen (2002) label the audit market "thin"; they denote the relation AF/FEE with the "relative reputational value of an audit market".

To reach a FC equilibrium, legal liability in the second period needs to be higher than in the one-period MAR case (i.e., $L_2 > L_{MAR}$). In the first period, it depends on the AF/FEE relation whether the legal liability needs to be higher or lower than in the MAR scenario. If the audit market is thin (i.e., if AF/FEE is relatively large), legal liability in the first period needs to be higher than in the one-period MAR case to reach a FC or PC equilibrium (i.e., $L_1 > L_{MAR}$). Ceteris paribus, higher current audit fees AF tend to lead to more collusion, while higher normal fees FEE tend to increase auditor independence. Moreover, compared to the type B auditors, type A auditors have higher incentives to protect their reputation for independence. Gietzmann and Sen (2002) conclude that MAR has a positive effect if the audit market is sufficiently thin. The reason is that under a MAR regime, auditor independence can be achieved with a comparatively low liability threat. Thus, implementing a MAR regime can save the costs for maintaining a strict legal liability regime when the audit market is thin. However, if the audit market is sufficiently developed, the threat of a potential loss of future clients and the corresponding normal fees is sufficiently strong to prevent implicit collusion. In such a situation, MAR could lead to unnecessary additional costs.

³⁵ Like in the single-period setting, a NC equilibrium cannot exist in any period. Further, equilibrium combinations with a PC equilibrium in the second period are ruled out, as in this case, the liability in the second period is required to be lower than in the first period.

Lu and Sivaramakrishnan (2009) compare client firms' investment decisions between a non-MAR and a MAR regime. The firm's objective is to maximize its market price. Investment efficiency is used as a criterion for evaluating the desirability of a regime. Auditors in the model can be of one of two (observable) types: they are either aggressive, A , or conservative, C .³⁶ When audit evidence is inconclusive on whether the firm's investment project is in a good state, g , or in a bad state, b , aggressive auditors report a good state ($rep = g$), whereas conservative auditors report a bad state ($rep = b$). The probability that the audit reveals the actual state of the investment project is denoted by q (audit quality); with probability $1 - q$, the audit evidence is inconclusive. Lu and Sivaramakrishnan (2009) further differentiate between the audit quality of an incumbent auditor, q_{inc} , and audit quality of a new auditor, $q_{new} < q_{inc}$. The auditors are thus modeled as a technology, but do not have an own objective. In addition to the differences between non-MAR and MAR regimes and the auditor types, Lu and Sivaramakrishnan (2009) differentiate between settings where opinion shopping is a concern or not. The client firm can make its auditor choice either *ex ante* (i.e., before it observes the realized state g or b) or *ex post* (i.e., after the incumbent has proposed a report, the client firm can either retain the incumbent or switch to a new auditor). This assumption allows for opinion shopping.

The basic timeline in case of *ex ante* auditor choice is as follows: First, nature determines the probability p that a firm's investment project is good (with probability $1 - p$, it is bad). Then the firm makes an (observable) investment of $1/2 \cdot I^2$ and chooses an auditor type. The firm observes the realized project state, g or b . The audited accounting report rep is issued. The (perfectly rational) capital market prices the firm at $V(rep)$. The return on investment, $gI > 0$ or $bI = 0$, is realized. In case of *ex post* auditor choice, the firm can choose whether to appoint a new auditor of a certain type after having observed the realized project state under a non-MAR regime, but has to change the auditor under a MAR regime.

Lu and Sivaramakrishnan (2009) begin their analysis by examining the complete information case in which p is public knowledge. In the case of symmetric information, neither the auditor types A or C nor whether the auditor is an incumbent or a new auditor matter for investment efficiency. Consequently, there are no differences between a non-MAR and a MAR regime. Then, Lu and Sivaramakrishnan (2009) turn to the case where p is private information and thus information is not symmetric. In such a case, overinvestment occurs. For the *ex ante* auditor choice setting (without opinion shopping), they find that overinvestment is more intense under a MAR regime. For the *ex post* auditor choice setting, the results are more differentiated. For firms with an incumbent auditor of type A , MAR decreases (increases) overinvestment in case the project's prospect p is relatively low (high). For firms with an incumbent auditor of type C , the result turns to the opposite. MAR increases (decreases) overinvestment in case the probability p for a good project is rather low (high).

VI.2.2. The prohibition on the joint provision of audit and non-audit services

Kornish and Levine (2004) build a common agency model in which an auditor is an agent of two principals: A manager who hires the auditor to provide NAS, and an audit committee (representing

³⁶ In the main analysis, auditor biases are exogenous. In the Appendix, Lu and Sivaramakrishnan (2009) introduce auditor incentives and endogenize the biases.

the shareholders) that hires the auditor to provide AS.³⁷ Kornish and Levine (2004) argue that a prohibition on the joint supply of AS and NAS leads to certain costs (e.g., economies of scope cannot be realized) and that lifting the prohibition on contingent audit fees can lead to a truthful audit report.

The timeline of the model is as follows: (1) The auditor and the audit committee agree on an audit service contract. The audit fee is given by AF_{rep} , where the subscript rep indicates the level of reported earnings. In case of non-contingent audit fees, AF_{rep} is identical for all reported earnings, whereas AF_{rep} can differ across the levels of reported earnings in case of contingent audit fees. The shareholders' loss from a misleading audit report, $Loss$, depends on the difference between the reported earnings and actual earnings $earn$, that is, $Loss(rep-earn)$ is convex in its argument. Kornish and Levine (2004) assume that the auditor can observe the true level of earnings. The earnings are modelled as a discrete set where 1 is the lowest possible level of earnings. (2) The manager, who also knows the true earnings, offers the auditor a contract that consists of two components: A required report of earnings and a NAS contract that generates the NAS fees NAS_{rep} for the auditor. If the reported earnings exceed a certain threshold (that is smaller than the highest possible earnings from the discrete set of earnings), the manager receives the bonus $Bonus_{rep}$ that depends on the reported earnings. To incentivize the auditor to agree to such a contract, the manager is willing to buy an amount of NAS from the auditor that exceeds the optimal amount. (3) If the auditor accepts the manager's offer, the auditor issues an unqualified opinion (i.e., approves the level of reported earnings rep) and receives the benefits from the NAS contract. However, the auditor may suffer from legal liability because of misreporting. The liability cost $L(rep-earn)$ is convex in its argument. If the auditor refuses the manager's offer, the auditor issues a qualified opinion. In this case, the addressees of the report infer the lowest possible level of earnings $earn = 1$, and the auditor is paid accordingly.

The auditor is assumed risk-neutral. To maximize his/her utility, the auditor will accept the manager's offer if the net benefit of accepting the report rep exceeds the net benefit of rejecting it:

$$(64) \quad Accept_{earn} = \begin{cases} 1 & \text{if } AF_{rep_{earn}} - AF_1 + NAF_{rep_{earn}} + NAF_1 \geq L(rep-earn) - L(1-earn) \\ 0 & \text{otherwise} \end{cases},$$

where $Accept_i = 1$ ($= 0$) denotes the acceptance and the subscript rep_{earn} denotes the manager's proposed level of reported earnings rep , given the true earnings $earn$. Based on this decision logic, the audit committee's and the manager's objective functions can be stated as

$$(65) \quad \min_{AF} \sum_{earn} p_{earn} \left[\begin{array}{l} \left(Loss(rep_{earn}^* - earn) + AF_{rep_{earn}^*} \right) Accept_{earn}^* \\ + \left(Loss(1-earn) + AF_1 \right) (1 - Accept_{earn}^*) \end{array} \right] \text{ for the audit committee and}$$

$$(66) \quad \min_{NAF_{rep}, rep} \left(Bonus_{rep} - \delta NAF_{rep} \right) Accept_{earn}^* \text{ for the manager.}$$

p_{earn} is the ex-ante probability of true earnings $earn$ (from the discrete set of earnings), rep_{earn}^* is the report the manager requires, $Accept_{earn}^*$ is an indicator variable that maps the auditor's optimal

³⁷ Common agency goes back to Bernheim and Whinston (1986), who first extended a principal-agency model to account for situations where several principals contract (non-cooperatively) with a single agent.

acceptance decision, and $\delta \in (0,1]$ is a weight on the manager's utility from paying NAS fees (i.e., the manager values received bonus payments higher than paid NAS fees).

Based on this model, Kornish and Levine (2004) first analyze a situation where the audit committee can pay only non-contingent AS fees (i.e., audit fees AF are fixed and normalized to zero); the NAS fees, however, are *de facto* contingent. Kornish and Levine (2004) derive the conditions that are necessary for the manager to offer the auditor a NAS contract that is unfavorable for the shareholders. Then, Kornish and Levine (2004) turn to a situation where the audit committee can pay contingent audit fees that counterweight the incentives the manager provides through the NAS contract. They derive the conditions that need to hold for an equilibrium to exist in which the auditor reports truthfully (graphs based on a numerical example illustrate the compensation schemes the audit committee and the manager offer). The optimal AS contract is non-monotonic in the report, that is, it first increases and then decreases in the report. The intuition is that, *ceteris paribus*, the auditor has an incentive to reject reports that are not conservative (i.e., reports of high earnings). Only if the threshold for the bonus payment is reached, the manager is willing to compensate the auditor for accepting non-conservative reports. However, she will not compensate the auditor for a report in a non-bonus state, and this is the reporting region the audit committee has to provide incentives for.

Finally, Kornish and Levine (2004) extend their model to a multi-period framework with an infinite time horizon and again consider the cases without and with contingent audit fees. Here, a truth-telling equilibrium is possible with both contingent and non-contingent audit fees, as the audit committee can *de facto* pay contingently even if the audit fees in single periods are non-contingent (i.e., the threat of hiring another auditor influences the incumbent auditor's decision). In sum, Kornish and Levine (2004) conclude that a prohibition on the joint provision of AS and NAS is not necessary as the less restrictive approach of lifting the ban on contingent audit fees can achieve a favorable outcome for the shareholders (who have a preference for conservative reporting).

Beck and Wu (2006) use a non-strategic, dynamic Bayesian model with an auditor and a client to analyze the interdependencies between learning and advisory effects. Learning effects stem from the accumulation of client-specific knowledge during an auditor-client relationship. Advisory effects result from the provision of NAS that enrich the auditors' knowledge and can influence the client's managerial decisions and thus alter the earnings dynamics over time (i.e., reduce earnings volatility).

In the first part of the paper, Beck and Wu (2006) focus on the auditor's engagement risk when NAS do not affect audit quality. Beck and Wu (2006) model the client's earnings distribution over time as a stochastic process, $\{EARN_{ev_t}; ev_t \geq 1, \text{ and } t = 1, 2, \dots\}$, where ev_t reflects the events influencing the client's earnings production and t is a time index. These events are regarded as exogenous and thus are not affected by the provision of NAS. $EARN_{ev_t}$ is not directly observable by the client or the auditor. Conducting the audit, however, generates a private noisy signal of the earnings distribution in period t , that is, $SIGN_{ev_t,t} = EARN_{ev_t} + \varepsilon_{SIGN,t}$, where $\varepsilon_{SIGN,t}$ is an identically and independently distributed (iid) variable with mean m and precision s (i.e., a positive s denotes the reciprocal of the variance); $EARN_{ev_t}$ and $\varepsilon_{SIGN,t}$ are independent of each other. The auditor's objective is to minimize the engagement risk ER (i.e., the expected squared reporting errors), that is,

$$(67) \quad \min_{rep_{ev_t}} ER_{ev_t,t} = E_t \left[\left(SIGN_{ev_t} - rep_{ev_t} \right)^2 \middle| ev_t \right].$$

rep denotes a (single summary statistic) report of the client's earnings. The FOC yields the auditor's optimal reporting strategy $rep_{ev_t}^* = E_t \left[EARN_{ev_t} \right] + m$. Substituting into the auditor's objective function leads to the auditor's minimum engagement risk in the case without the provision of NAS, $ER_{ev_t,t}^* = Var_t \left[EARN_{ev_t} \right] + 1/s$. When the auditor observes $SIGN_{ev_t,t} = sign_{ev_t,t}$ at the end of each period by conducting the audit, the (imperfect) audit technology enables the auditor to learn about the earnings dynamics over time through outcome. If the posterior precision $Var_t^{-1} \left[EARN_{ev_t} \middle| SIGN_{ev_t,t} = sign_{ev_t,t} \right] = Var_t^{-1} \left(EARN_{ev_t} \right) + s = q_{ev_t,t}$ is used as a measure of audit quality and the earnings distributions do not change over time (i.e., $ev_t = ev$), then in the end, the auditor will completely learn about the earning's dynamics (i.e., $\lim_{t \rightarrow +\infty} q_{ev,t} = +\infty$).

Building on this general model, Beck and Wu (2006) turn to the learning and advisory effects resulting from the provision of NAS. They assume that providing NAS leads to additional knowledge about the client's earnings process. Beck and Wu (2006) model the advisory effect as

$$(68) \quad EARN_{ev_{t+1}} = \sigma^{k/2} EARN_{ev_t} + \rho^{k/2} \varepsilon_{EARN,t},$$

where $k \in (0,1]$ maps the knowledge increment from NAS (i.e., the auditor's knowledge in period $t+1$ is ev_t+k when NAS were provided in period t).³⁸ Bayesian updating then yields the posterior precision over $EARN_{ev_t+k}$:

$$(69) \quad q_{ev_t+k,t+1} = \frac{1}{\sigma^k / q_{ev_t,t} + \rho^k / u} + s.$$

Thus, audit quality in a period depends on the audit quality in the previous period. Beck and Wu (2006) then derive the long-run equilibrium levels of audit quality, given different levels of σ and ρ , which represent the client's business type (i.e., σ determines the impact of k on the trend component of the earnings process) and the "diffusion" of NAS on the client's earnings process (i.e., the variance ρ^k/u increases (decreases) in k for $\rho > 1$ ($\rho \in (0,1)$)). Beck and Wu (2006) show that if both σ and ρ are lower than or equal to one (i.e., NAS have a dampening effect on both the trend and the dispersion components of the client's earnings dynamics), the long-rung level of audit quality increases (and consequently $k^* = 1$ is the optimal strategy of knowledge acquisition). On the contrary, when σ and ρ are larger than one (i.e., NAS accelerate both the trend and the dispersion components of the client's earnings dynamics), the long-rung level of audit quality decreases (and consequently $k^* = 0$ is the optimal strategy of knowledge acquisition). Further, in comparison to the infinitively high quality level in the long run, the optimal level is now finite.

In the last part of the paper, Beck and Wu (2006) investigate the conditions under which the auditor trades off the NAS fees against audit quality. They assume fixed audit fees AF , whereas NAS fees are contingent on the auditor's NAS decision to gain knowledge, that is, NAS fees are modeled as

³⁸ Further $\sigma, \rho \geq 0$; $\varepsilon_{EARN,t} \sim N(0, 1/u)$, $u > 0$; and $Cov(EARN_{ev_t}, \varepsilon_{EARN,t}) = Cov(\varepsilon_{EARN,t}, \varepsilon_{EARN,-t}) = 0$ holds.

a function of k , $NAF(k)$. The provision of audit services and NAS induces costs of $c(k)$. Thus, the auditor's profit contribution PC is given by

$$(70) \quad PC(k) = AF + NAF(k) - c(k) \text{ (with } PC''(k) \leq 0 \text{)}.$$

For a given level of audit quality, the auditor's engagement risk is

$$(71) \quad ER_{ev_i+k,t}^*(q, k) = \sigma^k / q + \rho^k / u + 1/s.$$

As there is a trade-off between the NAS fees and the engagement risk, the auditors' objective function is

$$(72) \quad \max_k PC(k) - ER_{ev_i+k,t}^*(q, k).$$

The analysis shows that, depending on the parameters σ and ρ , low- or high-quality auditors (i.e., auditors with an initially high or low audit quality q) must have or need not have a fee incentive to provide NAS. With respect to the question of the desirability of the joint provision of AS and NAS, the analysis of Beck and Wu (2006) suggests that the joint provision leads to an increase in audit quality when NAS have a dampening effect on the trend and the dispersion components of the client's earnings dynamics. However, large NAS fees can lead the auditor to provide NAS that increase the client's earnings volatility, which reduces audit quality over time.

Wu (2006) does not specifically investigate how offering NAS to an audit client affects the auditor's and client's actions, but rather analyzes the interplay between the market for AS and the market for NAS. Wu (2006) assumes that there are two oligopolistic markets with two suppliers each: An audit market, where auditors A and B compete, and a consulting market, where A competes with the consultant C . B and C are thus "pure" auditors and consultants, respectively, whereas A is an auditor who also offers NAS. A and B are assumed to offer identical audit quality and to compete on price (i.e., they choose the strategic variables AS^A and AS^B representing the inverse of audit prices, that is, $AS = 1/AF$); A and C are assumed to compete on NAS quantity (i.e., they choose the strategic variables NAS^A and NAS^C representing NAS portfolios). The incremental profitability of NAS over that of audit services is defined as NAS profitability, π_{NAS} . The demands for AS and NAS are assumed to be independent. The profits P of A , B , and C are given as

$$(73) \quad P^A = rev_{AS}^A(AS^A, AS^B) + rev_{NAS}^A(NAS^A, NAS^C) - c^A(AS^A, AS^A) - c_F^A + NAF^A \cdot \pi_{NAS},$$

$$(74) \quad P^B = rev_{AS}^B(AS^A, AS^B) - c^B(AS^B) - c_F^B, \text{ and}$$

$$(75) \quad P^C = rev_{NAS}^C(NAS^A, NAS^C) - c^C(NAS^C) - c_F^C + NAS^C \cdot \delta \cdot \pi_{NAS},$$

where rev denotes revenues, c denotes the costs that are contingent on the auditors' and consultants' choices, and c_F are the fixed costs. δ is a constant representing a policy parameter for "market segmentation" (e.g., $\delta = 0$ implies a policy where only auditors can provide NAS, whereas $\delta > 1$ implies a policy where only consultants can provide certain NAS). The auditors and consultants maximize their profits P by choosing optimal values of AS and NAS .

Building on this profit maximization, Wu (2006) derives the impact of the NAS profitability, π_{NAS} , on audit pricing (i.e., $dAS^A/d\pi_{NAS}$ and $dAS^B/d\pi_{NAS}$) and on NAS quantity ($dNAS^A/d\pi_{NAS}$ and

$dNAS^C/d\pi_{NAS}$). The results show that the impact of π_{NAS} on audit pricing depends on the extent to which auditor-consultant A strategically interacts with consultant C : $dAS^A/d\pi_{NAS}$ and $dAS^A/d\pi_{NAS}$ depend on $\Phi = \pi_{NAS} \cdot \partial^2 P^A / (\partial NAS^A \partial NAS^C) - \partial^2 P^C / (\partial NAS^C)^2$, which indicates how competition in the consulting market “crosses over” to the audit market and affects how the auditors A and B interact. Wu (2006) calls this effect “competition crossover” and his main observation is that the impact of NAS profitability on audit pricing does not only depend on “knowledge spillovers” (i.e., on $\partial^2 P^A / (\partial AS^A \partial NAS^A)$), but also on “competition crossover” (i.e., on Φ) if the auditor competes in two oligopolistic markets.

In the next section of the paper, Wu (2006) analyzes the impact of the NAS profitability on the auditors’ profits (i.e., $dP^A/d\pi_{NAS}$ and $dP^B/d\pi_{NAS}$). He shows that the impact crucially depends on whether the auditors’ audit services are substitutes or complements, and on whether the generalist A has scope economies or scope diseconomies.³⁹ Wu (2006) then further analyzes how the results change if the audit and consulting market do not clear simultaneously (like in the first part of the paper), but sequentially (i.e., there is a knowledge flow from NAS to AS if the consulting market clears first, and *vice versa*). As audit quality is not an issue in the study of Wu (2006), direct conclusions on the desirability of a ban on the joint provision of AS and NAS are not feasible. The results of Wu (2006) suggest, however, that empirical audit researchers should control for audit market concentration to account for competition crossover. The common dichotomic control for Big 4/non-Big 4 audit firms might neglect strategic interactions between the Big 4 in oligopolistic markets. Further, it might not be sufficient to consider only proxies for auditor specialization and leadership in the audit market while neglecting the audit firms’ presence and competition in the NAS markets. Offering NAS to non-audit clients can also affect the auditors’ decisions.

In a certain sense comparable to the approach of Wu (2006), Friedman and Mahieux (2021) investigate the effects of competition in audit and NAS markets, but focus on auditors’ investments in audit quality, average audit quality, and social welfare. Friedman and Mahieux (2021) extend a model of one auditor and one client (Dye (1995); Laux and Newman (2010)) to a model with three clients (i.e., A , B , and C indexed by j), two auditors (i.e., 1, 2 indexed by i), and a consultant. The clients have projects $Proj_j$ that require initial investments I and yield a return of $ret > 0$ ($ret = 0$) in case they are good (g) (bad (b)). The projects are bad with the probabilities $1 > 1-p_A > 1-p_B > 1-p_C > 0$ ($1-p_j$ is called “client business risk”). Clients have private information about their types. Clients always report to have a good project, and the auditor issues an audit report $rep_{ij} \in \{b, g\}$. The auditor will always identify a good project (i.e., $\Pr(rep_{ij} = g \mid Proj_j = g) = 1$), but might fail to detect a bad project. Audit quality is defined as $q_i = \Pr(rep_{ij} = b \mid Proj_j = b)$ and an auditor’s audit quality is public knowledge. Investors will invest in the projects if the auditor’s report is $rep_{ij} = g$; they will however not invest in case the auditor reports the project to be bad, that is, $rep_{ij} = b$. Thus, the value of an audit is $q_i(1-p_j)I$. The costs for providing audits are $k_i J_{q,i} q_i^2 / 2$, where $J_{q,i}$ is the number of audit clients of auditor i (for the cost parameters, $k_1 > 0$ and $k_2 > 0$ holds). Auditor 2 (but not auditor 1) can make an *ex ante* investment in audit quality and, in equilibrium, auditor 2 offers higher audit quality than auditor 1 (i.e., $q_2 > q_1$). In the NAS market, auditor 2 competes with a

³⁹ Audit services for “ordinary” clients who demand “similar” audit services are regarded as substitutes, whereas audit services for “rival” clients who do not wish to share the same audit firm are regarded as complements.

pure NAS provider via Bertrand price competition. Auditor 2 (the consultant auditor 2 competes with) chooses NAS fees NAS_2 (NAS_{Cons}); the value of NAS for the client does not depend on the provider of the NAS. All suppliers aim at maximizing their surplus.

The timing of the events is as follows: (1) Auditor 2 invests in audit quality. (2) The auditors and the consultant choose their fees. As client types are clients' private knowledge, the fees do not depend on the client's type. (3) The client firms decide whether to buy AS and NAS; the audit and NAS markets clear simultaneously. The client's expected utility is given by

$$(76) \quad U_j = \underbrace{p_j ret - I}_{\text{investment return}} + \underbrace{q_i (1 - p_j) I}_{\text{audit value}} + \underbrace{(1 - \delta) p_j + \delta (1 - p_j) v_{NAS}}_{\text{NAS value}} - \underbrace{AF_{q,i}}_{\text{audit fee}} - \underbrace{NAF}_{\text{NAS fee}},$$

where δ captures the correlation between the demand for AS and NAS and v_{NAS} scales the value of NAS. In their main analysis, Friedman and Mahieux (2021) assume a weakly positive correlation between audit service demand and NAS demand (i.e., $\delta \in [1/2, 1]$). (4) The auditors report their findings, NAS are provided, and the client decides about the investment in the project. (5) Cash flows are realized. Average audit quality is defined as $(q^A + q^B + q^C)/3$, where q^j is the audit quality supplied to client j ; social welfare is the sum of the three clients' utilities, the two auditors' utilities, and the consultant's utility.

In the main analysis, Friedman and Mahieux (2021) investigate three scenarios where (1) auditor 2 is not restricted in offering NAS; (2) auditor 2 can offer NAS only to clients for which he/she is not the auditor; and (3) auditor 2 is not allowed to provide NAS at all.

If there are no restrictions for auditor 2 to offer NAS, no rents can be earned in the NAS market because of the Bertrand price competition. In the audit market, the high-risk client A (low-risk client C) always buys AS from the high-quality auditor 2 (low-quality auditor 1) at a relatively high (low) price; whether the medium-risk client B buys AS from auditor 2 or from auditor 1 depends on auditor 2's cost parameter k_2 . For small (large) k_2 , auditor 2 sells NAS to clients A and B (only to client A) and chooses audit quality $(1 - p_B)I/k_2$ ($(1 - p_A)I/k_2 > (1 - p_B)I/k_2$). Whether social welfare is higher when auditor 2 or auditor 1 audits client B depends on client B 's risk $(1 - p_B)$.

Next, Friedman and Mahieux (2021) analyze the situation where auditors are not allowed to offer NAS to their audit clients but to third parties. They show that if auditor 2's audit costs k_2 are relatively small, high-quality auditor 2 sells AS to the more risky clients A and B and NAS to the less risky client C ; the consultant provides NAS to clients A and B . If k_2 is relatively large, auditor 2 (auditor 1) sells AS to client A (to clients B and C), but provides NAS to clients B and C (whereas the consultant provides NAS to client A). As compared to the case with unrestricted NAS, the fees for NAS are not zero anymore. Restricting the provision of NAS can thus make auditor 2 and the consultant better off. Whether the average audit quality is higher or lower than in the case without restrictions depends on the audit quality auditor 1 provides. Further, dependent on k_2 and client B 's risk $(1 - p_B)$, social welfare varies between the scenarios. Social welfare is higher (for intermediate k_2 when $(1 - p_B)$ is sufficiently low) or lower (for intermediate k_2 when $(1 - p_B)$ is sufficiently high) than in the case without restrictions or equal (for large and small k_2).

Friedman and Mahieux (2021) also analyze a setting where auditors are not allowed to offer NAS at all. The consultant is thus a monopolist, whereas auditor 2 provides only AS. As it was not possible to earn rents in the first setting without restrictions, the equilibrium in the audit market

remains unchanged compared to the first setting. The consultant charges NAS fees, however. Nevertheless, as NAS fees cancel out in the social welfare calculation, social welfare without restrictions on NAS is identical to social welfare with restrictions on NAS for all clients. To sum up, whether a restriction on the joint provision of AS and NAS leads to higher audit quality or not depends on the costs of audit quality and the association between the demand for AS and NAS. Allowing for joint AS and NAS can increase audit quality due to higher investments in audit quality of high quality auditors. However, average audit quality can decrease when risky clients switch to low quality auditors.

VI.2.3. Joint audits

Deng et al. (2014) compare audit quality (i.e., audit evidence precision) and audit fees across single audits conducted by a Big 4 auditor, JAs exerted by two Big 4 auditors, and JAs performed by one Big 4 and one non-Big 4 auditor. The analysis is based on two crucial assumptions: (1) Big 4 auditors have lower marginal costs of audit evidence precision than non-Big 4 auditors, and (2) Big 4 auditors bear a larger proportion of the misstatement costs (e.g., litigation risk and reputational losses).

The auditor's (or auditors') task is to file a report rep on the fundamental value of a client company. The company's market value $V(rep) = \alpha + \beta \cdot rep$ increases linearly in this report. The true value v is normally distributed with mean v_0 and precision s (i.e., $\tilde{v} \sim N(v_0, 1/s)$). When the auditor conducts an audit, she produces audit evidence $sign$ about v (i.e., $\widetilde{sign}|v \sim N(v, 1/e)$). The audit precision e is the auditor's private decision, cannot be verified by the client company, and causes audit resource costs $k \cdot c(e)$. $k > 0$ is an exogenous cost parameter (that differs for Big 4 and non-Big 4 auditors); $c(e) = e^2/2$ is a quadratic cost function. The (initial) audit report rep_{init} is the auditor's best estimate of v , conditional on the audit evidence $sign$. The audit fees AF are non-contingent. The client company can additionally offer the auditor an amount of FEE (that is unobservable to the market) in return for a certain report rep the company prefers more than the initial report rep_{init} . Potential legal liability and reputational losses from misreporting create a disutility of $(rep - v)^2$ for the auditor. The client's and the auditor's payoffs are consequently given by

$$(77) \quad P^C = V(rep) - AF - FEE \quad \text{and}$$

$$(78) \quad P^A = AF + FEE - kc(e) - (rep - v)^2, \quad \text{respectively.}$$

In a single audit with only one Big 4 auditor, the audit resource cost function is $k_{Big4}c(e)$ (where the subscript $Big4$ denotes a Big 4 auditor) and the audit precision e_{Big4} is

$$(79) \quad rep_{init} = E\left[\tilde{v} \mid sign_{Big4}\right] = \frac{sv_0 + e_{Big4}sign_{Big4}}{s + e_{Big4}}.$$

In a JA with two Big 4 auditors, the two Big 4 auditors accumulate audit evidence $sign_{Big4}$ and $sign_{2.Big4}$ (where the subscript $2.Big4$ denotes the second Big 4 auditor). To be more precise, as an auditor audits one division of the client's company and reviews the other auditor's audit of the other division, the overall signal received by the first (second) Big 4 auditor is \widetilde{sign}_{Big4}

$= \widetilde{sign}_{Big4,a} + \widetilde{sign}_{Big4,b}$ ($\widetilde{sign}_{2.Big4} = \widetilde{sign}_{2.Big4,a} + \widetilde{sign}_{2.Big4,b}$), where a and b denote the different divisions, and the client's value equals the sum of the values of the two divisions (i.e., $\tilde{v} = \tilde{v}_a + \tilde{v}_b$). The audit resource costs for the first auditor in this situation are $k_{Big4}c(e_{Big4}) = k_{Big4}c(e_{Big4,a} + e_{Big4,b})$ and the total audit resource costs are $k_{Big4}c(e_{Big4}) + k_{Big4}c(e_{2.Big4})$. The resulting audit precision of such a JA is given by

$$(80) \quad rep_{init} = E\left[\tilde{v} \mid sign_{Big4}, sign_{2.Big4}\right] = \frac{sv_0 + e_{Big4}sign_{Big4} + e_{2.Big4}sign_{2.Big4}}{s + e_{Big4} + e_{2.Big4}}.$$

Deng et al. (2014) assume that each auditor bears 50% of the misstatement costs. In JAs with one Big 4 and one non-Big 4 auditor, audit costs differ between the auditors. The non-Big 4 auditor has a cost function of $k_{small}c(e)$, where $k_{small}/k_{Big4} > 1$ (the fraction of the cost components is thus a cost efficiency parameter; the subscript *small* denotes the non-Big 4 auditor). Total audit resource costs are $k_{Big4}c(e_{Big4}) + k_{small}c(e_{small})$ and the initial audit report is

$$(81) \quad rep_{init} = E\left[\tilde{v} \mid sign_{Big4}, sign_{small}\right] = \frac{sv_0 + e_{Big4}sign_{Big4} + e_{small}sign_{small}}{s + e_{Big4} + e_{small}}.$$

Deng et al. (2014) suppose that the non-Big 4 auditor bears only a relatively small fraction of the misstatement costs.

Deng et al. (2014) use backward induction to conduct the equilibrium analysis under the different regimes. They first analyze the (concealed) compensation FEE , the certified report rep , and the market price $V(rep)$. Considering a perfect Bayesian equilibrium, Deng et al. (2014) demonstrate that the capital market correctly prices the company in all three regimes.

In a next step, Deng et al. (2014) derive the auditors' optimal decisions on audit evidence provision e . When deciding about their precision levels, the auditors trade off audit resource costs and expected misstatement costs. Deng et al. (2014) find that the Big 4 auditors' optimal choice of audit evidence precision is lower under JAs than in SAs. To be more precise, because of technological inefficiency, the non-Big 4 auditor has a free-riding incentive, as the Big 4 auditor bears a larger share of the misstatement cost. Further, as the Big 4 auditors in a JA regime with two Big 4 auditors are homogenous (and share audit work and risk equally), total evidence precision in a JA with two Big 4 auditors and a SA with one Big 4 auditor is identical, whereas it is lower in a JA with one Big 4 and one non-Big 4 auditor.

Deng et al. (2014) assume a competitive audit market where audit fees, AF , satisfy the auditors' break-even condition by covering both the audit resource costs and the expected misstatement costs. Because of the assumption of convex audit resource costs, total audit fees in JAs with two Big 4 auditors are lower than audit fees for SAs performed by one Big 4 auditor. Further, the total audit fees in JAs with one Big 4 auditor and one non-Big 4 auditor are lower (higher) than the audit fees in a SA regime when the fraction of the cost components k_{small}/k_{Big4} is sufficiently small (large), and when the Big 4 auditor bears a sufficiently large (small) proportion of the misstatement costs.

Biehl et al. (2021) analyze the effects of JAs on audit quality (i.e., the probability to detect mis-statements) and audit costs (i.e., the sum of the effort costs and the expected litigation costs). The analysis compares the audit outcomes of a SA scenario with those of JA scenarios that differ in the auditors' client-specific expertise, their (dis)similarity in expertise, and the institutional and environmental settings (i.e., the mandated allocation of the audit work, the litigation setting, and the synergy from collaboration). Biehl et al. (2021) assume proportional litigation and that a regulator defines the allocation of the audit work in a JA. The client's decision about the auditor choice is exogenous: In the SA scenario, the client chooses the auditor with the highest audit-relevant expertise, and in the JA scenario, the client hires the first- and second-best matching auditors. An important assumption of the model is that JAs, but not SAs, can increase the probability of mis-statements if benefits from the "four-eye" principle and additional external cross-reviews are exploited. The synergy parameter, ρ , specifies the quality-increasing benefit from JAs if both auditors provide audit effort.

The JA model in Biehl et al. (2021) uses a normal-form game with two auditors, $i = 1, 2$, simultaneously choosing between two pure effort strategies, that is, $e_i = 1$ (i.e., cooperation, which means that the auditor provides effort), and $e_i = 0$ (i.e., defection, which means that the auditor provides no audit effort). Each auditor's optimal effort strategy, $0 \leq e_i^* \leq 1$, given the other auditor's best-response strategy, $0 \leq e_{-i}^* \leq 1$, minimizes her own expected audit costs, AC_i . The equilibrium effort choice of auditor i is given by:

$$(82) \quad e_i^* = \underset{e_i}{\operatorname{argmin}} E[AC_i | e_{-i}^*].$$

Audit costs, AC_i , include the audit effort costs and the litigation costs. The effort costs for each auditor, $e_i \cdot \alpha_i \cdot c(x_i)$, increase in (1) the auditor's probability to choose effort (e_i), (2) the auditor's share of the audit work (α_i), and (3) the auditor's expertise-dependent costs to audit the particular client ($c(x_i)$). x is thus an inverse measure for the auditor's expertise. The auditors' (dis)similarity in expertise for a particular client is $\beta \geq 1$, with $x_1 = x \leq x_2 = \beta \cdot x$. The auditor with higher expertise conducts at least one-half of the audit work (i.e., $\alpha_1 = \alpha \geq \alpha_2 = 1 - \alpha$). Expected litigation costs, $\theta \cdot (1 - w(e_1, e_2, \alpha, \rho)) \cdot \alpha_i \cdot L$, consist of (1) the probability that there is an (un)intentional mistake in the client's financial statements (θ), (2) the auditors' probability to jointly fail to detect this mistake ($1 - w(\cdot)$), (3) the proportion by which the auditor will be held liable (α_i), and (4) the litigation payment (L). The detection probability function $w(e_1, e_2, \alpha, \rho)$ is concave and equals $w(\rho)$ if $e_1 = e_2 = 1$, and $w(\alpha \cdot e_1 + (1 - \alpha) \cdot e_2)$ otherwise.

Total expected audit costs in a JA are

$$\begin{aligned}
E[TAC_{JA}] &= e_1 \cdot e_2 \cdot (\alpha \cdot c(x) + (1-\alpha) \cdot c(\beta \cdot x) + \theta \cdot (1-w(\rho))) \cdot L \\
&+ e_1 \cdot (1-e_2) \cdot (\alpha \cdot c(x) + \theta \cdot (1-w(\alpha))) \cdot L \\
(83) \quad &+ (1-e_1) \cdot e_2 \cdot ((1-\alpha) \cdot c(\beta \cdot x) + \theta \cdot (1-w(1-\alpha))) \cdot L \\
&+ (1-e_1) \cdot (1-e_2) \cdot (\theta \cdot (1-w(0))) \cdot L.
\end{aligned}$$

The expected audit costs attributable to auditor i are given by

$$\begin{aligned}
E[AC_i | e_{-i}] &= e_i \cdot e_{-i} \cdot (\alpha_i \cdot c(x_i) + \theta \cdot (1-w(\rho))) \cdot \alpha_i \cdot L \\
(84) \quad &+ e_i \cdot (1-e_{-i}) \cdot (\alpha_i \cdot c(x_i) + \theta \cdot (1-w(\alpha_i))) \cdot \alpha_i \cdot L \\
&+ (1-e_i) \cdot e_{-i} \cdot (\theta \cdot (1-w(\alpha_{-i}))) \cdot \alpha_i \cdot L \\
&+ (1-e_i) \cdot (1-e_{-i}) \cdot (\theta \cdot (1-w(0))) \cdot \alpha_i \cdot L.
\end{aligned}$$

The expected audit quality in a JA is

$$\begin{aligned}
(85) \quad E[AQ_{JA}] &= e_1 \cdot e_2 \cdot w(\rho) + e_1 \cdot (1-e_2) \cdot w(\alpha) \\
&+ (1-e_1) \cdot e_2 \cdot w(1-\alpha) + (1-e_1) \cdot (1-e_2) \cdot w(0).
\end{aligned}$$

Biehl et al. (2021) use this general JA game to differentiate nine JA scenarios of four different scenario groups (i.e., the defection, cooperation, coordination, and free-riding scenario) that are based on the auditors' best-response strategies. In a defection scenario, both auditors choose no audit effort, whereas in a cooperation scenario, both auditors choose effort. The coordination scenario means that auditors choose effort with some positive probability below one, whereas the free-riding scenario refers to a JA situation in which one auditor chooses effort but the other does not. The different scenario groups are specific to the relative size of the model parameters. This implies that also the resulting audit quality and audit costs are specific to the auditors' individual expertise, ranging from low to high, x , the auditors' continuous difference in expertise, β , the allocation of the audit work being balanced or unbalanced, α , and the strength of the synergy effect, ρ . Biehl et al. (2021) then benchmark audit quality and audit costs for each JA scenario against the audit outcomes in a SA scenario, assuming that the auditor's optimal audit effort from cost-minimization in a SA scenario is $e_{SA}^* = 1$ and the auditor's expertise is similar to the expertise of at least one auditor in the JA scenario.

Biehl et al. (2021) find that balanced JAs with two similar auditors lead to a cooperative JA scenario if both auditors have high expertise and a positive synergy effect exists. The cooperation JA scenario leads to higher audit quality and lower audit costs than a SA. Imbalances in the allocation of the audit work and differences in expertise decrease audit quality and increase audit costs. Further, JAs with dissimilar auditors (i.e., one auditor has high expertise and the other has low expertise) result in a free-riding scenario that is characterized by lower audit quality and higher audit costs than a SA. According to Biehl et al. (2021), free-riding drives up the expected litigation costs of a JA due to a low joint detection probability if only one auditor chooses effort and the other does not. Allocating more work to the auditor with high expertise can mitigate the harmful effects of free

riding. Yet, relatively small differences in expertise between auditors can still result in a cooperative scenario rather than in a free-riding scenario if gains from the synergy effect can be exploited and the audit work is balanced. Interestingly, if both auditors have similar expertise but the synergy effect is low (e.g., due to rivalry and organizational problems such as establishing a hierarchy and exchanging information), the auditors find it difficult to coordinate on an efficient audit outcome with high quality and low costs. If coordination problems exist, auditors do not always choose audit effort but free ride, occasionally. Audit quality is highest and audit costs are lowest in the coordination JA scenario if the auditors balance the audit work such that no auditor excessively benefits from shirking. Nevertheless, if the synergy effect in a JA is low, coordination problems can result in lower audit quality and higher audit costs than in a SA, even if auditor expertise is high.

VI.3. Summary

The results derived from analytical models show that the effects of MAR, of a prohibition on the joint supply of AS and NAS, and of JAs are not straightforward but depend on various factors related to the auditor, the client, and the legal environment (e.g., audit costs and audit efficiency, client risk, and legal liability).

However, one critical aspect regarding the validity of the predictions of the effects of regulations on audit outcomes is the degree to which the model considers the interaction among the players. Whereas Arruñada and Paz-Ares (1997) propose a decision model of a cost-minimizing auditor, Gietzmann and Sen (2002) consider the strategic interaction between the owner, the manager, and the auditor to analyze the effects of MAR. Lu and Sivaramakrishnan (2009), on the contrary, model the auditor as a technology and focus on the effect of MAR on the client firm's investment decision. To investigate the effects of a prohibition on single-provider auditing and consulting, Beck and Wu (2006) address the decision problem of the auditor, and Wu (2006) takes into account auditors and consultants (i.e., these studies neglect the client as a strategic player). Kornish and Levine (2004), in contrast, consider a manager, an audit committee, and an auditor, and Friedman and Mahieux (2021) present a model with three clients, two auditors, and a consultant. To analyze the effects of JAs, Deng et al. (2014) propose a game between an auditor and a client, and Biehl et al. (2021) models the strategic interaction between the auditors. To sum up, only some of these models take into account the strategy of the client (who has a crucial impact on the quality of audited financial statements), and most of these studies do not model the reactions of rational addressees to the client's and auditor's joint report.

Another criterion is that the analytical papers mentioned above do not take into consideration that audit regulations do not only have direct incentive effects, but might also affect the market structure. Arruñada and Paz-Ares (1997) assume that under MAR, auditors' acquisitions of new clients are proportional to their initial market shares. This rather mechanical alignment of market shares is not specific to MAR, but would also emerge if the respective assumption were made for voluntary auditor changes. As clients and auditors are homogenous, there is no need to take into account auditor changes for strategic reasons. Gietzmann and Sen (2002) and Lu and Sivaramakrishnan (2009) do not consider potential market structure effects of MAR. Most of the analytical research on the effects of a prohibition on the joint supply of AS and NAS also does not model the interdependency between incentive effects and market structure effects (Kornish and Levine (2004); Beck

and Wu (2006)). Wu (2006), in contrast, focuses on the strategic connections between the oligopolistic markets for NAS and AS, and highlights the importance of competition crossovers between these markets. Friedman and Mahieux (2021) determine the demand for AS and NAS from different suppliers. However, the effects of a ban on single-provider auditing and consulting on the structure of the audit market are not considered. Research on the effects of JAs also does not consider potential market structure effects. Deng et al. (2014) uses the Big 4/non-Big 4 dichotomy as an input, not as the equilibrium strategy.

Moreover, heterogeneity of clients and auditors, which could be regarded as a driver of auditor-client matching, is neglected in some of these models. Exceptions are Gietzmann and Sen (2002), who consider two types of auditors that are unobservable *ex ante*, Beck and Wu (2006), who include observable types of AS and NAS suppliers, Deng et al. (2014) and Biehl et al. (2021), who consider two observable types of auditors, and Friedman and Mahieux (2021), who take into account different client types. However, the effect of heterogeneity on the structure of the audit market is not fully exploited.

VII. ANALYTICAL PAPERS THAT CONSIDER THE STRUCTURE OF THE AUDIT MARKET AS ENDOGENOUS

VII.1. Introduction

Certain regulations do not only have incentive effects, but also can have (intended or unintended) market structure effects. Regulators expect a decrease in audit market concentration specifically from the implementation of MAR and JAs, but also from the prohibition on the joint supply of AS and NAS. Opponents of these regulations do not deny the existence of potential market structure effects, but claim that such regulations might rather further increase concentration. However, most of the analytical and the empirical research on audit regulations neglects the possible interdependencies between incentive effects and market structure effects.

In this chapter, we first provide an overview of various basic models of spatial competition and discuss their usefulness for analytical and empirical audit research that simultaneously takes into account incentive effects and market structure effects. We then summarize analytical audit papers that use spatial competition models, but are not specific to audit regulations. Finally, we present two analytical papers on the effects of MAR and the joint provision of AS and NAS that specifically account for possible interdependencies between incentive effects and market structure effects.

VII.2. Spatial competition models

One basic approach to model market behavior goes back to Hotelling (1929), who proposed a static two-stage game. In the first stage, two identical suppliers of one homogenous product choose their locations on a linear and bounded market. In the second stage, suppliers compete on prices. Consumers have to incur linear transportation costs in addition to the product price. Since the focus of the Hotelling (1929) model is on the Nash equilibrium in the price-setting stage of the game, the Hotelling (1929) model is especially suitable to analyze audit fee settings. There are indeed a few

empirical papers investigating audit fees that build up—at least to some degree—on the Hotelling (1929) model. Examples of such studies are Numan and Willekens (2012), Bills and Stephen (2016), Keune et al. (2016), and Boone et al. (2017).

Papers subsequent to Hotelling (1929) have also addressed suppliers' location choices (e.g., Hurter Jr. and Lederer (1985); Anderson and De Palma (1988); MacLeod et al. (1988); Hamilton et al. (1989); Anderson and Neven (1991); Gupta (1992); Braid (2008); for an overview, see Biscaia and Mota (2013)). The results of these studies indicate that suppliers tend to choose the socially optimal locations if they can use spatial price discrimination, and if suppliers—instead of consumers—incur the transportation costs. The reason for this result is the trade-off between maximizing the benefits of price discrimination and minimizing the transportation costs. One possible avenue for future research could be to adapt models in the tradition of Hotelling (1929) that have been developed for analyzing competition in the retail market to the audit market. Models of the retail market where suppliers can open shops consider various endogenous variables (e.g., geographic locations of stores, store capacities, and product prices, quantities, and quality) or incomplete information about suppliers' profits. Especially analyses on the audit office level might benefit from such approaches. There are also dynamic models of market entry and exit in which suppliers can adjust the location(s) of their store(s) in response to changes in demand and cost parameters in order to maximize their expected intertemporal profits (Aguirregabiria and Vicentini (2016); for an overview, see Aguirregabiria and Suzuki (2016)). Applied to the audit market, these models could be used to explain audit firm (industry) specialization.

One drawback of the Hotelling (1929) model is that a linear and bounded market does not allow to take into account more than two identical audit firms or to endogenize the number of competing auditors (i.e., changes in audit market concentration as a result of the implementation of regulations). For analyzing regulations' market structure effects, the circular market of Schmalensee (1978) and Salop (1979) might thus be more appropriate. Salop (1979) presents a static model in which consumers are located on a circle instead of on a line, whereas the suppliers' locations are given. As in the Hotelling (1929) model, the distance between the consumer and the supplier affects the consumer's transportation costs. A realistic assumption in using the Salop (1979) model in an audit context, however, would be that audit costs vary across an auditor's client base, but that clients do not initially prefer certain auditors. Put differently, auditors differ in their specializations, which, in turn, determine clients' preferences for specific auditors. We regard circular market matching models as suitable for simultaneously analyzing the incentive effects and market structure effects of regulations. The idea is to extend a circular market matching model in a way that captures the regulation's effect on the cost structures of audit firms, like, for example, done in the analytical papers of Bleibtreu and Stefani (2018) and Bleibtreu and Stefani (2020).

There are also variations of the Salop (1979) model that are used to investigate markets with different types of suppliers, but without product differentiation. There are, for example, models with a hub-and-spoke structure (Balasubramanian (1998)) or models with two circles to account for hybrid suppliers in-between two market segments (Viswanathan (2005)). These models might be especially interesting when the analysis focuses on different types of audit firms that compete with each other, but also might add new insights on multi-market competition which is, for example, empirically investigated by Dekeyser et al. (2019) or Deméré et al. (2019).

VII.3. Analytical spatial competition models in auditing

Chan (1999) extends the Hotelling (1929) model under the assumption that audit firms make strategic specialization and pricing decisions. The demand side in the two-period model of Chan (1999) consists of clients, which are uniformly distributed on a unit interval. The clients' locations on the interval map their audit-specific characteristics. On this interval, two competing audit firms choose their location; the audit firms' locations map their specializations. Audit costs increase linearly in the difference between a client's characteristics and the auditor's specialization. Further, if an auditor serves a client for two periods, the audit costs in the second period are smaller than in the first one (i.e., there are start-up costs for newly established audit firm-client relationships). For his analyses, Chan (1999) applies a three-stage game with complete information (the first two stages occur in the first period, the third stage in the second period). In the first stage of the game, the two auditors choose their specializations (i.e., their location on the unit interval). In the second stage, the audit firms' simultaneously quote audit fees for the first period to each client, and clients choose the audit firm demanding the lowest fee. The third stage is again audit fee quoting, but this time for the second period.

Chan (1999) shows that audit firms can obtain market power and the ability to price-discriminate by offering specialization and relationship-specific audit fees. Further, low-balling (i.e., pricing initial audit engagements below audit costs) occurs only in market segments with sufficient competition between the audit firms.

Chan et al. (2004) extend the work of Lederer and Hurter Jr. (1986) and assume a multi-dimensional vector of client characteristics instead of one-dimensional client characteristics like in Chan (1999). The number of audit firms that can specialize in these characteristics is not restricted to two, but can also be higher. In the first stage of the (one-period) game with complete information, audit firms enter the audit market by simultaneously choosing a set of specializations. This specialization, however, requires (investment) costs. Like in Chan (1999), the costs for auditing a client increase in the difference between the client's characteristics and the audit firm's specialization. In the second stage of the game, the audit firms' simultaneously quote audit fees to each client and the clients choose the audit firm quoting the lowest fee.

Chan et al. (2004) find that to earn rents, audit firms choose market niches that differ from their competitors' specializations. If the model is extended in a way that specialization does not only decrease the audit firms' audit costs, but also increases the value of the audit for the clients, the results do not change qualitatively. However, in such a case audit fees and the audit firms' profits are higher.

Simons and Zein (2016) use a model based on Hotelling (1929) to investigate the effect of the existence of mid-tier audit firms on competition and average audit quality. In their model, the locations of the three audit firms on the bounded linear market do not represent their specializations in clients' audit-relevant characteristics like in Chan (1999), but rather stand for the audit quality offered. The clients' positions on the unit interval indicate their complexity. Audit costs depend both on the auditor's supplied level of quality and on the distance between the client's quality needs and the audit firm's quality level. In the first step of the model, the first-tier (high-quality) and the mid-tier (medium-quality) audit firms decide about their quality level (i.e., their position on the unit interval); the third-tier (low-quality) audit firm is assumed to offer the lowest possible quality (i.e., it is located at the end of the interval). In the second and third step, the audit firms determine

their fees and clients choose the audit firm offering the lowest fee. This determines the market segment border conditions. The game is solved by backwards induction.

Simons and Zein (2016) find that the effect of the existence of medium-quality audit firms on average audit quality is ambiguous: In some situations, mid-tier audit firms improve average audit quality, but they fail to do so in other settings. The reason is that if the mid-tier audit firm is not present in the market, the high quality audit firm lowers its offered quality to increase its market share. Consequently, there is a trade-off between a lower level of high quality and more clients being audited by the high-quality audit firm.

There are studies that do not build on classical spatial competition models, but also do not consider the market structure as given. Sirois and Simunic (2014), for example, adapt the Cournot oligopoly model proposed by Sutton (1991) to investigate the connection between audit quality and audit firm size, which are both endogenous in their model. In addition to variable audit inputs (i.e., auditor effort), Sirois and Simunic (2014) also consider fixed inputs (i.e., audit technology) in the production of audit quality. Sirois and Simunic (2014) describe how and why the audit market can evolve to an oligopoly dominated by a few (high-quality) audit firms. Further, differences in the investment strategies are presented as a possible explanation for the emergence of the Big 4/non-Big 4 dichotomy in most audit markets.

Another example is Mirza et al. (2019), who present a vertical product differentiation model of the audit market that is based on Jaskold Gabszewicz and Thisse (1980) and Shaked and Sutton (1983). In the model, audit firms of higher quality enable better investment decisions for the clients, and thus the clients, *ceteris paribus*, prefer high-quality audit firms. The model consequently yields a high concentration level as the equilibrium outcome because the clients' preferences tend to drive low-quality audit firms out of the market. In their analysis, Mirza et al. (2019) further show that in a market with vertical product differentiation, regulations like an increase of minimum audit standards, liability caps, or the prohibition on the joint supply of AS and NAS do not significantly reduce (or even increase) audit market concentration.

VII.4. Analytical spatial competition models investigating the effects of audit regulations

Studies that use spatial competition models to explicitly investigate the interdependencies between the incentive effects and the market structure effects of audit regulations are Bleibtreu and Stefani (2018) and Bleibtreu and Stefani (2020). Both studies are based on the Salop (1979) model that allows modelling potential market entries and exits of audit firms.

Bleibtreu and Stefani (2018) analyze the effects of MAR on client importance, which affects auditor independence and thus audit quality. In their model, a continuous mass of potential audit clients is located on the circumference of a unit circle (the mass of clients is normalized to 1). Clients' positions on the circle map their audit-relevant characteristics. The supply side of the model consists of (a discrete number of) n audit firms that are also equally distributed on the circle. The distance x between an audit firm and a client can be interpreted as an inverse measure of auditor specialization or expertise in auditing a client with particular characteristics. The clients have no preferences with respect to the audit firms; they always hire the audit firm offering the lowest fees. In addition to fixed costs, c_F , the audit firms' direct costs consist of two cost components: A component that

depends on the length of the audit firm's tenure with one specific client, d , and expertise-dependent costs that increase in the distance x :

$$(86) \quad c_d^i(d) = \begin{cases} \left(1 - \frac{d}{\tau}\right) \cdot (\bar{c}_d - 1) + 1 & \text{for } 0 \leq d < \tau \\ 1 & \text{for } \tau \leq d \end{cases}$$

with $\bar{c}_d > 1$ and

$$(87) \quad c_e^i(x) = c_e \cdot x.$$

For a new client (and for a client that the auditor has re-acquired after some interruption of at least τ periods), the tenure cost component is at its maximum of $\bar{c}_d > 1$ (which can be interpreted as start-up costs). The cost component then is continually reduced during the auditor-client relationship (i.e., as long as $0 < d < \tau$ holds). Its minimum of one is reached when the relationship has had a duration of τ or more periods (i.e., $d \geq \tau$). Reversely, when there is a pause in the relationship between the audit firm and the client due to MAR, the cost component gradually increases again until it reaches \bar{c}_d , but does not immediately jump up to this maximum level. Thus, the experience gained with specific clients is not immediately lost when the audit firm has to turn down the client. The expertise-dependent cost component increases linearly in the distance x , and the direct costs of audit firm i for auditing a client at distance x are then given by the product of both components:

$$(88) \quad c^i(d, x) = c_d^i(d) \cdot c_e^i(x).$$

Under the assumption of Bertrand price competition, Bleibtreu and Stefani (2018) show that in a setting without MAR, an audit firm i demands an audit fee that depends on the distance x that is equal to the direct costs of the competitor $i-1$ ($i+1$) located nearest on the unit circle:

$$(89) \quad FEE^i(\tau, x) = \bar{c}_d \cdot c_e \cdot (1/n - x) \quad \text{with } x \leq 1/(2n)$$

(in a setting without MAR, each auditor serves a clientele at a distance $x \leq 1/(2n)$ in both directions on the unit circle). In comparison to other analytical studies, the model allows considering a high degree of price discrimination. The profit contribution the audit firm generates is the difference between the fee earned and the costs incurred for auditing the specific clients. The total profit contribution PC is computed by integrating (in order to take the total clientele of the auditor in one direction of the unit circle into account) and multiplying by two (in order to account for both sides of the unit circle):

$$(90) \quad PC^i = 2 \cdot \int_0^{1/(2n)} (FEE^i - c^i) dx = \frac{(3 \cdot \bar{c}_d - 1) \cdot c_e}{4 \cdot n^2}.$$

In line with DeAngelo (1981b), Bleibtreu and Stefani (2018) use the ratio CI between the (expected future) profit contributions that audit firm i earns from auditing one specific client, and the (expected future) total profit contributions as a measure of a client's economic importance:

$$(91) \quad CI^i(x) = \frac{E_{inf} [pc^i(x)]}{E_{inf} [PC^i]}.$$

Building up on this framework, Bleibtreu and Stefani (2018) then investigate the effect of a MAR regulation that restricts the maximum audit tenure to T_{max} and enforces a cooling-off period of cooling-off period by $T_c < T_{max}$. In contrast to previous analytical MAR studies, Bleibtreu and Stefani (2018) thus explicitly allow for re-contracting after a certain period. The analysis reveals that the audit firms apply different re-contracting strategies for different client groups. Clients the audit firms are “experts” in (i.e., clients very close to an audit firm’s location on the circle, that is, in a distance below a threshold \underline{x}) will be required immediate after the cooling-off period (without low-balling). For clients the audit firm is “relatively specialized” in (i.e., clients in a distance $\underline{x} < x \leq 1/(2n)$) a low-balling or a waiting strategy might be optimal, dependent on how strongly audit firms discount future profits. Further, depending on these different strategies, the implementation of MAR can either lead to a decrease or increase in client importance.

Finally, Bleibtreu and Stefani (2018) use the zero-profit condition

$$(92) \quad E_{inf} [PC^i(n^*)] - c_F = 0.$$

to investigate the market structure effects resulting from MAR (i.e., the effect of MAR on the equilibrium number of audit firms n^*) and its interconnection with the incentive effects (i.e., the direct effects on client importance). Bleibtreu and Stefani (2018) show that the effect of MAR on the equilibrium number of audit firms depends on the start-up costs $\overline{c_d}$ and the audit firms’ discount rates: For low start-up costs $\overline{c_d}$, the number of audit firms decreases. For high start-up costs, the number decreases (increases) if the audit firms discount future profits strongly (weakly). Bleibtreu and Stefani (2018) conclude that the desired effects of a decrease in client importance and a decrease in audit market concentration cannot be achieved simultaneously, but that the goals are in direct contrast (i.e., a decrease in client importance comes along with an increase in audit market concentration and *vice versa*).

Bleibtreu and Stefani (2020) address the effects of a prohibition on the joint supply of AS and NAS on market structure and financial reporting quality. To do so, they combine an extensive-form game with imperfect information that covers the auditor-client interaction with a circular market matching model that allows endogenizing the number of competing audit firms.

In the extensive-form game, the economic condition of the client’s firm is bad (good) with probability $0 < \theta < 1$ ($1-\theta$) and its intrinsic value V is normalized to zero (one). The client observes the condition and reports on it. In case the client reports a good condition and the auditor issues a clean opinion, the client’s payoff equals the addressees’ rational expectations about the company’s intrinsic value $E[V]$. If the client truthfully reports a bad condition, the client’s payoff is zero. If the client misreports the condition of the company, the client incurs misreporting costs of $m < E[V]$. Further, the detection of an incorrect report results in a decrease in the client’s payoff of d_M , and the addressees will recognize that the company’s true value is zero. Pr_M is the probability that the client misreports a bad condition as good.

When receiving a report of a good economic condition, the auditor decides whether to exert high or low effort (as a report of a bad condition is always reliable, the auditor does not need to exert effort in this case). High (low) effort induces effort costs of $c \cdot x$ (0), where x is a measure of the auditor’s expertise in the client’s characteristics. High effort allows the auditor to perfectly observe the true economic condition of the client. If the auditor exerts low effort after having observed a

report of a good condition, the auditor cannot prove that the client has misreported the company's condition and therefore has to issue a clean opinion. However, if it later turns out that the auditor had confirmed an incorrect report of the client, the auditor faces liability l that exceeds the high effort costs. Pr_H is the probability that the auditor will choose high effort.

This extensive-form game then is combined with a circular spatial competition model where audit clients (with a mass of one) are uniformly distributed on the circumference of a unit circle. Further, a discrete number n of audit firms is also uniformly distributed on the circle. The distance x between a potential client and an audit firm on the circle is an inverse measure for auditor expertise (i.e., the costs for high effort increase in x). If a client has hired an audit firm in distance x , the client's individual probability to misreport is

$$(93) \quad Pr_M^*(x) = \frac{(1-\theta)}{\theta} \cdot \frac{c \cdot x}{l - c \cdot x},$$

while the auditor's probability to exert high effort after having observed a report of a good condition solves the following equation:

$$(94) \quad Pr_H^*(x) \cdot (-m - d_M) + (1 - Pr_H^*(x)) \cdot \left(\frac{(1-\theta)}{(1-\theta) + \theta \cdot Pr_M^*(x) \cdot (1 - Pr_H^*(x))} - m \right) = 0.$$

Bleibtreu and Stefani (2020) use these optimal decisions to calculate expected effort costs and litigation costs, and, under the assumption of Bertrand price competition, the fees the different audit firms can demand from their clients if price discrimination (dependent on the audit firms' expertise) is possible. Like in Bleibtreu and Stefani (2018), the total profit contribution PC is computed by integrating and multiplying by two:

$$(95) \quad PC = 2 \cdot \int_0^{1/(2n)} (FEE^i - c^i) dx,$$

and the zero-profit condition

$$(96) \quad E[PC(n^*)] - c_F = 0$$

is used to derive the equilibrium number of audit firms. Audit quality AQ is defined by the probability that the audited report will accurately reflect the economic condition of the client's company:

$$(97) \quad AQ(x) = 1 - \theta \cdot Pr_M^*(x) \cdot (1 - Pr_H^*(x)).$$

Bleibtreu and Stefani (2020) then extend the model by the possibility for the audit firms to offer NAS to their audit clients. To be more precise, audit firms can expect future NAS fees if they do not issue a qualified opinion on a client's report of a good economic condition. Further, the joint provision of AS and NAS reduces the auditor's costs of high effort. The model thus incorporates both the argument of the proponents of a ban on NAS that NAS fees might impair the auditor's incentives to conduct proper audits, and the opponents' arguments that NAS might lead to beneficial spillover effects. And indeed, as long as the market structure is considered as given (i.e., the number of audit firms n is held constant), the possibility of the auditor to provide NAS with rela-

tively high NAS fees (relatively high spillover-effects) decreases (increases) audit quality. However, when the market structure is allowed to adjust, these results change. The results of Bleibtreu and Stefani (2020) indicate that the prohibition on NAS with high NAS fees has undesired effects on both audit market concentration and audit quality. The ban on the joint provision of AS and NAS decreases the audit firms' profit contributions which, in turn, decrease the equilibrium number of audit firms active in the market. The resulting decrease in the average degree of auditor expertise can overcompensate for the regulation's effect on incentives, and tends to decrease overall audit quality. In contrast, for NAS with high spillover effects, Bleibtreu and Stefani (2020) predict that audit market concentration decreases as a result of a ban on the joint provision of AS and NAS. However, there is also a decrease in audit quality. Additionally, the results show that the effects are more intense if the regulation is implemented in audit markets that are characterized by a high degree of concentration.

VII.5. Summary

As shown in Chapter III, the structure of the audit market can have an effect on audit quality and audit fees. However, as presented in Chapters V and VI, empirical and analytical studies that investigate the effects of audit regulations usually do not consider the potential market structure effects resulting from regulations. A promising path to simultaneously account for such effects might be the application of spatial competition models that allow for adjustments on the supply side. Whereas applications of the linear model of Hotelling (1929) seem particularly useful to analyze audit fees, circular models in the tradition of Salop (1979) can provide new insights on the effects of regulations.

VIII. DISCUSSION

Following a number of major accounting scandals around the world, and, particularly in the aftermath of the financial crisis, regulators have voiced criticism of the function of statutory audits. At the core of this criticism are the allegations that auditors either had not detected errors or irregularities in their clients' financial statements (insufficient audit effort) or had not reported negative results of their audits to the external users of financial information (impaired independence). Moreover, regulators regard the high degree of audit market concentration as problematic. The reason for this assessment is the assumed negative association between concentration and audit quality. Moreover, regulators are concerned about additional negative side effects of supplier concentration (e.g., excessive audit fees, barriers to market entry for smaller audit firms, systemic risks arising from the potential exit of one of the Big 4 audit firms from the market, etc.). Thus, regulators have resumed their discussion regarding the advantages and disadvantages of different audit market regulations in improving audit quality and decreasing audit market concentration.

In order to assess the benefits of individual regulatory measures, it is important to determine whether the goals of improving audit quality and reducing concentration can be achieved at all simultaneously. Regulators seem to assume this, as their arguments often follow the logic of the structure-conduct-performance hypothesis: An *exogenously* given market structure directly determines audit firms' conduct (which is not directly observable but is inferred from performance);

conduct, in turn, has a *causal* effect on performance. To put it bluntly, the *structuralist* view states that a high degree of concentration leads to high market power of the Big 4 audit firms, which they use to demand high fees for low-quality audits. Consequently, a reduction in concentration should (almost automatically) lead to an improvement in audit quality. This view is consistent with the audit market functioning as a *Cournot* oligopoly where clients regard audits as a *homogenous* product and suppliers compete on quantity.

If the audit market were to function according to the structure-conduct-performance paradigm, one would predict a *positive* association between concentration and audit fees and a *negative* association between concentration and audit quality. The results of audit fee research are mainly in line with this hypothesis (Willekens and Achmadi (2003); Feldman (2006); Carson et al. (2012); Ciconte et al. (2015); Huang et al. (2016); Eshleman and Lawson (2017); Gunn et al. (2019); Van Raak et al. (2020)). However, Pearson and Trompeter (1994), Numan and Willekens (2012), and Asthana et al. (2009) document a negative relation between concentration and audit fees. In contrast, the empirical findings on audit quality are mixed. Whereas Boone et al. (2012), Gunn et al. (2019), and Van Raak et al. (2020) confirm the hypothesis of a negative association between concentration and audit quality, there is evidence of even a *positive* relation (Kallapur et al. (2010); Francis et al. (2013); Newton et al. (2013); Huang et al. (2016); Newton et al. (2016); Eshleman and Lawson (2017)).

The latter finding is in line with the *efficiency* view of audit market concentration: Since audit firm networks are organized as partnerships, their possibilities to raise investment funds (e.g., to improve their audit technology) are mainly limited to the resources their partners provide. Thus, if clients have quality-differentiated demands, then audit firms need to obtain economies of scale or scope to be able to efficiently fulfill this demand. Thus, concentration arises *endogenously* as a response to clients' demand for high-quality audits. As a consequence, the observation of a positive association between concentration and audit fees (and audit quality) is not necessarily an indication for a low degree of competition. In line with this view, Dekeyser et al. (2019) and Willekens et al. (2020) argue that the audit market resembles a *Bertrand* oligopoly with competition on audit quality and fees. For the regulatory discussion, the validity of the efficiency view would mean that a decrease in concentration would be at the expense of audit quality. On the other hand, the regulator would not have to worry about the degree of audit market concentration (at least if only its effect on audit quality is considered and additional negative side effects are disregarded).

In our view, several research questions arise from this discussion:

1. To empirically disentangle the structuralist and the efficiency view, a simultaneous analysis of audit fees and audit quality is necessary. Today, there are only few studies that test the relation between concentration and both audit fees and audit quality (e.g., Huang et al. (2016); Eshleman and Lawson (2017); Chang et al. (2019); Gunn et al. (2019); Van Raak et al. (2020)), and the results are at least partially conflicting.
2. While traditional concentration metrics provide information on the distribution of market shares, their connection to competition and performance is less clear (Dedman and Lennox (2009); Numan and Willekens (2012)). This raises the question of how competition can be measured (instead of inferred from performance). A first step to test the effect of market behavior on audit fees and quality is using as explanatory variables competition metrics that are based on spatial competition models instead of applying the traditional concentration

measures. Numan and Willekens (2012) have proposed the measures “auditor-client-alignment” (i.e., the audit firm’s industry portfolio share to measure the degree of auditor-client industry fit) and “incumbent-competitor-distance” (i.e., the absolute difference in industry market shares between the incumbent and its closest competitor to measure the incumbent’s market power). Several researchers use these metrics (or measures derived from these metrics) to investigate the connections between market structure, conduct, and performance. For example, Bills and Stephen (2016) investigate the effect of competition within and between the groups of Big 4 and non-Big 4 audit firms on audit fees, and Chu et al. (2018) consider the effect of the relative size difference between the largest audit firm in a market and the other audit firms on audit pricing. Francis et al. (2017) include year-over-year changes in the auditor’s relative distance to its nearest competitor to examine the dynamic effects of an audit firm gaining or losing a major client on auditor reputations and fee premiums. Dekeyser et al. (2019) investigate whether passing on to clients the cost reductions an audit firm gains from industry scale at the audit office level is conditional on an auditor’s market power. Newton et al. (2016) analyze the association between competition and internal control opinion shopping, and Asthana et al. (2019) investigate the association between fee competition and audit quality, contingent on the incumbent’s market power, which they proxy by using the spatial distance measure proposed by Numan and Willekens (2012). Willekens et al. (2020) also use the distance measure as an input to audit quality, and Stein (2019) uses the portfolio share measure of Numan and Willekens (2012) to examine asset impairment decisions. Van Raak et al. (2020) measure competition with the mobility of market shares.

3. Empirical analyses have only started to take into account that audit fees and audit quality also depend on the client’s relative bargaining power (Bandyopadhyay and Kao (2004); Chu et al. (2018)). In our opinion, the further development and more consistent application of variables that measure the client’s bargaining power (instead of fees, which might be endogenous, and in addition to simple client-size measures) would be extremely useful. These metrics could also be derived from spatial competition models.
4. Empirical analyses should test whether it is appropriate to regard the structure of the audit market as exogenous to audit quality and fees. Today, there are only few studies that implicitly (Eshleman and Lawson (2017); Huang et al. (2016)) or explicitly (Kallapur et al. (2010); Boone et al. (2012)) address this issue. However, extended sample periods are necessary to capture the potential effects of audit fees and audit quality, respectively, on concentration, since these effects need time to unfold (e.g., through mergers or the growth of audit firms).

Regulators worldwide have taken action: In the EU, clients have to hire a new audit firm after ten years, and audit firms have to abide a “cooling-off” period of four years. This rule applies since 2016 (European Parliament and Council of the European Union (2014b), Article 17). In addition, the European Parliament and Council of the European Union (2014b) have implemented a prohibition on the joint supply of AS and NAS, but decided not to require mandatory JAs. In the United States, the United States House of Representatives (2002) has passed the Sarbanes-Oxley Act. The SOX of 2002 also contains a prohibition on single-provider auditing and consulting, but does not require MAR or mandatory JAs.

A self-evident research question therefore consists of analyzing the (potential) effects of these regulations. However, the evidence is mixed. With respect to MAR, there are findings that this regulation would decrease audit quality (Ruiz-Barbadillo et al. (2009); Cameran et al. (2015); Mali and Lim (2018)), but other results indicate that MAR would be beneficial (Corbella et al. (2015); Cameran et al. (2016)). Some findings support the prohibition of the joint supply of AS and NAS (Blay and Geiger (2013); Markelevich and Rosner (2013); Lisic et al. (2019); Carcello et al. (2020)), but there is also evidence that single-provider auditing and consulting is associated with higher audit quality (Koh et al. (2013); Bell et al. (2015)). In contrast, the evidence on the effect of JAs is more consistent. Except for Haak et al. (2018), the empirical evidence indicates that JAs would at least not decrease audit quality (Zerni et al. (2012); André et al. (2016); Al-Hadi et al. (2017); Lesage et al. (2017); Holm and Thinggaard (2018)).

Thus, the question arises as to why the results are inconsistent. Among the obvious reasons are differences in the samples, that is, in the country, time span, and market segment analyzed, in the audit quality measures applied, and in the explanatory variables included in the regression model. But beyond that, we see a more theoretical reason for the different results: Regulations are primarily designed to affect the auditors' incentives to exert sufficient effort and to truthfully report the findings of their audits, and to change the clients' incentives to prepare financial statements that are in line with the accounting standards (*direct incentive effects*). Of course, audit regulations can also have unintended incentive effects. More important, however, is that regulations can also have an effect on the number of auditors who are active in the market, their market shares, and the degree of competition between the suppliers of audit services (*direct market structure effects*). The fact that market structure affects incentives (*indirect incentive effect*), and *vice versa* (*indirect market structure effect*), makes the prediction of the net effect of regulations on audit quality even more complicated. However, most of the empirical literature neglects the market structure effects of regulations.

From this discussion, the following opportunities for future empirical audit market research emerge:

5. More research on the effects of regulations on audit quality is needed. One reason for the scarcity of studies on the effects of MAR, for example, is the lack of data. However, data from European countries will soon become available.
6. There is some evidence that regulations have an effect on the market structure. For example, the passage of SOX has had an effect on the number of smaller audit firms active in the market (DeFond and Lennox (2011); Fargher et al. (2018)) and on audit fees (Ghosh and Lustgarten (2006); Ghosh and Pawlewicz (2009); Huang et al. (2009); Alali et al. (2019)). Further, the EU Audit Reform has affected audit firms' market shares in the EU (Willekens et al. (2019)). There are only few studies that investigate the market structure effects of specific regulations like MAR (Comunale and Sexton (2005); Gerakos and Syverson (2015); Cheynel and Zhou (2020)) or mandatory JAs (Piot (2007); Audousset-Coulier (2015); Guo et al. (2017); Lesage et al. (2017); Kermiche and Piot (2018)). We are not aware of any study addressing the market structure effects of a prohibition of the joint supply of AS and NAS. Testing for the existence of market structure effects resulting from regulations is important for at least two reasons: First, decreasing audit market concentration is on top of the regulator's agenda. Second, there is an association between market

structure and audit quality. Thus, the market structure effects of regulations can intensify or lessen their incentive effects.

7. An interesting topic would be to test whether the degree of concentration at the country-level that is observed before a new regulation goes into effect affects the regulation's effect on audit quality. This research question could eventually be answered with a cross-country study that uses data from the EU Member States covering the period beginning with the implementation of the EU Audit Reform.
8. Empirical studies on the effects of regulations consider the market structure mainly by using the Big 4/non-Big 4 dichotomy. To control for the auditor's market power, using the traditional concentration measures (at the MSA-, the MSA-industry-, or the audit firm's office-level), metrics derived from spatial competition models (Numan and Willekens (2012); Bills and Stephen (2016); Chu et al. (2018); Willekens et al. (2020)), or the mobility of market shares (Van Raak et al. (2020)) could be meaningful.
9. Taking into account competition measures that are derived from spatial competition models is preferable to the use of traditional concentration measures. However, doing so does not take into account the demand side. Therefore, Gerakos and Syverson (2017) emphasize that interpreting the coefficients on the explanatory variables in an audit fee regression as representing only supply-side effects is incorrect (arguably, similar arguments could be made with regard to audit quality regressions). Thus, to disentangle supply and demand effects on audit fees, Gerakos and Syverson (2017) propose the usage of demand estimation techniques as a more appropriate method to empirically investigate the strategies of clients and audit firms. To estimate demand, Gerakos and Syverson (2017) discuss the structural application of the discrete choice model, which has been used by Gerakos and Syverson (2015), Guo et al. (2017), and, recently, by Cheynel and Zhou (2020) and Guo et al. (2020). The first step is to estimate the client's (indirect) utility function derived from hiring an auditor from the "choice set" (e.g., the Big 4 audit firms in Gerakos and Syverson (2015), or the Big 4 firms and two medium-sized audit firms in Guo et al. (2017)), as compared to hiring an auditor from the "outside set". The explanatory variables in the client's utility regression are fixed audit firm brand effects, the fees that the audit firms would charge, observable non-price characteristics of the audit firm-client pair, and an error term. If these explanatory variables are known (or can be estimated), one can compute the expected utility the client would derive from hiring one of the audit firms from the choice set. These expected utilities can be used to determine the client's predicted choice probabilities for each potential audit firm. From this demand curve, one can derive the market shares for the audit firms in the choice set. To address the problem of price endogeneity and to obtain unbiased estimates of the price sensitivity of demand, an instrumental variables approach is used. Gerakos and Syverson (2015) use the demise of Arthur Andersen as an instrument (i.e., as a factor that affects the supply curve but not the demand curve), whereas Guo et al. (2017) exploit the supply shock caused by client firm mergers and acquisitions. Taken together, demand estimation techniques allow predicting the effect of changes in client characteristics, auditor characteristics, or audit fees on auditor choice. One application of this method is to determine the effect of regulatory measures that restrict the client's choice set on market shares and consumer surplus. For example, Gerakos and Syverson (2015) investigate the effect of MAR, and Guo et al. (2017) evaluate mandatory JAs. Moreover, the coefficients on the audit firms' fixed effects can be interpreted as the utility levels that audit firms

deliver to the client, relative to each other and relative to the utility that the client derives from hiring an auditor from the outside set. The approach also considers that clients with different characteristics value the audit firms differently and allows determining how the client's characteristics promote utility. Most importantly, demand estimation techniques provide indications of the degree of competition in the audit market.

Turning to the analytical audit literature, we observe that the number of studies analyzing the effects of regulations is rather limited. For example, Arruñada and Paz-Ares (1997), and Gietzmann and Sen (2002) focus on MAR, Kornish and Levine (2004), Beck and Wu (2006), Wu (2006), and Friedman and Mahieux (2021) address the prohibition of the joint supply of AS and NAS, and Deng et al. (2014) and Biehl et al. (2021) investigate the effects of JAs. Although these studies differ with respect to the number of players and the strategic interactions they consider, the main advantage of all these models is that they provide a theoretical basis for the evaluation of regulatory measures. In particular, they highlight the incentive effects that are likely to affect the outcome. However, these papers neglect potential market structure effects. Moreover, most of these models do not take into account heterogeneity of clients and auditors (exceptions are Gietzmann and Sen (2002), Beck and Wu (2006), Deng et al. (2014), Biehl et al. (2021), and Friedman and Mahieux (2021)). Thus, there is no need for an efficient auditor-client matching, and distortions of this matching resulting from regulations cannot be analyzed. Thus, little is known about the joint association between audit regulations, incentives, market structure, and the quality of audited reports.

We therefore consider an approach that provides a simultaneous analysis of market structure, conduct, and performance to be highly beneficial. Identifying the channels through which regulations affect audit quality is important for the advancement of analytical and empirical audit research, the understanding of the mixed empirical results, and the enhancement of the regulatory debate. One way to model firms' strategic interactions is to apply models of spatial competition. Most of the analytical audit literature that uses spatial competition models as a basis take advantage of the model of Hotelling (1929) with a linear and bounded market. Chan (1999), Simons and Zein (2016), and Mirza et al. (2019), for example, have proposed models of the audit market that are in the tradition of this model.

To analyze the market structure effects of regulations, however, circular market matching models based on Schmalensee (1978) and Salop (1979) seem particularly suited, since they allow to endogenize the number of competing audit firms. In the model of Hotelling (1929), in contrast, the number of audit firms is fixed and restricted to two. One attribute of adaptations of circular market matching models to an auditing context is that heterogeneity of the auditors with regard to their specializations and heterogeneity of the clients with regard to their audit-relevant characteristics are considered. Thus, a regulation's effect on the matching of auditors and clients can be analyzed in addition to incentive effects. Bleibtreu and Stefani (2018) have used such an approach to simultaneously investigate the effects of MAR on audit quality and market structure, and Bleibtreu and Stefani (2020) analyze the effects of a prohibition of the joint supply of AS and NAS.

We identify the following research opportunities:

10. Bleibtreu and Stefani (2018) and Bleibtreu and Stefani (2020) consider the locations of the audit firms on the unit circle as given. Thus, an extension would be to address audit firms' location choices in a static model of complete information (e.g., by analyzing audit firms' investment decisions to become a specialist).

11. Another possibility would be to adapt models of the retail market to the audit market. In these models, suppliers can open shops as an optimal response to their competitors' decisions and their clients' needs. Moreover, to explain audit firm (industry) specialization, dynamic models of market entry and exit can be used. In these models, suppliers can adjust the location(s) of their store(s) to changing demand and cost parameters (Aguirregabiria and Vicentini (2016); for an overview, see Aguirregabiria and Suzuki (2016)).
12. There are also circular market matching models with two circles (Viswanathan (2005)). These models are useful for analyzing multi-market competition (Dekeyser et al. (2019); Deméré et al. (2019)) or the dual structure of the audit market.
13. Bleibtreu and Stefani (2018) and Bleibtreu and Stefani (2020) as well as Gerakos and Syverson (2015) and Guo et al. (2017) assume a static setting in the sense that clients' preferences are stable over time and over regulations. However, Gerakos and Syverson (2015) and Guo et al. (2017) do not take into account market entries or exits of audit firms as a response to the implementation of a new regulation. Thus, to connect the empirical and the analytical audit literature, demand estimation techniques could be extended to allow testing of the formal audit market models in the tradition of the spatial competition models. Since the extension of demand estimation techniques to dynamic settings is quite demanding, the literature has only recently started to follow this path (Cheynel and Zhou (2020)).

The conclusion drawn from the overview in this article could not be expressed better than with the statement of Gerakos and Syverson (2017), p. 1591, that “the level of competition in the market for audits of public companies is a first-order question in the audit literature”. First, although the regulator has always been concerned about the degree of concentration in the audit market, the results of both the analytical and the empirical literature are inconclusive as to whether higher concentration actually leads to less intense competition, and if so, to lower audit quality. Second, the effects of regulatory measures depend on the degree of concentration that exists in a national audit market. However, regulatory measures also have intended and, in some cases, unintended effects on concentration. Thus, the costs and benefits of regulations like MAR, the prohibition on the joint supply of AS and NAS, and JAs are far from straightforward.

IX. REFERENCES

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