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European Telecommunication Regulation – Effects on Telecommunication Providers

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Non-technical summary

The European Telecom Regulatory system is a two-stage system where the European Parliament jointly with the European Commission (EC) and the member states determines the common regulatory system to be implemented to national laws. Against this common regulatory background, the EC also intervenes if it suspects a particular national or international market not to be in line with common EU guidelines. Most prominent examples of interventions are international mobile roaming (2006), mobile network sharing agreements in the UK and Germany (both in 2003) and the abuse-of-dominance decision against Telefonica in 2007.

The EC controls mainly three alternative instruments to intervene on national and international market situations: First, the EC could intervenes on issues present in multiple EU markets or affecting multiple member states at the same time addressing national governments and national regulatory authorities (NRAs) (the international-mobile-roaming example). Second, if an existing national regulatory approach favors one company over its competitors the EC addresses the national regulatory practice (the mobile-network-sharing examples). Finally, the EC also intervenes on individual companies. In contrast to the others, this last type is a direct intervention in companies' market practices (the abuse-of-dominance example).

In this paper I compare the market outcomes of the three types of EC interventions. As regulatory adjustments try to accomplish a long-term change in the market situation in the direction of more competition one can hardly disentangle the impact of a particular regulatory change from other driving market forces. As one cannot evaluate the outcomes of regulation employing standard econometric IO methodologies, I use an event study approach which measures the direct impact of a regulatory announcement on the change in a company's stock prices. In doing so, I find significantly positive effects of the first two types of interventions (addressing multiple member states and individual governments) which show that EC interventions improve individual market situations. On the other hand, directly addressing companies has a negative impact on the affected companies (as expected) but has no significant positive impact on competitors in the same market. While stock price volatilities are not significantly affected by the first two types of interventions, the company-addressing type results in significantly lower volatilities which means a more directed reaction across shareholders.

These findings let us draw key conclusions for telecom regulation in the EU: First, EC interventions actually drive markets to a state of more competition and compensates for an a priori inferior position of new entrants. Second, comparing the individual approaches the second and the third type of interventions are (partially) substitutable. In particular, the comparison of stock price volatilities after announcements shows that the national implementation step in line with the second type introduces additional uncertainty about the final outcome as national governments and regulators adjust EC interventions to the national situation. Thus, if both types of interventions are feasible to reach a desirable adjustment in the market situation directly addressing a company results reduces uncertainty of market participants which is of particular interest in markets with complex infrastructure investments.

Das Wichtigste in Kürze

Die Regulierung des Telekommunikationssektor folgt in der Europäischen Union (EU) einem zweistufigen System, bei dem zunächst das Europäische Parlament gemeinsam mit der Europäischen Kommission und den Regierungen der Mitgliedsstaaten das gemeinsame Regulierungssystem vorgeben, welches auf nationaler Ebene umzusetzen ist. Zusätzlich kann die Kommission auch direkt in das Marktgeschehen eingreifen, wenn sie eine nationale oder internationale Marktsituation als unzureichend vor dem Hintergrund der gemeinsamen Vorgaben erachtet. Bekannte Beispiele für solche Interventionen sind die internationale Mobilfunk-Roaming-Vereinbarung (2006), die gemeinsame Netznutzung unterschiedlicher Mobilfunkanbieter in Großbritannien und Deutschland (beide 2003) und der Missbrauch einer dominanten Marktposition durch Telefonica (2007).

Der Kommission stehen drei unterschiedliche Instrumente zur Intervention zur Verfügung: Erstens kann sie nationale Regierungen und Regulierungsbehörden bei Problemen auf internationaler Ebene (bspw. die internationale Mobilfunk-Roaming-Vereinbarung) adressieren. Zweitens greift die Kommission in nationale Märkte ein, wenn ein nationaler Regulierungsansatz einzelne Unternehmen begünstigt (bspw. die gemeinsame Netznutzung unterschiedlicher Mobilfunkanbieter). Drittens interveniert die Kommission auch gegen einzelne Unternehmen (das Marktmissbrauch-Beispiel).

In diesem Papier vergleiche ich die Ergebnisse der drei unterschiedlichen Interventionsarten. Da Anpassungen von Regulierungsmaßnahmen eine langfristige Veränderung der Marktsituation zu mehr Wettbewerb herbeiführen wollen, kann man nur schwer das Ergebnis der Regulierungsanpassung von weiteren langfristig marktbeeinflussenden Faktoren isolieren. Klassische ökonometrische Verfahren der Industrieökonomik können zur Evaluation von Regulierungsentscheidungen daher nur bedingt herangezogen werden. Um dieser Herausforderung begegnen zu können, verwende ich eine Ereignisstudie, die den direkten Effekt von Regulierungsankündigungen durch die Veränderung der Aktienkurse der betroffenen Unternehmen misst. Es ergeben sich signifikant positive Effekte der ersten beiden Interventionsansätze (bei denen mehrere Mitgliedsstaaten oder einzelne nationale Märkte adressiert werden), die zeigen, dass Eigentümer der betroffenen Unternehmen durch die Interventionen eine Verbesserung der Marktsituation erwarten. Im Gegensatz dazu hat die Intervention gegen einzelne Unternehmen einen negativen Einfluss auf deren Aktienkurse aber keinen auf Wettbewerber im gleichen Markt. Während Aktienkursvolatilitäten nicht signifikant durch die ersten beiden Interventionsarten verändert werden, führt die letzte zu einer signifikanten Reduktion der Volatilität, was auf eine gleichgerichtetere Reaktion der Aktionäre hindeutet.

Aus diesen Ergebnissen lassen sich zentrale Schlussfolgerungen für die europäische Regulierungspraxis ableiten: Kommissionsentscheidungen kompensieren neu eingetretene Wettbewerber für eine zunächst schlechtere Ausgangsposition gegenüber etablierten Anbietern. Vergleicht man die einzelnen Ansätze, so verfolgen gerade der zweite und der dritte (teilweise) identische Ziele. Die Betrachtung der Aktienkursvolatilitäten nach einer Ankündigung zeigt, dass die Stufe der nationalen Anpassung bei der zweiten Interventionsart zu einer zusätzlichen Unsicherheit über deren nationale Umsetzung für Marktteilnehmer führt, da nationale Regierungen und Regulierer Einfluss nehmen. In Fällen, in denen beide Ansätze anwendbar sind, zeigen daher die Schätzergebnisse, dass der dritte Ansatz dem zweiten vorgezogen werden sollte.

European Telecommunication Regulation – Effects on Telecommunication Providers

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Abstract This paper considers the impact of European telecom regulation on the value of affected companies. Employing a repeating AR-GARCH model, I compare the effect of three types of regulation which are categorized based on the addressed subject, i.e. cross-market, country-specific and company-specific regulation. While standard event study approaches are a special case of AR-GARCH models, the approximation process chosen in this paper shows a better estimation of the stock price development based on autoregressive models and, thus, more robust estimation results for the reaction to a regulatory change.
Turning to the economic results, I find positive reactions to cross-market and country-specific regulation and negative reactions to regulation which directly addresses individual firms. The impact on volatility supports the findings of the returns analysis. These findings show that European Commission interventions are competition enhancing and support the expected performance of the affected companies in the telecommunications sector. However, while country-addressing interventions and company-addressing interventions follow similar aims, country-addressing interventions cause more uncertainty to a market because of the national process of governments' adjustments. Thus, the estimation results provide evidence that companies prefer direct European regulation over the implementation by national governments, independent of providers' incumbency.

Keywords regulation, telecommunications, company value
JEL Classification L51, L52, L86, L96, O31, O33

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1 Introduction

Regulation intends to change the behavior of companies with significant market power (SMP) to enforce market competition or to move a market to a state of higher efficiency. Affected companies react to regulatory changes and adjust their market-related strategies. Due to their adjustment in strategies, additionally, expected future profits and, thus, companies' net present values change.

In the European Union (EU), telecommunication regulation is a two-stage scheme; on the higher stage, the EU Parliament in cooperation with the European Commission (EC) and EU member states determines the common regulation scheme which, subsequently, has to be transposed to national laws, taking into account country specificities. While these long-term guidelines join into so-called Regulatory Packages which provide the framework to harmonize regulation across member states, the EC uses various regulatory measures to foster market competition and efficiency. These measures could be categorized into three classes depending on the addressees, cross-market interventions, country-addressing interventions and company-specific interventions.

Cross-market interventions refer to regulatory instruments which affect a particular market type in all member states. In contrast to Regulatory Packages, cross-market interventions relate to a distinct issue in a market which expectedly hampers upcoming competition or efficiency and which exists across all national markets (e.g. Regulation 2887/EC on local loop competition). Country-addressing interventions differ from cross-market interventions as they pick up an issue which is found only in one national market (EC (1997)). This might either arise from an governmentally accepted dominance of one company or it might stem from insufficient transposition of regulatory guidelines. While these two types of EC interventions require the implementation to national laws by national governments and their adoption to markets by national regulators (NRAs), the EC also directly intervenes if it suspects a company to abuse its dominant position in a particular market (Articles 81 and 82, 87 and Regulation 134/2004 EC)(company-specific interventions). In this paper, I analyze the expected outcomes of alternative announcements and compare the results of the different types of interventions to each other.

At the point in time when a regulatory announcement is published, it does not directly lead to a change in market structures or companies' behavior. However, owners of affected companies react to these publications, either taking into account forthcoming

transpositions to national law or other changes in the competition of the addressed markets. Under the assumption of rational shareholders, stock price reactions have been used multiply as a proxy for market reactions on announcements.[1] The consideration of how an announcement changes shareholders' expectations is based on the deviation of stock price returns from a known path. This deviation is assumed to be a linear transformation of a representative firm owner's expectation about how a shock affects future cash-flows. Thus, one can directly "measure" the monetary effect of an unexpected event by considering stock prices.

What is heavily criticized with the so-called event-study methodology is, first, that stock prices follow an autoregressive process (Salinger (1992)) and, second, that significant shocks are accompanied by changes in stock price volatility, in particular when the effect of an announcement is unclear (MacKinlay (1997), Lütkepohl (2006)). Both of these criticisms cannot be taken into account with the traditional event study approach which only focusses on current returns but ignores the time structure and the volatility of returns.[2] For considering the impact on volatility it is recommended to use two-step methods which modulate the error term structure of the return estimation as an autoregressive process.

Two-step AR-ARCH-/GARCH-models enable the successive consideration of a shock on returns and on volatility. While, usually, the lag structure is assumed to be exogenously given for the return and for the volatility estimations, I select the optimal lag length based on an iterative estimation approach.

The following results can be drawn from the estimations: First, cross-market interventions and country-related interventions increase the stock-price returns of the affected companies. Secondly, company-addressing actions reduce the stock price returns of the company and, simultaneously, reduce the volatility in returns. In contrast, other companies in the same market remain unaffected. These findings provide evidence that regulatory interventions and changes in the regulation structure fulfil the aims of the EU Parliament. Moreover, if a particular company is addressed, the effect on expected future profits does not significantly differ from cross-market- or company-related interventions, but stock price volatility is reduced. As a result, regulatory interventions are interpreted differently depending on the type of intervention.

[1] Schwert (1981) provides a broad overview over studies, including also regulation studies. After 2000, stock price reactions have been used also comprehensively in the context of telecommunications as will be discussed below.

[2] A detailed discussion is given in the introduction to the chapter "Nonlinearities in Financial Data" in Campbell et al. (1997).

The remainder of the paper is organized as follows: Section 2 provides an overview over findings in the related literature. Afterwards, the alternative types of interventions by the European Commission are specified in more detail and related hypotheses are derived (Section 3). Section 4 explains how pre-estimations are implemented. Subsequently, a descriptive overview over the employed variables is given and the estimation results of the pre-estimations are summarized and discussed. Moreover, a descriptive overview over the variables of the main estimations is provided (Section 5). Section 6 discusses the estimation results. The last section summarizes the key findings, concludes the paper and gives an outlook to further research.

2 Literature Review

This section considers the existing literature on company and market regulation and its impact on the value of affected companies. As an ongoing discussion of methodological improvements is in place for the event study approach, I start with a broader overview. Event studies were originally used to consider regulatory changes in financial markets. Examples are Stigler (1961) or Officer (1973), who both analyze the 1934 introduction of the Securities Act and the establishment of the Securities and Exchange Commission (SEC) and how NYSE stock prices reacted to this introduction of regulation. As the SEC provides guidelines on stock exchanges, it directly addresses the shareholders' behavior influencing shareholders' evaluation of companies.

Schwert (1981) proposes alternative ways, how event studies could also be used in a broader context of regulation, not only to measure the impact on the addressees but to gain information about the expected reactions of addressees. Thus, event studies are also adopted to non-financial markets; this opens a broader range for the implementation of the event study methodology. Considering a change in the structure of non-financial markets differs from considering changes in financial market structures in the sense that a regulation does not address shareholders' behavior but the strategic behavior of the related company by assuming rational behavior of agents.[3]

Binder (1985) focuses on alternative weaknesses of event studies. Among others, he highlights the importance of the correct announcement date. By assuming the announcement date to be a priori unknown, he finds only little evidence for stock price reactions on

[3] E.g. in the context of telecommunications, Schwert proposes to adopt event study-based measures to evaluate frequency licenses.

regulation. Following his argumentation, uncertainty of the first announcement date strongly weakens the validity of an event study analysis. However, with the upcoming internet and the online availability of information, news are offered simultaneously to a larger group of interested parties. Thus, announcements should have a stronger effect on share values. Moreover, the online storage of information also enables a detailed back-tracing of information, which makes it easier to find the most relevant announcements for event study analyses. As a consequence, a larger range of studies on single events or event groups have been implemented after around 1995/1996.

While the previous papers provide an overview of the steps of adopting the event study methodology to economic regulation analyses, the following studies focus on the implementation of event studies in the context of telecommunication markets.[4]
Considering the development of Deutsche Telekom stock prices, Rudolph and Johanning (2004) compare the announcement of changes in regulation with announcements of management decisions. They choose the period between 1997, i.e. shortly after the IPO of Deutsche Telekom, and 2002. Thus, Rudolph and Johanning's work covers a period of comprehensive changes in the company culture from a former public monopolist to a more privately-owned company[5], and, simultaneously, the transition period from monopoly to regulated competition in the German telecommunication sector. The authors show that management decisions have a significantly stronger effect on stock prices than regulatory decisions, both being mostly negative in the period under consideration. Ehrmann et al. (2005) extend the analysis of Rudolph and Johanning by adopting additional news until March 2005. While the latter find significantly positive stock price reactions before 2001, their results turn negative for the second half of the observation period.
Bel and Trillas (2005) use the event study approach to gain more insights into the interplay of governmental ownership, regulation and company activities in a study on the Spanish incumbent Telefonica. Regulatory changes between 1996 and 2000 altered not

[4]Despite knowing of the pitfalls of event studies in the context of antitrust and the evaluation of mergers and acquisitions (see e.g. McAfee and Williams, 1988; Shleifer and Vishni, 2003), the event study methodology is a commonly accepted method in competition economics (Whinston, 2006). It has been used for the evaluation of alternative topics which comprise among others anticompetitive horizontal mergers (Eckbo, 1983; Stillman, 1983; Eckbo and Wier, 1985) or the evaluation of antitrust decisions and merger control (Duso et al., 2008; Neven and Zenger, 2010).
[5]The German state held 61 percent of Deutsche Telekom shares in 1997 and reduced its participation to 42.8 percent by 2002.

only the market structure but had an effect on the internal structure of Telefonica (see also Kole and Lehn, 1997). In particular, Bel and Trillas consider the following agency problem: The state keeps a Golden Share in Telefonica, thus, preventing the company's takeover. In contrast, no powerful shareholders exist which build a counterpart to the government. The authors expect that in this protectory situation, management decisions are strongly affected by the government. In line with Ehrmann et al. (2005), Bel and Trillas find regulation to have a significantly positive impact on stock price returns for the period until 2000. With regard to liberalization, the authors argue that a positive impact on shareholder value stems from the expectations about an increase in demand. Instead of considering the effect of regulation on the incumbent provider, Krouse and Park (2003) use a broader data set covering both incumbents and new entrants on the local exchange level and consider how the introduction of the 1996 Telecommunications Act in the United States changed net present values of affected companies. They find no significant impact of the announcement on the incumbents' stock prices but significantly positive excess returns on competitors' stock prices. Krouse and Park argue that this result is strongly in line with the intention of this new legal framework as the introduction of competition reduces market concentration in favor of the entrants, thus enhancing competition in local telecommunication markets. In a quite similar approach, Bittlingmayer and Hazlett (2002) analyze the effect of changes in regulation on American broadband companies and find that deregulation decisions increase shareholder values. Approvals on the deregulation of long distance markets have no significant effect on internet providers' stock prices whereas denials negatively affect stock prices.

In contrast to most of the previous studies, I use data for multiple companies active in multiple countries and markets. In doing so, I consider the impact of regulation announcements for incumbent and entrant providers. I focus on regulation announcements of the EC which are less susceptible to a potential endogeneity challenge as characterized e.g. in Duso and Röller (2003) or in Bel and Trillas (2005). The EC can choose from a set of various regulatory instruments, which provoke alternative reactions. In the next section, I provide an overview of the types of interventions and their expected impact on affected companies.

3 Regulation in Europe

Regulation in the EU is based on a two-stage approach, in which the Commission coordinates, monitors and controls common steps of regulation across all EU member states. One key instrument are Regulatory Packages with which the EU Parliament in cooperation with national governments and the Commission offers a common set of directives to harmonize the steps from monopoly to competition in the EU member states. The member states have to adopt these guidelines to national laws taking into account country distinctions.[6]

However, during implementation processes, problems become obvious which mainly arise due to technological innovations and market developments. In consequence, the Commission adopts multiple steps to remedy these specific problems of the transposition process and unexpected market developments (e.g. local loop access regulation or the repeated interventions in line with Golden Shares). While these steps ease the process of the installation of competition and efficiency, they do not directly address particular national market issues. In contrast to national regulators, the Commission takes a superior position: It monitors markets from a cross-national perspective and intervenes if it suspects national markets and rules not to satisfy the European regulatory requirements. One commonly known example is the decision on international mobile communication roaming.[7] Following the Commission, both approaches support companies as a whole as they reduce bureaucratic challenges, give a more reliable framework for NRAs' actions and reduce market barriers.

With its interventions, the Commission seeks to improve competition and efficiency in a

[6] While the First Regulatory Package of 1998 has been installed to coordinate a harmonized move from monopolistic to competitive markets, this move rapidly turned to an acceleration of technological and demand evolution. Therefore, the Second Regulatory Package was adopted in 2002/2003, which seeks to balance static and dynamic regulation aims, i.e. competition aims as well as investment and innovation aims. A detailed discussion is provided in the initial proposition for the new regulatory framework by the Commission, `http://ec.europa.eu/information_society/topics/telecoms/regulatory/new_rf/documents/com2000-393en.pdf`. In line with the 2006 market review of the Second Regulatory Package, new guidelines were discussed which even stronger take into account customers' behavior in line with the development of Web 2.0. `http://ec.europa.eu/information_society/policy/ecomm/tomorrow/roadmap/index_en.htm`.

[7] The Commission ordered mobile network providers (MNPs) to reduce termination rates stepwise to a predetermined level and, beginning in March 2007, reduced the upper bound wholesale price using cross-market regulation for all EU member states. More information is provided in the latest regulatory intervention in this context: `http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:167:0012:0023:EN:PDF`. Additional information about the tariff structure can be found here: `http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/07/251`

market under scrutiny either tackling problems in line with the introduction of a Regulatory Package or technological deployments or in the consequence of an identified market difficulty. As the intervention intends to improve the market situation, this should also increase the firm value of the companies in the addressed market situation as a whole.

> **H1 (Type 1: Cross-market interventions):** The Commission's activities to introduce and establish competition and more efficiency in the telecommunication sector positively affect the situation of telecommunication companies as a whole.

Besides cross-national steps of interventions, the Commission's services also monitor individual national markets as do national regulators. However, they base their consideration on common European requirements and analyze whether individual national regulation is in line with European guidelines. This Commission initiative is accompanied by regular queries on the implementation of the guidelines and also by queries on national regulators' market monitorings. If they identify a national telecommunication law or its regulatory implementation not to be in line with European requirements, the Commission intervenes by addressing its concerns to the national authorities in charge. Subsequently, the national government has to remedy its telecommunication law or the NRA has to adjust its market implementation. If national institutions refrain from such a step, the Commission brings the case to the European Court of Justice. An example of such a far-reaching decision has been the intervention in line with regulatory holidays in the context of the German VDSL roll-out.[8] After the Commission has multiply remarked its concerns without amendments by the German government, it brought the case to the European Court of Justice in June 2007. The case was decided in December 2009 impeding the German intention.[9]

If the Commission intervenes on a particular issue in a national market it suspects the previous situation not to be in a stage of adequate competition and not to turn to competition in the near future under the current national telecommunication rules (Monopolies Commission, 2009). Interventions therefore intend to improve the market situation and, thus, the situation of the market players as a whole.[10] As asymmetric national market

[8] The German government wanted to change national telecommunication law to enable regulatory holidays for the establishment of new high-speed internet access if the national regulator Bundesnetzagentur would have decided VDSL to be a new market.

[9] `http://www.euractiv.com/en/infosociety/eu-court-sets-precedent-germany-telecoms-ruling/article-188017`

[10] Please see also Bel and Trillas (2005) with regard to regulators' decisions concerning total markets.

boundaries are reduced and more transparency is provided, companies in the addressed market should benefit from the Commission's action, which increases their firm values.

> **H2 (Type 2: Country-addressing interventions):** Shareholders expect a positive impact of market-structural Commission interventions on firm values.

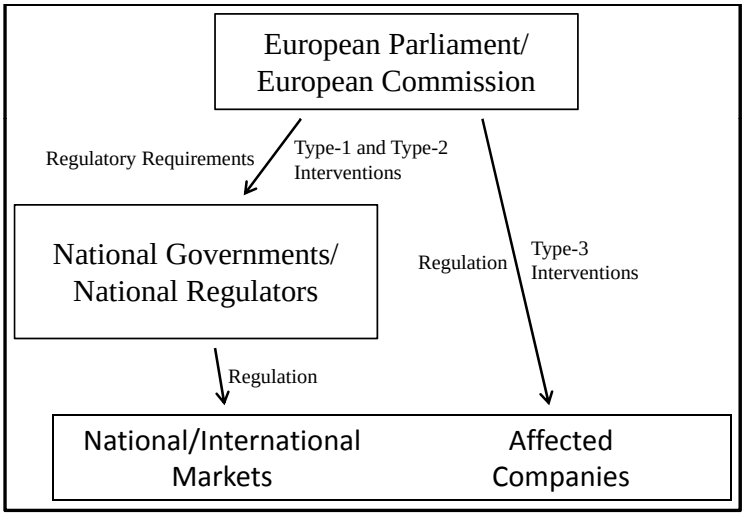
While the activities described so far concern issues which comprise markets as a whole, the Commission also intervenes if it suspects individual market participants to hamper competition. Similar to country-addressing interventions, it first informs the company about its concerns. Afterwards, it warns the company and brings the case to the European Court of Justice if the company does not adjust its behavior in line with the recommendation. Multiple examples exist in which mainly former monopolists have been part of such a process, e.g. KPN for abusing its dominant position for mobile call termination in 2002 or France Telecom to pay back state aid in 2004. There are also cases in which market entrants are suspected to be in an anti-competitive position such as the state aid decision on Mobilcom in 2003.

Moreover, the Commission is obliged to consider cases of major players' mergers, demergers and acquisitions, including infrastructure sharing between providers or common licence acquisitions. It intervenes or accepts a project imposing conditions if it suspects subsequent market concentration to hamper competitors. Examples are the merger of the two Scandinavian incumbents Telia and Sonera in 2002 or the 3G mobile network sharing agreement in the UK in 2003. As in general most of the companies face trials concerning forms of anti-competitive behavior or the prohibition of a future supremacy, this type of intervention should have a negative impact on the value of the respective firms.[11]

[11] Please note that company-addressing actions are a gray area between regulation and antitrust actions particularly in markets with an ex-ante dominant provider. Rey (2002) identifies four criteria how to distinguish regulation from antitrust issues. These are, first, *procedures and control rights* in the sense that regulatory authorities have more powerful instruments to intervene on firm behavior than antitrust authorities, second, *timing of oversight*, which means the issue of ex ante interventions (typically regulation) and ex post interventions (typically antitrust), thirdly, *information intensiveness and continued relationship* meaning that regulators have to cultivate a continuous relationship to the market and the companies, and, finally, *relationship to political powers* comprising the impact of politicians on the agency. While individual NRAs actively take over antitrust tasks, such as the UK regulator OFCOM, current regulation habits in the preparation of the Third Regulatory Package try to increase regulators' independence from political authorities and also, to some extent, the proximity of regulators to markets. In the further analysis, I consider cases of individual company-specific interventions from the regulatory perspective keeping in mind the ongoing transition from pure regulation to antitrust actions of the Commission in the telecommunication sector. In addition, please see also Knieps (2003), Neumann (2003) and Vogelsang (2003).

H3 (Type 3: Company-specific interventions): Company-specific interventions reduce the shareholder value of the addressed firms.

Figure 1: Overview of Alternative Types of Regulatory Interventions



The first and the second hypotheses concern interventions, which relate to the telecommunication sector as a whole or to a particular market whereas the third hypothesis focuses on individual companies' actions (see also Figure 1). While the first two types of interventions require national institutions to adopt and apply regulation measures to national markets, the third approach directly addresses particular companies' behavior in the markets. Thus, from the first two types of interventions to the third type, the Commission's actions turn from a superior cross-national or national level of interest to a firm-specific one. As actions are much more focussed with type-3 interventions they should also receive more attention by shareholders.

H4a: The impact of interventions on stock price returns increases from cross-market and country interventions to individual company requirements in absolute terms.

Type-1 and type-2 interventions require the adoption of regulations to national laws taking into account national distinctions. Even with the knowledge of forthcoming interventions, the actual market implementation has an ex ante unknown outcome. Therefore, stock price volatilities should be higher with type-1 and type-2 interventions than with

type-3 interventions as intermediate authorities provide additional uncertainty about the actual implementation of outstanding regulatory requirements.

> **H4b:** Stock-price volatilities decrease from cross-market and country interventions to individual company requirements.

4 Empirical Implementation

In the event study literature, two approaches for explaining shocks exist, which either focus on stock price returns or on volatilities. For analyzing both returns and volatilities, it is necessary to decompose one effect from the other. A common approach is the AR-GARCH model (Autoregressive-Generalized Autoregressive Conditional Heteroscedasticity model) (Ferenstein and Gasowski, 2004; Lütkepohl, 2006). In AR-GARCH models, the stock price return path is estimated using the standard AR approach and assuming a GARCH process for the error term structure. I employ the AR-GARCH model to estimate the stock price returns development for the companies under scrutiny assuming a total observation window of 201 days around the event (100 days before and 100 days after the event). The lag-structure of the AR and the GARCH process are determined by iteration as described below. In contrast, in standard event studies, either no autocorrelation or a one-period lag structure for stock price returns is assumed. These approaches are special cases of the approach which I adopt here as I allow the model to calibrate to the optimal time structure.

I employ the following three-step estimation approach: I first estimate stock price returns for the 201-days observation window for each event. Afterwards, I estimate the error term structure to get information about the return volatilities. For each observation window, each of the two steps is iterated until the best estimator is found. The selection of the best estimator is based on the Akaike Information Criterion (AIC) as described in Lütkepohl (2006) and as used in a magnitude of time series prediction studies.[12] Finally, I use the results of the first two steps to consider the effect of events in windows with three alternative lengths around the event date (3, 7 and 11 days).

[12] In a previous version of this paper, I have double-checked results using the Bayes/Schwartz Information Criterion for the AR process and for the GARCH process. This method dedicates more weight to the number of explanatory variables. Nevertheless, results with regard to lag-length change only slightly.

For the first two steps, I assume the following return and error term equations:[13]

$$\begin{aligned} R_{it} &= \alpha_{Ri} + \textstyle\sum_{j=0}^{j<t} \beta_{it-j} R_{it-j} + \beta_{TI} TI_t + \varepsilon_{it} \\ \varepsilon_{it} &= \sigma_{it} \nu_{it} \end{aligned} \tag{1}$$

R_{it} is the stock price return of firm i in period t and TI_t corresponds to the returns of a market index at date t. ν_{it} is white noise following an iid(0,1) process. The first equation corresponds to the standard AR-part of an AR-GARCH model. With the GARCH assumptions, the error term of the return equation satisfies the second equation and σ_{it} is determined by the following process (Bollerslev, 1986):

$$\sigma_{it}^2 = \alpha_{\sigma i} + \sum_{p=0}^{P<t} \beta_{\varepsilon it-p} \varepsilon_{it-p}^2 + \sum_{q=0}^{Q<t} \beta_{\sigma it-q} Var(\sigma_{it-q}^2) \tag{2}$$

with $Var(\varepsilon_{it}|\varepsilon_{it-1}, \varepsilon_{it-2}, ...) = \sigma_{it}^2$, $E(\varepsilon_{it}) = 0$, $Cov(\varepsilon_{it}, \varepsilon_{is}) = 0$, $t \neq s$. When all $\beta_{\sigma i}$'s equal zero, the process is an ARCH model as described in Engle (1982).[14]

In contrast to other event study approaches which postulate a specific lag length, the approach chosen here keeps the estimation flexible in the sense that each estimation is multiply repeated employing the ARCH or the GARCH restrictions to determine the optimal lag-length based on the AIC.

In the third step, I focus on the individual event window and analyze if and how an event causes a deviation from the expected returns and the volatilities process. Abnormal returns (AR) and abnormal volatilities (AV) are assumed to be normally iid with zero means over the observation period but not necessarily in the event window. Therefore, abnormal returns and abnormal volatilities are given by the following equations:

$$\begin{aligned} AR_{id}^m &= R_{id}^m - \hat{R}_{id}^m \\ AV_{id}^m &= \sigma_{id}^{m2} - \hat{\sigma}_{id}^{m2} \end{aligned} \tag{3}$$

m marks the event, i the firm and d the date of the observation. $\hat{R}_{id}^m$ and $\hat{\sigma}_{id}^{m2}$ are the estimates of equations (1) and (2) for each event. Daily abnormal returns and volatilities are cumulated around the event day to obtain the cumulated abnormal returns and the cumulated abnormal volatilities with

[13] The event index is neglected as long as the consideration of a single event is sufficient.
[14] For more details, please see e.g. Campbell et al. (1997).

$$\begin{aligned} CAR_i^m &= \sum^{2\tau+1} AR_{i\tau}^m \\ CAV_i^m &= \sum^{2\tau+1} AV_{i\tau}^m \end{aligned} \tag{4}$$

I compare the results of three alternative event windows with a length of three, seven and eleven days before and after the event ($\tau = 3$, 7, 11).
I use alternative exogenous variables, which explain cumulative abnormal returns and volatilities:

$$\begin{aligned} CAR_i^m &= \alpha^{m,r} + expl.\ var.'\beta_{expl,i}^{m,r} + control\ var.'\beta_{contr,i}^{m,r} + \eta_i^{m,r} \\ CAV_i^m &= \alpha^{m,v} + expl.\ var.'\beta_{expl,i}^{m,v} + control\ var.'\beta_{contr,i}^{m,v} + \eta_i^{m,v} \end{aligned} \tag{5}$$

Exogenous variables are classified in explanatory variables *expl. var.*, which are cross-market, addressed-country and addressed-company dummies, and control variables *control var.*, which are fix-line, mobile, incumbent, foreign fix-line and foreign mobile and combinations of these variables.
Although the AR-GARCH approach improves the estimate of stock price return developments, it still has some pitfalls known from the standard approach. In particular, it assumes the independence of stock price returns at the same point in time, $corr(R_{it}, R_{jt}) = 0$, and across different series across time, $corr(R_{it}, R_{js}) = 0$, $\forall i \neq j, s \neq t$. Multivariate GARCH models exist which adjust the variance-covariance matrix to take stronger into account cross-sectional correlations by simultaneously estimating returns of multiple companies. However, these approaches are only implemented in studies with a low number of companies due to the exponential growth of processing capacity requirements in the number of considered companies and the lag-length employed (Lütkepohl, 2006). Because of the high number of companies in my sample, I refrain from these multivariate AR-GARCH models and follow the standard approach by adding market indices to the model to control the cross-company structure at least partially. Nevertheless, this approach cannot completely absorb cross-company correlations.

5 Data and Pre-Estimations

5.1 Data Description

To test the hypotheses, I use information on Commission decisions, which were selected for the time period between January 1, 2000 and December 31, 2008. Announcements,

not actual decisions, are employed as it is explained in the literature that the first announcement of a significant change should affect stock prices as soon as it is available (Binder, 1985). The information is taken from the database Cullen International, which collects per-day information on changes in telecommunication regulation and competition. The selected news are displayed in Table 8 in the appendix.

Thomson Financial Datastream provides share values for about 90 companies characterized as telecommunication companies in the selected countries, which are EU-15 countries as well as Norway and Switzerland during the observation period. From this schedule, five companies had to be excluded because they are listed after mid 2006 and, thus, might be stronger affected by the firm-specific value-finding processes of the market. Subsequently, I re-examined the remaining companies by collecting information about firm activities from their websites. Additional companies were excluded from the sample as either the companies are not active in the field of interest, i.e. fix-line or mobile telecommunications, or as not enough stock price data points are available for the observation period.

After these corrections, I ended up with 2447 independent event-company combinations whereof 816 are combinations with incumbents. 32 events concern cross-market related issues, 6 events concern country-related topics and 26 events concern company-related announcements. There exists an over-representation of incumbent-events in particular in the first years of the sample as most incumbents have been listed over the whole observation period.[15] Some companies are active both in fix-line and mobile markets in multiple countries. However, no or only little information could be collected on their activities in these countries and markets. What would be most interesting are market shares and sales ratios. Nevertheless, the only information, which is available from company websites and information systems, is the particular market, i.e. either fix-line or mobile markets, and the year of entry and exit. Furthermore, information about the regional reach is obtained, i.e. whether a company is active in Europe or globally. Information about multi-market activities is collected from alternative information sources including Bureau van Dijk's Amadeus database and the companies' websites.

I employ two alternative market indices, the Dow Jones 600 Telecommunications Index Europe (Telecom Index) and the Dow Jones 600 Technology Index Europe (Technol-

[15] Exceptions are Telia Sonera, listed since June 14, 2000, Telekom Austria, listed since November 21, 2000, Telenor, listed since December 05, 2000, and Belgacom, listed since March 22, 2004.

ogy Index). The first includes major European telecommunication companies meaning also some of the companies under scrutiny of the analysis. Therefore, a spurious correlation challenge might exist in particular when analyzing the impact of cross-market announcements. For these events, the impact on returns is probably mainly explained by the change of the index. Additionally, regulation announcements potentially also affect other companies of the index (see Rudolph and Johanning, 2004). Therefore, the actual effect might be downward-deterred in absolute values both for returns and for volatilities. To control for this issue, the Technology Index is used as it excludes any telecommunication companies but covers companies from sectors which perform very similarly over the sample period. Some minor endogeneity might still exist as the products and services of technology companies mainly depend on adequate telecommunication infrastructure (such as software etc.). However, this challenge could be neglected.

Table 1: Mean Descriptive Statistics of the Variables of Steps 1 and 2

	Pooled		**Incumbents**		**Entrants**	
	Mean	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Mean(returns)	-0.0018	0.0076	-0.0015	0.0038	-0.0019	0.0089
Std. Dev.(returns)	0.2996	0.1875	0.2298	0.0651	0.3346	0.2167
Mean(Telecom Index)	-0.0002	0.0005	-0.0002	0.0005	-0.0002	0.0005
Std. Dev.(Telecom Index)	0.0073	0.0032	0.0076	0.0032	0.0071	0.0032
Mean(Technology Index)	-0.0003	0.0007	-0.0003	0.0008	-0.0003	0.0007
Std. Dev.(Technology Index)	0.0094	0.0041	0.0099	0.0041	0.0092	0.0041
Obs.	2447		816		1631	

The descriptive statistics of the variables used in the step-1 and step-2 estimations are displayed in Table 1. Figures are mean variables in the sense that for each event, I calculate the descriptive statistics of the observation window and aggregate results over all events and all companies. The resulting mean values and the standard deviations of the means are displayed here. $returns$ is the daily relative change in stock prices, $std.\ dev.(returns)$ is the calculated mean standard deviation of returns, $Telecom\ Index$ and $Technology\ Index$ variables are daily relative changes of the indices and, similarly, the $std.\ dev.$ terms correspond to the mean standard deviations of the index returns. By comparing the pooled results with the incumbents' and with the competitors' results, it is found that average returns are at a comparable level. However, average standard deviations are much more volatile for competitors than for incumbents.

Table 2: Descriptive Statistics of the Dependent Variables

3 days	**Pooled**	**Incumbents**	**Entrants**	**Fix-Line**	**Mobile**
CAR	-0.0001	-0.0001	-0.0001	-0.0003	-0.0001
(Telecom Index)	(0.0076)	(0.0048)	(0.0087)	(0.0076)	(0.0076)
CAR	-0.0001	-0.0001	-0.0001	-0.0002	0.0000
(Technology Index)	(0.0076)	(0.0048)	(0.0087)	(0.0076)	(0.0076)
CAV	0.0010	0.0006	0.0011	0.0009	0.0010
(Telecom Index)	(0.0013)	(0.0005)	(0.0015)	(0.0013)	(0.0013)
CAV	0.0010	0.0006	0.0012	0.0009	0.0010
(Technology Index)	(0.0013)	(0.0005)	(0.0015)	(0.0013)	(0.0013)
7 days	**Pooled**	**Incumbents**	**Entrants**	**Fix-Line**	**Mobile**
CAR	-0.0013	-0.0015	-0.0012	-0.0028	-0.0007
(Telecom Index)	(0.0270)	(0.0179)	(0.0306)	(0.0272)	(0.0266)
CAR	-0.0009	-0.0015	-0.0006	-0.0021	-0.0003
(Technology Index)	(0.0270)	(0.0180)	(0.0305)	(0.0271)	(0.0267)
CAV	0.0052	0.0031	0.0062	0.0051	0.0053
(Telecom Index)	(0.0069)	(0.0023)	(0.0081)	(0.0069)	(0.0071)
CAV	0.0052	0.0031	0.0063	0.0052	0.0053
(Technology Index)	(0.0069)	(0.0023)	(0.0081)	(0.0069)	(0.0071)
11 days	**Pooled**	**Incumbents**	**Entrants**	**Fix-Line**	**Mobile**
CAR	-0.0013	-0.0019	-0.0011	-0.0044	-0.0003
(Telecom Index)	(0.0473)	(0.0305)	(0.0538)	(0.0472)	(0.0468)
CAR	-0.0007	-0.0019	-0.0001	-0.0034	0.0003
(Technology Index)	(0.0470)	(0.0304)	(0.0535)	(0.0471)	(0.0463)
CAV	0.0105	0.0063	0.0126	0.0104	0.0107
(Telecom Index)	(0.0139)	(0.0046)	(0.0163)	(0.0139)	(0.0143)
CAV	0.0106	0.0063	0.0128	0.0105	0.0107
(Technology Index)	(0.0138)	(0.0045)	(0.0162)	(0.0139)	(0.0141)

Note: Variables are means of the relevant category, std. dev. in brackets.

The descriptive statistics of step-3 dependent and explanatory variables are displayed in Table 2 and in Table 3, respectively.

Table 2 shows only small cumulative abnormal returns and also volatilities around the announcement dates. Following Rudolph and Johanning (2004), changes in European regulations are probably of a minor interest for shareholders. This might be due to the fact that the result of regulation is not directly linked to returns but is a long-run driver of companies' profits. Furthermore, low values could also stem from the estimation approach for predicted returns functions of step 1 and step 2. As the approach chosen here is the result of an iterative estimation optimization, the results should meet stock price evolutions much more appropriate than known standard techniques. Consequently,

the deviation, which is identified around an event, is expected to be less extensive in absolute terms but much more robust.
Means differ only slightly depending on the underlying indices. With a larger window size, entrants CAR are lower when applying the Technology Index, which also affects the pooled estimation outcome. However, estimation results for the incumbents estimations and the consideration of CAV show nearly identical results. In consequence, only little evidence is found for a potential spurious regression problem. With larger event windows, a stronger reaction exists both for incumbents returns in comparison to entrants returns and for fix-line operators returns in comparison to mobile operators returns. The comparison of the three alternative event windows shows that the seven-days window provides the largest deviation in returns. In contrast, cumulative abnormal volatilities increase with the window size. Controlling for fix-line or mobile operators leads to similar results.
With regard to volatilities, significant differences are only found between incumbent and entrant providers: Entrants stock prices react much more volatile on announcements, which might be due to the stronger heterogeneity in this group. In contrast, no significant differences in volatilities exist between fix-line and mobile operators.

Let us next turn to Table 3. In 26.9 percent of company-event combinations, companies are involved, which are active in both fix-line and mobile markets, in 26.4 percent only fix-line and in 46.7 percent only mobile companies are involved. Due to double-markets activities, fix-line and mobile means do not sum up to 1. On average, each fix-line provider (mobile network provider) is active in 1.8 (1.4) European markets over the observation period. No provider in the sample has left one market and afterwards entered another. About one third of the companies are incumbent providers in one country but are also active in another country as a new entrant. These companies are counted only once (as incumbents), as stock prices cannot be disentangled based on country-market activities. One special case is Telia Sonera, which is the incumbent in Sweden and in Finland after the companies merged in 2002. Less than 10 percent of fix-line and of mobile providers are active in countries other than the EU-15 countries, Norway or Switzerland. Dummies for regulation-addressed companies are used to separate addressed companies from others in the same market.

Table 3: Descriptive Statistics of the Explanatory Variables

	Mean	Std. Dev.	Min	Max
fix-line	0.5333	0.4990	0	1
mobile	0.7360	0.4409	0	1
fix-line (multi-market activity) (1)	1.7941	2.5841	0	15
mobile (multi-market activity) (2)	1.4334	1.6973	0	9
incumbent (3)	0.3335	0.4715	0	1
foreign fix-line	0.0919	0.2890	0	1
foreign mobile	0.0826	0.2753	0	1
cross-market (4)	0.4843	0.4999	0	1
addressed market (5)	0.1606	0.3672	0	1
addressed company (5)	0.0090	0.0944	0	1
affected company fix-line	0.2795	0.4489	0	1
affected company mobile	0.3551	0.4787	0	1
1 x 4	0.8606	1.9723	0	15
2 x 4	0.6980	1.3932	0	9
4 x 5	0.0523	0.2227	0	1
4 x 6	0.0074	0.0855	0	1

5.2 Pre-Estimation Results

Table 4 provides pooled summary statistics and test results for the step-1 and the step-2 estimations.[16] Estimations with the Technology Index have an, on average, lower optimum lag length in all three specifications both for the AR and for the GARCH process. Comparing the outcomes of the incumbents estimations and the entrants estimations, the AR process is shorter for the entrants estimations but the (G)ARCH process is longer, which is in line with the findings on cumulated abnormal returns (Table 2). The Chi-square tests and also the Log-Likelihood tests are found to be weak instruments to compare variable and estimation quality because of their broad volatility across the alternative estimations.[17]

The standard approach used in the literature to proxy the actual stock price returns process assumes no explicit time structure, which corresponds to $ar = 0$ and also $p = 0$ and $q = 0$. If the iteration provides a lag length variance of zero, $q = 0$, to be best the ARCH model meets the underlying error term process better than the GARCH model. However, this specification neither exists for the incumbents nor for the entrants

[16] Tables 10 and 11 in the appendix show the results separated for incumbents and entrants.

[17] Moreover, the Chi-square test is not a test to compare specifications of alternative estimations.

Table 4: Summary Statistics and Test Results of the Iterative Estimation Process

Pooled	**Technology Index**			**Telecom Index**		
	Mean (Std. Dev.)	**Minimum (Share Min.)**	**Maximum (Share Max.)**	**Mean (Std. Dev.)**	**Minimum (Share Min.)**	**Maximum (Share Max.)**
AR						
lag ar	3.826 (1.675)	0 (0.056)	6 (0.193)	4.114 (1.899)	0 (0.048)	7 (0.133)
Chi_sq (df)	76.6 (4.914) (77.5)	0.000	1553.6	77.8 (5.122) (77.0)	0.000	1561.1
log likelihood	43.0 (200.3)	-347.6	830.1	44.3 (203.3)	-339.8	890.4
(G)ARCH						
lag error_sq (=p)	1.924 (2.152)	0 (0.357)	8 (0.017)	2.097 (2.240)	0 (0.340)	8 (0.014)
lag sigma_sq (=q)	1.980 (1.688)	1 (0.678)	6 (0.095)	2.112 (1.994)	1 (0.675)	8 (0.042)
Chi_sq (df)	35183 (1.886) (1584476)	0.000	7014.8	306.2 (1.954) (12898)	0.000	617316
log likelihood	1320.5 (305.4)	-296.2	1191.8	57.8 (212.7)	-293.8	1289.4

Note: lag sigma_sq = 0 corresponds to an ARCH process, whereas lag sigma_sq > 0 represents a GARCH process.
lag error_sq = 0 and lag sigma_sq = corresponds to the standard assumption of the usual model.

models. Moreover, as the combination of $lag\ ar = 0$, $p = 0$ and $q = 0$ is found in no estimation to be the best estimation approach, the AR-GARCH estimator with higher lag lengths always meets the actual stock price development better. In consequence, the pre-estimation results provide evidence that the iterating method is preferable to standard approaches, in particular for the incumbents estimations.

6 Estimation Results and Discussion

After the very technical consideration of descriptive statistics and pre-estimation results, let us now turn to the step-3 estimation results and their discussion. Results are provided for multiple estimation specifications starting with the less restricted estimations, including all relevant dummies, subsequently, including additional country controls of the affected companies and, finally, adding also interaction terms. In the appendix the

results of estimations are provided separately for each event group (Tables 12 - 14). The step-3 estimation results are based on heteroscedasticity-consistent GLS-estimations of equations (5) (based on Huber-White-corrected variance-covariance matrices).

From the discussions in line with Hypothesis 1, a positive impact of type-1 interventions should be expected as this type of interventions is implemented to increase competition and market efficiency after the adoption of the Regulatory Packages is found to be insufficient. The coefficients of **cross-market interventions** are significantly positive, in particular with larger event windows and when controlling for country differences. Due to the complexity of such regulatory adjustments, interested groups gain detailed information prior to the date of the official implementation via rumors and leading announcements and actions. In consequence, the findings are in line with Binder (1985) and Sallinger (1992) who both argue that stock prices already adjust before the actual date of an official announcement. Concerning volatilities, no significant coefficients are found. Only the interaction term with fix-line operators provides evidence for a significantly higher volatility. Thus, the estimation results confirm Hypothesis 1 of a positive impact of cross-market regulation on stock prices.
Following the second hypothesis, **regulation addressing individual national markets** should have a positive impact on stock prices. The Commission adopts this type of actions suspecting a country's regulation or behavior to favor particular companies. An intervention is therefore implemented to reduce a potential deterrence, which should increase producer surplus as a whole. The estimation results support this discussion as the relevant coefficients are significantly positive in all estimations. From the selected news (Table 8 in the appendix), it might be expected that country biases are mainly in favor of the incumbents before regulation is introduced. In consequence, interventions reduce the exceptional position of incumbents, which should have a negative impact on their firm values. I introduce interaction terms for companies' incumbency in a country to the estimations to analyze this extensional aspect. However, the results in Table 7 show no significant additional effect leading to the conclusion that the incumbents' stock prices react not significantly different from competitors' stock prices. This finding is in line with the analyses in Krouse and Park (2003) and Bel and Trillas (2005), who also identify positive or, at least, no significantly negative effects on incumbents' stock prices due to country-specific regulations. With regard to volatilities in stock prices, no significant effect could be identified. Following Krouse and Park's (2003) arguments, these results support the expectations that Commission interventions approve the effectiveness of the

Table 5: Estimation Results without Control Variables

	Technology Index			Telecom Index		
	CAR (3)	**CAR (7)**	**CAR (11)**	**CAR (3)**	**CAR (7)**	**CAR (11)**
cross-market	0.0001	-0.0002	0.0014	0.0002	-0.0000	0.0016
	(0.0003)	(0.0012)	(0.0021)	(0.0003)	(0.0012)	(0.0021)
addressed country	0.0012 **	0.0032 *	0.0054 *	0.0012 **	0.0030 *	0.0054 *
	(0.0005)	(0.0018)	(0.0031)	(0.0005)	(0.0018)	(0.0031)
addressed company	-0.0018 *	-0.0096 ***	-0.0100 *	-0.0019 *	-0.0101	-0.0113 **
	(0.0010)	(0.0031)	(0.0053)	(0.0010)	(0.0029)	(0.0052)
fix-line	0.0001	-0.0018	-0.0050 **	-0.0000	-0.0024*	-0.0063 ***
	(0.0004)	(0.0013)	(0.0023)	(0.0004)	(0.0013)	(0.0023)
mobile	0.0007	0.0017	0.0017	0.0006	0.0012	0.0008
	(0.0005)	(0.0016)	(0.0027)	(0.0005)	(0.0016)	(0.0027)
constant	-0.0009	-0.0015	-0.0008	-0.0008	-0.0013	-0.0001
	(0.0005)	(0.0020)	(0.0034)	(0.0005)	(0.0020)	(0.0034)
# Observations	2411	2411	2411	2437	2437	2437
F-Test (df)	2.21 (5)	4.06 (5)	3.38 (5)	2.35 (5)	4.90 (5)	2.21 (5)
R2	0.0040	0.0055	0.0056	0.0040	0.0062	0.0076
	CAV (3)	**CAV (7)**	**CAV (11)**	**CAV (3)**	**CAV (7)**	**CAV (11)**
cross-market	-0.0000	-0.0002	-0.0006	0.0000	0.0000	-0.0001
	(0.0001)	(0.0003)	(0.0006)	(0.0001)	(0.0003)	(0.0006)
addressed country	-0.0000	-0.0003	-0.0007	-0.0000	-0.0001	-0.0001
	(0.0001)	(0.0004)	(0.0008)	(0.0001)	(0.0004)	(0.0008)
addressed company	-0.0006 ***	-0.0033 ***	-0.0065 ***	-0.0005 ***	-0.0028 ***	-0.0054 ***
	(0.0001)	(0.0004)	(0.0007)	(0.0001)	(0.0004)	(0.0007)
fix-line	-0.0000	-0.0000	0.0002	-0.0000	-0.0000	0.0002
	(0.0001)	(0.0004)	(0.0007)	(0.0001)	(0.0003)	(0.0007)
mobile	0.0000	0.0001	0.0005	0.0000	0.0003	0.0009
	(0.0001)	(0.0004)	(0.0008)	(0.0001)	(0.0004)	(0.0008)
constant	0.0010 ***	0.0053 ***	0.0106 ***	0.0009 ***	0.0050 ***	0.0099 ***
	(0.0001)	(0.0005)	(0.0010)	(0.0001)	(0.0005)	(0.0010)
# Observations	2411	2411	2411	2431	2431	2431
F-Test (df)	16.32 (5)	23.62 (5)	19.26	9.92 (5)	15.04 (5)	14.27 (5)
R2	0.0020	0.0021	0.0023	0.0019	0.0019	0.0019

Note: ***, **, * represent significance at the 1, 5 and 10 percent significance level, standard errors are displayed in brackets.

addressed markets, which outweighs the negative direct impact on incumbents.

Table 6: Estimation Results with Control Variables

	Technology Index			Telecom Index		
	CAR (3)	**CAR (7)**	**CAR (11)**	**CAR (3)**	**CAR (7)**	**CAR (11)**
cross-market	0.0011	0.0111 *	0.0285 **	0.0017	0.0118 *	0.0288 **
	(0.0014)	(0.0063)	(0.0117)	(0.0014)	(0.0062)	(0.0117)
addressed country	0.0014 ***	0.0037 *	0.0064 *	0.0013 **	0.0030	0.0054 *
	(0.0005)	(0.0020)	(0.0035)	(0.0005)	(0.0020)	(0.0034)
addressed company	-0.0018 *	-0.0097 ***	-0.0099 **	-0.0019 *	-0.0103 ***	-0.0112 **
	(0.0011)	(0.0030)	(0.0046)	(0.0011)	(0.0028)	(0.0045)
incumbent	0.0000	-0.0002	-0.0007	0.0001	0.0004	0.0005
	(0.0003)	(0.0010)	(0.0018)	(0.0003)	(0.0010)	(0.0018)
fix-line	0.0001	-0.0019	-0.0047 *	-0.0000	-0.0025 *	-0.0060 **
	(0.0004)	(0.0015)	(0.0026)	(0.0004)	(0.0015)	(0.0026)
mobile	0.0007	0.0020	0.0021	0.0006	0.0015	0.0010
	(0.0005)	(0.0016)	(0.0028)	(0.0005)	(0.0016)	(0.0028)
foreign fix-line	0.0006	0.0025	0.0011	0.0008	0.0025	0.0011
	(0.0006)	(0.0024)	(0.0040)	(0.0006)	(0.0024)	(0.0041)
foreign mobile	-0.0002	0.0008	0.0034	-0.0002	0.0009	0.0032
	(0.0005)	(0.0019)	(0.0034)	(0.0005)	(0.0018)	(0.0033)
constant	-0.0020	-0.0015	-0.0285 **	-0.0008	-0.0138 **	-0.0282 **
	(0.0015)	(0.0020)	(0.0121)	(0.0005)	(0.0064)	(0.0121)
	country dummies included					
# Observations	2411	2411	2411	2437	2437	2437
F-Test (df)	0.99 (17)	2.37 (17)	2.48 (17)	1.03 (17)	2.83 (17)	2.97 (17)
R2	0.0061	0.0124	0.0130	0.0061	0.0136	0.0149
	CAV (3)	**CAV (7)**	**CAV (11)**	**CAV (3)**	**CAV (7)**	**CAV (11)**
cross-market	0.0002	0.0006	0.0008	0.0003	0.0013	0.0020
	(0.0003)	(0.0014)	(0.0028)	(0.0003)	(0.0014)	(0.0027)
addressed country	0.0000	-0.0001	-0.0002	0.0000	0.0002	0.0004
	(0.0001)	(0.0005)	(0.0009)	(0.0001)	(0.0005)	(0.0009)
addressed company	-0.0004 ***	-0.0018 ***	-0.0034 ***	-0.0002 **	-0.0011 **	-0.0021 **
	(0.0001)	(0.0004)	(0.0009)	(0.0001)	(0.0005)	(0.0010)
incumbent	-0.0006 ***	-0.0032 ***	-0.0065 ***	-0.0006 ***	-0.0032 ***	-0.0065 ***
	(0.0000)	(0.0002)	(0.0005)	(0.0000)	(0.0002)	(0.0005)
fix-line	0.0000	0.0001	0.0004	-0.0000	0.0000	0.0003
	(0.0001)	(0.0004)	(0.0008)	(0.0001)	(0.0004)	(0.0008)
mobile	0.0000	0.0003	0.0009	0.0001	0.000	0.0014 *
	(0.0001)	(0.0004)	(0.0008)	(0.0001)	(0.0004)	(0.0008)
foreign fix-line	0.0004 ***	0.0021 ***	0.0043 ***	0.0005 ***	0.0026 ***	0.0051 ***
	(0.0001)	(0.0006)	(0.0012)	(0.0001)	(0.0006)	(0.0012)
foreign mobile	-0.0002 **	-0.0015 ***	-0.0030 ***	-0.0003 ***	-0.0020 ***	-0.0042 ***
	(0.0001)	(0.0005)	(0.0009)	(0.0001)	(0.0004)	(0.0008)
constant	0.0009 ***	0.0052 ***	0.0107 ***	0.0008 ***	0.0044 ***	0.0093 ***
	(0.0003)	(0.0015)	(0.0030)	(0.0003)	(0.0015)	(0.0029)
	country dummies included					
# Observations	2411	2411	2411	2431	2431	2431
F-Test (df)	13.19 (17)	14.45 (17)	14.79 (17)	12.31 (17)	13.53 (17)	13.80 (17)
R2	0.0566	0.0067	0.0626	0.0607	0.0650	0.0663

Note: ***, **, * represent significance at the 1, 5 and 10 percent significance level, standard errors are displayed in brackets.

Table 7: Estimation Results with Control Variables and Interaction Terms

	Technology Index			Telecom Index			Technology Index			Telecom Index		
	CAR (3)	**CAR (7)**	**CAR (11)**	**CAR (3)**	**CAR (7)**	**CAR (11)**	**CAV (3)**	**CAV (7)**	**CAV (11)**	**CAV (3)**	**CAV (7)**	**CAV (11)**
cross-market (1)	0.0011	0.0102	0.0286 **	0.0017	0.0109 *	0.0289 **	0.0001	0.0000	-0.0005	0.0002	0.0006	0.0005
	(0.0014)	(0.0064)	(0.0119)	(0.0014)	(0.0063)	(0.0119)	(0.0003)	(0.0014)	(0.0029)	(0.0003)	(0.0014)	(0.0028)
addr. country (2)	0.0018 ***	0.0052 **	0.0090 **	0.0018 ***	0.0044 *	0.0075 *	0.0000	-0.0001	-0.0002	0.0000	0.0002	0.0005
	(0.0006)	(0.0024)	(0.0043)	(0.0006)	(0.0024)	(0.0042)	(0.0001)	(0.0006)	(0.0012)	(0.0001)	(0.0006)	(0.0012)
addr. company (3)	0.0017	-0.0017	-0.0041	0.0020	-0.0002	-0.0020	-0.0007 ***	-0.0042 ***	-0.0086 ***	-0.0006 ***	-0.0036 ***	-0.0072 ***
	(0.0015)	(0.0036)	(0.0070)	(0.0015)	(0.0033)	(0.0065)	(0.0001)	(0.0007)	(0.0013)	(0.0002)	(0.0009)	(0.0018)
incumbent (4)	0.0002	0.0004	-0.0009	0.0003	0.0009	0.0019	-0.0006 ***	-0.0032 ***	-0.0065 ***	-0.0006 ***	-0.0032 ***	-0.0066 ***
	(0.0003)	(0.0012)	(0.0021)	(0.0003)	(0.0012)	(0.0021)	(0.0001)	(0.0003)	(0.0006)	(0.0001)	(0.0003)	(0.0006)
fix-line (5)	0.0001	-0.0019	-0.0048 *	-0.0001	-0.0025 *	-0.0060 **	0.0000	0.0001	0.0005	0.0000	0.0001	0.0004
	(0.0004)	(0.0015)	(0.0026)	(0.0004)	(0.0015)	(0.0026)	(0.0001)	(0.0004)	(0.0008)	(0.0001)	(0.0004)	(0.0008)
mobile (6)	0.0007	0.0021	0.0020	0.0006	0.0016	0.0010	0.0000	0.0003	0.0009	0.0001	0.0006	0.0014 *
	(0.0005)	(0.0016)	(0.0028)	(0.0005)	(0.0016)	(0.0028)	(0.0001)	(0.0004)	(0.0008)	(0.0001)	(0.0004)	(0.0008)
foreign fix-line	0.0006	0.0023	0.0011	0.0008	0.0022	0.0011	0.0003 ***	0.0016 ***	0.0033 ***	0.0004 ***	0.0021 ***	0.0041 ***
	(0.0006)	(0.0023)	(0.0039)	(0.0006)	(0.0023)	(0.0039)	(0.0001)	(0.0005)	(0.0011)	(0.0001)	(0.0006)	(0.0011)
foreign mobile	-0.0002	0.0002	0.0040	-0.0002	0.0003	0.0039	-0.0002 **	-0.0015 ***	-0.0030 ***	-0.0004 ***	-0.0021 ***	-0.0045 ***
	(0.0006)	(0.0021)	(0.0040)	(0.0006)	(0.0021)	(0.0038)	(0.0001)	(0.0005)	(0.0010)	(0.0001)	(0.0005)	(0.0009)
1 x 5	0.0000	0.0002	0.0001	0.0000	0.0002	0.0001	0.0001 ***	0.0004	0.0008 ***	0.0000 ***	0.0004 ***	0.0008 ***
	(0.0001)	(0.0004)	(0.0007)	(0.0001)	(0.0004)	(0.0007)	(0.0000)	(0.0001)	(0.0002)	(0.0000)	(0.0001)	(0.0002)
1x 6	-0.0000	0.0003	-0.0003	-0.0000	0.0003	-0.0004	-0.0000	-0.0001	-0.0001	-0.0000	0.0000	0.0001
	(0.0001)	(0.0004)	(0.0007)	(0.0001)	(0.0004)	(0.0007)	(0.0000)	(0.0001)	(0.0002)	(0.0000)	(0.0001)	(0.0002)
2 x 4	-0.0012	-0.0047	-0.0081	-0.0012	-0.0043	-0.0069	-0.0000	-0.0001	-0.0001	0.0000	-0.0000	-0.0002
	(0.0008)	(0.0029)	(0.0050)	(0.0008)	(0.0029)	(0.0049)	(0.0001)	(0.0006)	(0.0011)	(0.0000)	(0.0006)	(0.0011)
3 x 4	-0.0045 **	-0.0102 **	-0.0080	-0.0049 ***	-0.0126 ***	-0.0122	0.0005 ***	0.0029 ***	0.0064 ***	0.0005 **	0.0030 ***	0.0064 ***
	(0.0019)	(0.0049)	(0.0087)	(0.0019)	(0.0045)	(0.0081)	(0.0002)	(0.0008)	(0.0015)	(0.0002)	(0.0010)	(0.0020)
constant	-0.0020	-0.0133 **	-0.0285 **	-0.0025 *	-0.0138 **	-0.0284 **	0.0009 ***	0.0052 ***	0.0107 ***	0.0008 ***	0.0045 ***	0.0093 ***
	(0.0015)	(0.0065)	(0.0121)	(0.0015)	(0.0064)	(0.0121)	(0.0003)	(0.0015)	(0.0030)	(0.0003)	(0.0015)	(0.0029)
	country dummies included											
# Observations	2411	2411	2411	2437	2437	2437	2411	2411	2411	2431	2431	2431
F-Test (df)	1.00 (21)	2.02 (21)	2.05 (21)	1.08 (21)	2.48 (21)	2.47 (21)	11.78 (21)	12.93 (21)	13.31 (21)	10.44 (21)	11.53 (21)	11.76 (21)
R2	0.0073	0.0137	0.0140	0.0074	0.0150	0.0156	0.0640	0.0698	0.0722	0.0691	0.0748	0.0758

Note: ***, **, * represent significance at the 1, 5 and 10 percent significance level, standard errors are displayed in brackets.

Company-specific regulations have a significantly negative impact on stock price returns. Moreover, including interaction terms with incumbency provides evidence that the negative effect stems from the combination regulation-incumbency as the explanatory power of the regulation term shifts to the interaction term. The reduction in volatility in line with company-specific regulation underlines these findings. If an intervention addresses single companies, shareholders' interpretations of the action are more akin leading to a significant reduction in stock price volatility. In alternative estimation approaches, I include dummies to consider the reactions of other companies in the market of the addressed companies (see Table 14). From the previous discussions, a positive externality on competitors should be expected if the SMP of one company in the same market is reduced. However, the estimation results provide only weakly significant evidence, if at all.

Following the discussion in line with **Hypothesis 4**, a stronger reaction in absolute terms for company-related interventions should be expected than for cross-market and country-addressing interventions. Moreover, volatilities in reactions should simultaneously be lower. The comparison of the relevant coefficients requires the consideration of the difference in absolute values. If this difference is significantly positive or negative the strength of the impacts differ from each other. Wald test results provide no evidence for significant differences between type-3 intervention coefficients and the coefficients of the other types of interventions for the returns estimations. In the volatility estimations, company-addressing interventions result in a significantly lower reaction than indirected interventions. Including interaction terms between country-addressing interventions and incumbency provides similar results that firm owners expect no differences in the size of the regulatory impacts on the affected companies dependent on the type. However, their reactions are more akin with directed interventions. These results confirm the argumentation in line with Hypothesis 4 only partially. By including an additional, national administrative stage, regulation better meets national distinctions due to regulators' proximity to markets under scrutiny. However, additionalinterested groups on the national level react on regulatory announcements, which are, first, national governments and regulators and, second, also the addressed companies in the market as soon as the announcement of a change in the market structure is available. In consequence, at the point in time of the Commission's regulatory announcement, companies do not know the actual regulatory outcome, which will be finally implemented to the markets.

This causes uncertainty, which is expressed by higher stock price volatilities. In contrast, directly addressing individual companies excludes this intermediate stage, which reduces regulatory uncertainty and the uncertainty about the final market outcome.
The comparison of the H2 estimation results and the H3 estimation results raises the question whether affected companies discriminate between the type of interventions. While no significant difference is identified in absolute values, Wald tests on the difference between the coefficients confirm the idea that companies discriminate. Thus, the estimation results support Hypothesis 4, i.e. companies distinguish between indirected regulation (cross-market-related regulation and country-related regulation) and directed regulation (company-related regulation) with their adjustments of market strategies. However, the strength of reactions does not differ between the types.

The consideration of the control variables provides little evidence for significant differences between fix-line activities, mobile or mixed activities. Mobile providers' stock price returns react in line with fix-line providers' stock price returns, independently of whether an event addresses a particular mobile or fix-line market. In contrast, a significantly negative effect is found for fix-line companies only for the largest event window. While no significant effect on returns exists for the cross-market - fix-line interaction coefficients, a significant increase in volatility is found. Including dummies for foreign-country activities results in an ambiguous picture: Fix-line providers' stock prices are more volatile. However, no such enhancement effect is found with multi-mobile market activities. The volatility effect is even stronger when being active in more fix-line markets.[18] Fix-line regulation has a much stronger impact on market outcomes than mobile regulation, which could be due to the higher market concentration in fix-line markets.

In a nutshell, the findings confirm the idea that affected companies react differently to regulatory interventions. While the Commission uses two alternative instruments to affect the outcome of particular national markets – either by addressing the country, i.e. the government or the regulator, or by addressing individual companies – company reactions to these regulation announcements do not significantly differ. While market-related actions shift the actual market implementation to the national administrative stage and, thus, leave more room for national adjustments, directly addressing companies excludes uncertainty stemming from national influences. However, stock-price reactions prove that company-addressing interventions do not necessarily improve the situation for competitors in the same market.

[18]Estimation results on multi-market activities are displayed in Table 12 in the appendix.

7 Conclusion

This article considers how the value of companies is affected by announcements about the adoption of alternative regulatory instruments by the Commission. Regulatory interventions are classified into three categories depending on the addressee. The first type of interventions are cross-market approaches to build or change the common regulatory and competition framework of all EU member states. The second type of interventions are actions against particular country laws or habits if the Commission finds one company or a group of companies to benefit from the national situation compared to competitors due to the actual implementation of the EU regulatory guidelines. The last type of interventions are actions against particular companies. Each of these interventions affects the market structure or the behavior of individual companies, which changes companies' expected future profits and, thus, their net present values.
By employing a modified event study approach, I have considered how these alternative types of interventions are evaluated by the market. While the first two types, cross-market and country-interventions, address markets as a whole, the last type directly addresses individual companies. However, all approaches are implemented to enforce competition and to increase efficiency. Cross-market- and country-related types of interventions are found to have a significantly positive effect on stock price returns, which is in line with the intention of the Commission. Similarly, a negative effect exists for the last type as this kind of interventions is implemented to weaken an anti-competitive advantage of the addressed company or group of companies. Nevertheless, no significant differences in the size of the reactions is found between alternative types of interventions but in the strength and the direction.

These results provide new insights into the intentions of European regulations and how to employ regulatory instruments more effectively. With regard to particular national market interventions, the Commission can choose between two instruments, which are country-related interventions or company-related interventions. The market outcome depends on the Commission's suspicion whether national administrations implement its aims adequately. While country-related interventions leave room for adjustments to national distinctions in the implementation process, company-related interventions exclude

this adjustment step. Although the expected size effect on companies is independent from the type of interventions, indirected interventions of regulatory adjustments result in more uncertainty about the actual implementation as regulation is additionally adjusted by governments and regulators on the national stage after the European announcement. Therefore, companies are aware of forthcoming regulatory changes but they do not know the actual implementation to the market structure which raises uncertainty.
Moreover, the estimation results provide evidence that country-related interventions lead to similar expectations of incumbents' and competitors' shareholders even if the reason for an intervention is existing significant market concentration in favor of the incumbent. These results support the findings in the literature on national regulations. Following Krouse and Park's (2003) argumentation, the efficiency increase of interventions outweighs the negative direct impact on the incumbent's firm value. On the other hand, company-related interventions, which mostly address incumbent providers, result in no significant externalities on competitors.

The event study methodology is an established approach to evaluate regulatory actions. So far, it has been mostly used for single company considerations in telecommunications (Rudolph and Johanning, 2004; Ehrmann et al., 2005; Bel and Trillas, 2005). Employing it to multi-companies studies allows for an econometric analysis of market reactions to regulatory changes. Nevertheless, some pitfalls have to be kept in mind, which require attention also in future work: First, a selection bias exists as only larger, listed companies could be considered. However, in regulated markets new entrants are mostly smaller and not necessarily listed at a stock exchange, which means that larger providers are over-weighted in a sample. Second, the methodology strongly relies on expectations about the future outcome of today's regulation as stock prices represent discounted expected future profits. Finally, multi-company studies require the consideration of cross-company effects. Multiple GARCH models allow for the consideration of cross-effects. However, estimation complexity still demands a short-time structure.
Nevertheless, until today the empirical consideration of single changes in regulatory patterns is mostly reduced to descriptive comparisons as a change in regulation can hardly be statistically isolated from other market drivers because of its long-term orientation. When keeping in mind the just-mentioned drawbacks, the event study methodology is a practicable instrument to bring a regulator's long-run expectations about a regulatory intervention down to a short-run evaluation of the market.

References

Bel, G., and F. Trillas (2005): "Privatization, Corporate Control and Regulatory Reform: The case of Telefonica," *Working Paper*, pp. 1–25.

Binder, J. J. (1985): "Measuring the Effects of Regulation with Stock Price Data," *The RAND Journal of Economics*, 16(2), 167–183.

Bittlingmayer, G., and T. W. Hazlett (2002): "Financial Effects of Broadband Regulation," *Working Paper*, pp. 1–29.

Bollerslev, T. (1986): "Generalised Autoregressive Conditional Heteroskedasticity," *Journal of Econometrics*, 31, 307–327.

——— (2008): "Glossary to ARCH (GARCH)," *CREATES Research Paper*, (49), 1–46.

Campbell, J. Y., A. W. Lo, and A. C. MacKinlay (1997): *The Econometrics of Financial Markets*. Princeton University Press, Princeton, New Jersey, 2 edn.

Duso, T., and L.-H. Röller (2003): "Endogenous Deregulation: Evidence from OECD Countries," *Economic Letters*, 81, 67–71.

Ehrmann, T., M. Mietzner, and A. Sürmann (2005): "The Effect of Regulatory Announcements on Daily Stock Returns in the German Telecommunication Market – Evidence from an Event-Study Approach," *Working Paper*, pp. 1–30.

Engle, R. F. (1982): "Autoregressive Conditional Heteroscedasticity with Estimates of Variance of United Kingdom Inflation," *Econometrica*, 50, 987–1008.

——— (2001): "GARCH 101: The Use of ARCH/GARCH Models in Applied Econometrics," *Journal of Economic Perspectives*, 15(4), 157–168.

Ferenstein, E., and M. Gasowski (2004): "Modelling Stock Returns with AR-GARCH Processes," *SORT*, 28(1), 55–68.

Kole, S. R., and K. Lehn (1997): "Deregulation, the Evolution of Corporate Governance Structure, and Survival," *American Economic Review*, 87(2), 421–425.

Krouse, C. G., and J. Park (2003): "Local Exchange Competition and the Telecommunications Act of 1996," *Information Economics and Policy*, 15(2), 223–241.

Lütkepohl, H. (2006): *New Introduction to Multiple Time Series Analysis*. Springer, Berlin, 1 edn.

McKinlay, A. C. (1997): "Event Studies in Economics and Finance," *Journal of Economic Literature*, 35(1), 13–39.

Monopolies Commission (2009): "Telekommunikation 2009: Klaren Wettbewerbskurs halten," *Sondergutachten gemäß §121 Abs. 2 Telekommunikationsgesetz*, pp. 1–104.

Officer, R. R. (1973): "The Variability of the Market Factor of the New York Stock Exchange," *The Journal of Business*, 46(3), 434–453.

Rudolph, B., and L. Johanning (2004): "Untersuchung der Aktienkursentwicklung der Deutschen Telekom AG," *Regulierung und Kapitalmarktbewertung in der Telekommunikation*, pp. 1–50.

Salinger, M. (1992): "Standard Errors in Event Studies," *Journal of Finance and Quantitative Analysis*, 27(1), 39–53.

Schwert, G. W. (1981): "Using Financial Data to Measure the Effect of Regulation," *Journal of Law & Economics*, 24(1), 121–158.

Stigler, G. J. (1961): "The Economics of Information," *Journal of Political Economy*, 69, 213–225.

Appendix

Summary News and Companies

The following tables comprise an overview of the selected news (Table 8) and the companies under scrutiny (Table 9). Relevant news are taken from the Cullen International database whereas companies are taken from Thomson Financial Datastream and were double-checked with regard to their main business subject and the regional reach.

Table 8: Selected News

Date	Event
02 Jan. 2000	Unbundling Regulation Scheme published in official journal
22 Mar. 2000	European Commission adopts Recommendation on "best practice" interconnection charges for 2000
30 May 2000	Judgement of the European Court of Justice on the Privatization of Public Enterprises and the use of Golden Shares
13 Jun. 2000	Directive on Local Loop Unbundling published
12 Jul. 2000	Commission adopts the Telecommunications Package
04 Oct. 2000	Telecommunications Council reaches Political Agreement on Unbundling Regulation
26 Oct. 2000	EP Plenary adopts Report on Unbundling of the Local Loop
06 Dec. 2000	Council adopts Unbundling Regulation
10 Jan. 2001	Commission Decision replacing Annex III of the Voice Telephony Directive
06 Apr. 2001	Access and Interconnection Directive
11 Jul. 2001	EP votes in the Lead Committee on the proposed Data Protection Directive
07 Dec. 2001	Council Political Agreement on the proposed Data Protection Directive
14 Feb. 2002	Final Adoption of the Telecom Package
25 Feb. 2002	European Commission phases out Recommendation on Call Termination Charges in Fix-Line Network
05 Jun. 2002	European Court of Justice Ruling on Golden Shares
27 Jun. 2002	Adoption of Data Protection Directive in Electronic Communications Sector
09 Jul. 2002	Commission publishes Guidelines on Market Analysis and the Assessment of Significant Market Power
30 Jul. 2002	Commission establishes European Regulators Group
23 Sep. 2002	Commission Directive on Competition in Electronic Communications Networks
09 May 2003	Council Conclusions on Lawful Interception and Mobile Pre-Paid Cards
14 May 2003	European Court of Justice rulings on the Golden Shares
27 Nov. 2003	IRG publishes Principles of Implementation and Best Practice on Mobile Call Termination Remedies
29 Mar. 2005	European Court of Justice ruling on Failure to transpose the 2003 Regulatory Framework
01 Apr. 2005	European Commission Recommendation on Pricing of Leased Lines Part Circuits
27 Sep. 2005	European Commission Recommendation on Accounting Separation and Cost Accounting
09 Feb. 2006	European Commission proposes new EU Regulation on International Roaming
13 Jul. 2006	European Commission Proposal for EU Regulation on International Roaming
26 Mar. 2007	European Parliament votes on Roaming get underway
07 Jun. 2007	Council gives Green Light to EU Roaming Regulation
18 Jul. 2008	Commission announces Plans to regulate SMS Roaming
24 Sep. 2008	Commission proposes to extend Roaming Regulation to cover SMS and Data
20 Nov. 2008	European Commission proposes to amend the GSM Directive
04 Jan. 2000	Commission Decision on the UK Request for a Deferment of the Implementation of Carrier Pre-Selection
21 Dec. 2000	Tariff Rebalancing: Commission sends Reasoned Opinion to Spain
24 Aug. 2001	Tariff Rebalancing: Commission sends Supplementary Reasoned Opinion to Spain
30 Apr. 2003	Commission approves 3G Mobile Network Sharing Agreement in the UK
16 Jul. 2003	Commission approves 3G Mobile Network Sharing Agreement in Germany
20 Jul. 2006	European Commission prohibits Public Funding of Broadband Project in the Netherlands

Source: Information selected from the Cullen International Database

Selected News (*continued*)

Date	Event
18 May 2000	Commission publishes Vodafone Airtouch/Mannesmann Merger Decision
06 Sep. 2000	Commission clears Hutchison/NTT Docomo/KPN Mobile Joint Venture
21 Dec. 2001	Commission suspects Wanadoo (France) of Abusing its Dominant Position
27 Mar. 2002	Commission suspects KPN of Abusing its Dominant Position for the Termination of Calls on its Mobile Network
08 May 2002	Commission suspects Deutsche Telekom of Abusing its Dominant Position for Wholesale and Retail Local Loop Access
11 Jul. 2002	EC clears Merger between Telia and Sonera subject to conditions
06 Aug. 2002	Commission approves Break Up of Italian Mobile Operator BLU
22 Jan. 2003	Commission decides on State Aid for Mobilcom
05 Feb. 2003	European Commission asks the Netherlands to give up Golden Share in KPN
22 May 2003	Commission fines Deutsche Telekom for Charging Anti-Competitive Tariffs for Access to its Local Network
18 Dec. 2003	European Commission takes the Netherlands to Court on KPN Golden Share
19 Dec. 2003	Commission suspects Telia Sonera (Sweden) of having abused its Dominant Position in the Provision of High-Speed Internet Access
14 Jul. 2004	European Commission conditionally approves Restructuring Aid to Mobilcom
21 Jul. 2004	France Telecom ordered to pay back State Aid
27 Jul. 2004	International Roaming: Commission sends 'Statements of Objections' to O2 and Vodafone
27 Sep. 2004	European Commission clears Acquisition of Orange's Danish Mobile Telephony Business by Telia Sonera
14 Feb. 2005	International Roaming - European Commission sends 'Statements of Objections' to T-Mobile and Vodafone in Germany
15 Nov. 2005	Commission opens In-Depth Investigation into Take-Over of Tele.Ring by T-Mobile Austria
11 Jan. 2006	European Commission approves Acquisition of O2 by Telefonica subject to Conditions
24 Feb. 2006	European Commission opens Abuse of Dominance Investigation against Telefonica
01 May 2006	European Commission and Austrian Regulator approve Acquisition of Tele.Ring by T-Mobile subject to Conditions
05 May 2006	European Court of First Instance annuls Commission Decision on 3G National Roaming between O2 and T-Mobile in Germany
05 Jan. 2007	European Commission Investigation into Funding of Amsterdam Fibre Network
02 Feb. 2007	Court of First Instance upholds Commission in Wanadoo Predation Case
06 Jul. 2007	European Commission fines Telefonica nearly €152m for Abuse of Dominant Position ('Margin Squeeze')
23 Jul. 2007	European Commission approves Acquisition of Tele 2 France by SFR subject to Conditions

Source: Information selected from the Cullen International Database

Table 9: Selected Companies

ID	Company Name	Fix-line Market	Mobile Market	Listing Date
1	Belgacom	X	X	22 Mar. 2004
2	BT Group	X	X	< 01 Jan. 1999
3	Deutsche Telekom	X	X	< 01 Jan. 1999
4	France Telecom	X	X	< 01 Jan. 1999
5	Hellenic	X	X	< 01 Jan. 1999
6	KPN Kon	X	X	< 01 Jan. 1999
7	Portugal Telecom	X	X	< 01 Jan. 1999
8	Swisscom	X	X	< 01 Jan. 1999
9	TDC	X	X	< 01 Jan. 1999
10	Telecom Italia	X	X	< 01 Jan. 1999
11	Telefonica	X	X	< 01 Jan. 1999
12	Telekom Austria	X	X	21 Nov. 2000
13	Telenor	X	X	05 Dec. 2000
14	Telia Sonera	X	X	14 Jun. 2000
15	Vodafone	X	X	< 01 Jan. 1999
16	3U Holding	X		24 Nov. 1999
17	Acotel	X	X	09 Aug. 2000
18	Adept	X		25 May 2006
19	Thus Group	X	X	05 Jan. 2004
20	Alternative Networks	X	X	17 Feb. 2005
21	Amitelo	X		12 Nov. 2005
22	BNS Telecom	X	X	24 Nov. 2005
23	Buongiorno		X	11 Oct. 2000
24	Cable & Wireless	X		< 01 Jan. 1999
25	Canisp	X		15 Oct. 2003
26	Colt Telecom	X		< 01 Jan. 1999
27	Completel	X		16 Sep. 2002
28	Convisual	X		13 Jan. 2006
29	Drillisch	X	X	< 01 Jan. 1999
30	Ecotel	X	X	29 Mar. 2006
31	Elisa	X	X	02 Jul. 1999
32	Eutelia	X		19 Apr. 2000
33	Tele 2 F	X	X	< 01 Jan. 1999
34	Fastweb	X		27 Mar. 2000
35	Freedom4	X		02 Sep. 2004
36	Getmobile		X	26 Apr. 2006
37	Teleunit	X		26 May 2004
38	Inmarsat	X	X	20 Jun. 2005
39	Jazztel	X		20 Dec. 2000
40	Kcom	X		14 Jul. 2000
41	Keyyo	X		< 01 Jan. 1999
42	KPN Qwest	X		09 Nov. 1999
43	Lannet	X	X	01 Jun. 2004
44	Messaging	X	X	25 May 2006
45	Millicom		X	< 01 Jan. 1999
46	Mobile Streams	X		25 May 2006
47	Mobile Tornado	X	X	25 May 2006
48	Mobistar		X	< 01 Jan. 1999
49	Mobyson		X	< 01 Jan. 1999
50	Netmobile		X	13 Jul 2005
51	Normaction		X	28 Jul. 2005
52	PNC Telecom		X	< 01 Jan. 1999
53	Retelit	X		03 Aug. 2000
54	Satcom		X	15 Jul. 2005
55	Sonaecon	X	X	02 Jun. 2000
56	Spiritel	X	X	11 Mar. 2004
57	Tele 2 SE	X	X	< 01 Jan. 1999

Source: Information taken from the Thomson Financial Database

Summary Statistics and Tests of Pre-Estimations

Table 10: Summary Statistics and Test Results of the Iterative Estimation Process (Incumbents)

Incumbents	**Technology Index**			**Telecom Index**		
	Mean (Std. Dev.)	**Minimum (Share Min.)**	**Maximum (Share Max.)**	**Mean (Std. Dev.)**	**Minimum (Share Min.)**	**Maximum (Share Max.)**
AR						
lag ar	4.414 (1.018)	2 (0.020)	6 (0.197)	4.675 (1.300)	2 (0.018)	7 (0.130)
Chi_sq (df)	80.0 (5.414) (37.2)	17.4	248.1	80.0 (5.675) (36.4)	19.0	245.5
log likelihood	44.1 (46.7)	-176.9	157.5	44.2 (46.5)	-176.3	156.5
(G)ARCH						
lag error_sq (=p)	1.778 (1.985)	0 (0.374)	8 (0.007)	1.791 (1.963)	0 (0.363)	8 (0.005)
lag sigma_sq (=q)	1.534 (1.241)	1 (0.781)	6 (0.042)	1.562 (1.376)	1 (0.780)	8 (0.014)
Chi_sq (df)	0.824 (1.279) (4.367)	0.000	103.4	0.965 (1.496) (3.215)	0.000	37.5
log likelihood	49.5 (45.2)	-169.0	163.8	49.0 (45.5)	-168.4	162.0

Note: lag sigma_sq = 0 corresponds to an ARCH process, whereas lag sigma_sq > 0 represents a GARCH process.
lag error_sq = 0 and lag sigma_sq = corresponds to the standard assumption of the usual model.

Table 11: Summary Statistics and Test Results of the Iterative Estimation Process (Entrants)

Entrants	**Technology Index**			**Telecom Index**		
	Mean (Std. Dev.)	**Minimum (Share Min.)**	**Maximum (Share Max.)**	**Mean (Std. Dev.)**	**Minimum (Share Min.)**	**Maximum (Share Max.)**
AR						
lag ar	3.531 (1.852)	0 (0.084)	6 (0.191)	3.833 (2.081)	0 (0.072)	7 (0.134)
Chi_sq (df)	74.9 (91.3)	0.000	1553.6	76.7 (90.9)	0.000	1561.1
log likelihood	42.4 (243.2)	-347.6	830.1	44.3 (246.9)	-339.8	890.4
(G)ARCH						
lag error_sq (=p)	1.999 (2.230)	0 (0.348)	8 (0.023)	2.252 (2.354)	0 (0.328)	8 (0.018)
lag sigma_sq (=q)	2.208 (1.835)	1 (0.625)	6 (0.123)	2.397 (2.194)	1 (0.620)	8 (0.057)
Chi_sq (df)	54635 (2.204) (1974468)	0.000	7.16 exp(07)	463.1 (2.088) (15869)	0.000	617316
log likelihood	54.5 (252.7)	-296.2	1191.8	62.4 (259.9)	-293.8	1289.4

Note: lag sigma_sq = 0 corresponds to an ARCH process, whereas lag sigma_sq > 0 represents a GARCH process.
lag error_sq = 0 and lag sigma_sq = corresponds to the standard assumption of the usual model.

Additional Estimation Results

Table 12: Estimation Results Cross-Market Estimations

	Technology Index			Telecom Index		
	CAR (3)	**CAR (7)**	**CAR (11)**	**CAR (3)**	**CAR (7)**	**CAR (11)**
fix-line	0.0004	-0.0005	-0.0012	0.0003	-0.0008	-0.0022
	(0.0005)	(0.0018)	(0.0030)	(0.0005)	(0.0018)	(0.0023)
mobile	0.0001	0.0022	0.0017	0.0000	0.0020	0.0011
	(0.0006)	(0.0021)	(0.0036)	(0.0001)	(0.0021)	(0.0036)
# fix-line countries	0.0000	0.0002	0.0002	0.0000	0.0003	0.0002
	(0.0001)	(0.0004)	(0.0007)	(0.0001)	(0.0004)	(0.0007)
# mobile countries	-0.0001	0.0002	-0.0006	-0.0001	0.0003	-0.0006
	(0.0001)	(0.0004)	(0.0008)	(0.0001)	(0.0004)	(0.0008)
incumbent	0.0002	0.0010	0.0022	0.0002	0.0013	0.0027
	(0.0005)	(0.0016)	(0.0028)	(0.0005)	(0.0016)	(0.0028)
foreign fix-line	0.0004	0.0004	-0.0015	0.0006	0.0004	-0.0016
	(0.0008)	(0.0030)	(0.0051)	(0.0008)	(0.0031)	(0.0052)
foreign mobile	0.0004	0.0004	0.0071	0.0004	-0.0004	0.0055
	(0.0009)	(0.0033)	(0.0057)	(0.0001)	(0.0033)	(0.0057)
constant	-0.0005	-0.0041	-0.0022	-0.0005	-0.0044	-0.0021
	(0.0008)	(0.0027)	(0.0045)	(0.0008)	(0.0027)	(0.0045)
# Observations	1177	1177	1177	1182	1182	1182
F-Test (df)	0.24 (7)	0.43 (7)	0.40 (7)	0.25 (7)	0.54 (7)	0.38 (7)
R2	0.0011	0.0026	0.0023	0.0012	0.0033	0.0023
	CAV (3)	**CAV (7)**	**CAV (11)**	**CAV (3)**	**CAV (7)**	**CAV (11)**
fix-line	0.0000	0.0003	0.0007	0.0000	0.0003	0.0007
	(0.0001)	(0.0005)	(0.0010)	(0.0001)	(0.0005)	(0.0001)
mobile	0.0000	0.0002	0.0007	0.0001	0.0008	0.0020 *
	(0.0001)	(0.0005)	(0.0011)	(0.0001)	(0.0005)	(0.0010)
# fix-line countries	0.0001 ***	0.0004 ***	0.0008 ***	0.0001 ***	0.0004 ***	0.0008 ***
	(0.0000)	(0.0001)	(0.0002)	(0.0000)	(0.0001)	(0.0002)
# mobile countries	-0.0000	0.0000	0.0001	0.0000	0.0001	0.0003
	(0.0000)	(0.0001)	(0.0002)	(0.0001)	(0.0001)	(0.0002)
incumbent	-0.0006 ***	-0.0035 ***	-0.0070 ***	0.0000	-0.0035 ***	-0.0072 ***
	(0.0001)	(0.0004)	(0.0008)	(0.0000)	(0.0004)	(0.0008)
foreign fix-line	0.0003 **	0.0016 **	0.0031 **	-0.0006 ***	0.0020 ***	0.0038 **
	(0.0001)	(0.0008)	(0.0015)	(0.0001)	(0.0001)	(0.0015)
foreign mobile	-0.0004 ***	-0.0024 ***	-0.0050 ***	-0.0005 ***	-0.0028	-0.0061 ***
	(0.0001)	(0.0008)	(0.0015)	(0.0001)	(0.0007)	(0.0015)
constant	0.0010 ***	0.0054 ***	0.0104 ***	0.0009 ***	0.0048 ***	0.0094 ***
	(0.0001)	(0.0001)	(0.0013)	(0.0001)	(0.0006)	(0.0012)
# Observations	1177	1177	1177	1180	1180	1180
F-Test (df)	15.41 (7)	16.12 (7)	16.65 (7)	15.71 (7)	16.39 (7)	16.53 (7)
R2	0.0720	0.0784	0.0813	0.0804	0.0840	0.0850

Note: ***, **, * represent significance at the 1, 5 and 10 percent significance level, standard errors are displayed in brackets.

Table 13: Estimation Results of Particular Market Events

	Technology Index			Telecom Index		
	CAR (3)	**CAR (7)**	**CAR (11)**	**CAR (3)**	**CAR (7)**	**CAR (11)**
fix-line	-0.0024	-0.0005	-0.0284 **	-0.0026	-0.0087	-0.0022 **
	(0.0020)	(0.0012)	(0.0139)	(0.0020)	(0.0077)	(0.0140)
mobile	.	.	.	.	.	.
incumbent	-0.0009	-0.0033 ***	-0.0073	-0.0009	-0.0030	-0.0049
	(0.0008)	(0.0006)	(0.0047)	(0.0008)	(0.0027)	(0.0046)
foreign fix-line	0.0012	0.0016	-0.0098	0.0016	-0.0011	-0.0099
	(0.0014)	(0.0014)	(0.0102)	(0.0015)	(0.0060)	(0.0100)
foreign mobile	-0.0019	-0.0009	-0.0120	-0.0017	-0.0037	-0.0082
	(0.0016)	(0.0013)	(0.0149)	(0.0015)	(0.0067)	(0.0131)
constant	0.0014	0.0071 ***	0.0101	0.0021	0.0063	0.0293 **
	(0.0010)	(0.0016)	(0.0070)	(0.0023)	(0.0082)	(0.0147)
	country dummies included					
# Observations	386	386	386	393	393	393
F-Test (df)	1.17 (8)	1.13 (8)	1.41 (8)	0.82 (8)	0.89 (8)	1.40 (8)
R2	0.0203	0.0181	0.0272	0.0171	0.0146	0.0285
	CAV (3)	**CAV (7)**	**CAV (11)**	**CAV (3)**	**CAV (7)**	**CAV (11)**
fix-line	-0.0002	-0.0007	-0.0006	-0.0002	-0.0005	-0.0003
	(0.0002)	(0.0013)	(0.0025)	(0.0002)	(0.0012)	(0.0024)
mobile	.	.	.	.	.	.
incumbent	-0.0006 ***	-0.0032 ***	-0.0065 ***	-0.0006 ***	-0.0033 ***	-0.0068 ***
	(0.0001)	(0.0006)	(0.0011)	(0.0001)	(0.0006)	(0.0011)
foreign fix-line	0.0001	0.0005	0.0014	0.0003	0.0016	0.0038
	(0.0002)	(0.0012)	(0.0023)	(0.0003)	(0.0014)	(0.0029)
foreign mobile	0.0002	0.0007	0.0020	-0.0001	-0.0009	-0.0017
	(0.0003)	(0.0016)	(0.0034)	(0.0003)	(0.0013)	(0.0025)
constant	0.0009 ***	0.0052 ***	0.0105 ***	0.0014 ***	0.0071 ***	0.0140 ***
	(0.0001)	(0.0007)	(0.0014)	(0.0003)	(0.0016)	(0.0032)
	country dummies included					
# Observations	386	386	386	391	391	391
F-Test (df)	4.52 (8)	5.35 (8)	5.60 (8)	4.32 (8)	5.17 (8)	5.48 (8)
R2	0.0556	0.0640	0.0686	0.0546	0.0671	0.0744

Note: ***, **, * represent significance at the 1, 5 and 10 percent significance level, standard errors are displayed in brackets.

Table 14: Estimation Results of Particular Company Events

	Technology Index			Telecom Index			Technology Index			Telecom Index		
	CAR (3)	**CAR (7)**	**CAR (11)**	**CAR (3)**	**CAR (7)**	**CAR (11)**	**CAV (3)**	**CAV (7)**	**CAV (11)**	**CAV (3)**	**CAV (7)**	**CAV (11)**
fix-line	-0.0005	-0.0075 **	-0.0154 ***	-0.0008	-0.0089 ***	-0.0171 ***	-0.0001	-0.0005	-0.0006	-0.0001	-0.0006	-0.0009
	(0.0008)	(0.0031)	(0.0056)	(0.0008)	(0.0030)	(0.0055)	(0.0001)	(0.0007)	(0.0015)	(0.0001)	(0.0007)	(0.0015)
mobile	0.0019 **	0.0042	0.0048	0.0017 **	0.0033	0.0036	0.0001	0.0004	0.0012	0.0000	0.0001	0.0006
	(0.0008)	(0.0030)	(0.0052)	(0.0008)	(0.0030)	(0.0051)	(0.0001)	(0.0007)	(0.0014)	(0.0001)	(0.0007)	(0.0014)
addressed company	-0.0031 **	-0.0128 ***	-0.0136 **	-0.0031 **	-0.0138 ***	-0.0155 ***	-0.0005 ***	-0.0025 ***	-0.0048 ***	-0.0004 ***	-0.0023 ***	-0.0045 ***
	(0.0012)	(0.0037)	(0.0060)	(0.0012)	(0.0037)	(0.0060)	(0.0001)	(0.0007)	(0.0013)	(0.0002)	(0.0007)	(0.0015)
affected comp. (fix-line)	-0.0001	0.0054	0.0029	0.0001	0.0052	0.0034	0.0005 **	-0.0027 **	0.0056 **	0.0005 **	-0.0028 ***	0.0058 ***
	(0.0013)	(0.0053)	(0.0087)	(0.0014)	(0.0053)	(0.0046)	(0.0002)	(0.0011)	(0.0022)	(0.0002)	(0.0010)	(0.0021)
affected comp. (mob)	0.0015 *	0.0012	0.0018	0.0013	0.0017	0.0018	-0.0001	-0.0005	-0.0012	-0.0000	0.0001	0.0001
	(0.0008)	(0.0025)	(0.0044)	(0.0008)	(0.0026)	(0.0085)	(0.0001)	(0.0005)	(0.0011)	(0.0001)	(0.0006)	(0.0011)
incumbent	0.0004	0.0002	0.0070	0.0005	0.0008	0.0034	-0.0005 ***	-0.0029 ***	-0.0060 ***	-0.0005 ***	-0.0029 ***	-0.0059 ***
	(0.0005)	(0.0018)	(0.0031)	(0.0005)	(0.0018)	(0.0046)	(0.0001)	(0.0004)	(0.0008)	(0.0001)	(0.0004)	(0.0008)
foreign fix-line	0.0008	0.0069	0.0115 *	0.0009	0.0068	0.0115 *	0.0003 **	0.0018 **	0.0037 **	0.0003 *	0.0019 **	0.0038 **
	(0.0010)	(0.0042)	(0.0070)	(0.0010)	(0.0042)	(0.0070)	(0.0002)	(0.0009)	(0.0019)	(0.0002)	(0.0009)	(0.0018)
foreign mobile	-0.0006	0.0023	0.0064	-0.0003	0.0028	0.0070	-0.0001	-0.0013 *	-0.0027 *	-0.0003 ***	-0.0021 ***	-0.0043 *
	(0.0010)	(0.0028)	(0.0051)	(0.0010)	(0.0027)	(0.0051)	(0.0001)	(0.0007)	(0.0014)	(0.0001)	(0.0006)	(0.0013)
constant	-0.0013	-0.0062	-0.0163	-0.0018	-0.0059	-0.0157	0.0009 ***	0.0051 ***	0.0101 ***	0.0007 **	0.0044 ***	0.0088 ***
	(0.0017)	(0.0074)	(0.0138)	(0.0017)	(0.0074)	(0.0139)	(0.0003)	(0.0017)	(0.0035)	(0.0003)	(0.0016)	(0.0033)
	country dummies included											
# Observations	848	848	848	862	862	862	848	848	848	860	860	860
F-Test (df)	1.42 (16)	3.85 (16)	4.08 (16)	1.47 (16)	1.47 (16)	1.47 (16)	5.61 (16)	6.55 (16)	6.58 (16)	4.72 (16)	5.44 (16)	5.62 (16)
R2	0.0232	0.0521	0.0523	0.1667	0.1793	0.1468	0.0704	0.0729	0.0747	0.0702	0.0777	0.0774

Note: ***, **, * represent significance at the 1, 5 and 10 percent significance level, standard errors are displayed in brackets.