3 Analyst Behaviour: the Geography of Social Interaction

In this paper, I provide empirical evidence that an analyst working in Germany is more likely to publish a high (low) price target regarding a DAX30 stock when other Germany based analysts are also optimistic (pessimistic) about the same stock. This effect of geographical proximity is not biased by the fact that DAX30 companies are headquartered in Germany. Shedding light on how influence takes place, I show that influence through communication and the exchange of opinion within small groups of analysts plays a vital role. This mainly applies during a bullish market environment. When markets are bearish, analysts' incentives induce them not to deviate too much from the overall average, such that then observational learning has a greater impact.

3.1 Introduction

On June 30^{th} 2011, there have been roughly 42,000 actively traded stocks world wide.[1] Although financial markets are rather efficient regarding the availability of information nowadays, this quantity of investment opportunities makes it

[1]This number has been published by the World Federation of Exchanges members on www.world-exchanges.org and refers to the stocks that are traded on the 54 major stock exchanges in the world. Double counting has tried to be eliminated by only considering domestic stocks from the perspective of each stock exchange.

impossible for market participants to access and elaborate every piece of information. In this context, financial market analysts play a central role. Each of them focuses on a few investment opportunities, uses his sector expertise and tracking experience to provide forecasts of financial figures and thereof derives investment recommendations. The resulting impact analysts have on investment behaviour and market outcomes has led to a stream of literature that is concerned with how analysts derive their forecasts and recommendations and to what extend they are influenced by other analysts.

Empirical works of Hong et al. (2000) and Krishnan et al. (2006) show that equity sell-side analysts[2] herd while providing earnings forecasts. Zitzewitz (2001), Bernhardt et al. (2006) and Naujoks et al. (2009) find an anti-herding behaviour in the same context. Kim and Zapatero (2009) and Jegadeesh and Kim (2010) among others use analysts' investment recommendation to provide empirical evidence for herding behaviour.

All authors cited above assume that individual analysts are homogeneously influenced by all other analysts. Only few authors have considered heterogeneous influence among analysts so far. Graham (1999) finds that analysts are more strongly influenced by a lead analyst who is defined by his reputation. Cooper et al. (2001) consider several lead analysts who are determined by past performance and market recognition. Welch (2000) postulates that an analyst's investment recommendation is influenced by the consensus recommendation and the two most recently published recommendations of other analysts.

With this paper, I contribute to the literature on heterogeneous influence by providing a detailed analysis of the geographical structure of social interaction and relating it to the prevailing market environment. This represents a further step into the direction of understanding how analysts deviate from their own estimates and how analysts' forecasts thus have to be interpreted in or-

[2]Hereafter, the term analyst always refers to an equity analyst. Due to empirical data availability, the term analyst furthermore always refers to a sell-side analyst. See for instance Groysberg et al. (2007) for a detailed comparative analysis between buy-side and sell-side analysts.

der to get valuable investment recommendations. My first hypothesis is that analysts are more strongly influenced by analysts that are geographically proximate. The theoretical foundation for this hypothesis is derived from recent evidence in the psychological literature. Reis et al. (2011) found that individuals are more strongly attracted by individuals with whom they are more familiar. Translating this into the financial context, this means that forecasts and recommendations of analysts working in the same country could appear more reliable, as these analysts might be perceived to be more familiar due to the same language or a similar background. Analysts who work in the same city have a higher probability to know each other personally, which might amplify this effect. The hypothesis of familiarity is also motivated by the evidence that has already been provided in the context of portfolio selection (see e.g. Grinblatt and Keloharju (2001) and Huberman (2001)).

In the analyst literature, authors so far have always postulated that influence among analysts only takes place via "observation" (i.e. observational learning). It has mainly been argued that this is due to the fact that analysts work for different firms and thus are competitors. However, there are various theoretical settings that show that communication among competing participants on financial markets can be beneficial (Eren and Ozsoylev, 2006, Stein, 2008, Gray, 2010). The reason for this lies in the fact that through the exchange of opinion, also known as word-of-mouth[3], information and potential research advantage is not only given away. An analyst can also collect new pieces of information and learns about other analysts' views which helps to validate the own results.[4] Based on these theoretical considerations, my second hypothesis is that analysts are more strongly influenced by analysts with whom they

[3]I use the term "exchange of opinion" in order to emphasise that information is not only transmitted, but also discussed.

[4]One could also think of the situation where information is only given away, however, with the intention to influence other analysts such that they skew their valuation results into a desired direction, which makes the own already published result more credible for investors.

exchange their opinions. This hypothesis is related to the first one, because the likelihood that two analysts know each other and exchange their opinions is higher, if they are geographically proximate. Evidence in favour of this hypothesis has already been provided in the context of institutional investors (see e.g. Shiller and Pound (1989) and Hong et al. (2005)) as well as retail investors (see e.g. Ivkovic and Weisbenner (2007)).

With my third hypothesis, I state that effects of geographical proximity or the exchange of opinion are more strongly pronounced during an economic upturn compared to an economic downturn. I base this hypothesis on the incentive structure of analysts who are judged by their relative performance (Hong et al., 2000, Hong and Kubik, 2003, Chen and Jiang, 2006). This means that in times of a bull market they try to stand up from the crowd in order to distinguish themselves from their competitors (Zwiebel, 1995). Therefore, they seek to obtain research advantages from few other analysts who are familiar due to geographical proximity or with whom they exchange their opinions. However, during an economic downturn which generally induces a high uncertainty, they try not to deviate too much from the overall average in order to limit the potential loss (Scharfstein and Stein, 1990, Clarke and Subramanian, 2006).

My database consists of price targets regarding the stocks of DAX30 companies that have been published by sell-side analysts in the period from 2005 to mid 2010. A price target refers to the value of a stock an analyst considers to be fair and therefore expects to be reached by the market price within a predefined horizon that usually equals one year. Hence, price targets represent investment recommendations and thus might have a direct impact on market participants. In an empirical setting, the advantage of the price target compared to the verbal investment recommendation (buy, hold, sell) lies in the fact that it is a continuous variable that quantifies how optimistic or pessimistic an analyst is about a stock. The choice of DAX30 stocks is motivated by the high analyst coverage. Moreover, it allows the analysis of a homogenous group of international analysts who have an indirect impact on one of the major European indices. Such a focus has not been considered in the ana-

lyst literature so far. The database is unique to the extent that it represents a merger of the commonly used commercial database I/B/E/S provided by Thomson Reuters and the data of analyst reports that are publicly available on the webpage www.aktiencheck.de. While I/B/E/S is rather focussed on analyst reports of great brokerage houses and investment banks, the reports on www.aktiencheck.de include investment newsletters of research houses and daily newspapers that also have influence on market participants. The period of the database allows a very up-to-date analysis of analysts' behaviour before and during the recent financial and economic crisis that has not been conducted in the analyst literature yet. In order to examine the influence that results from the exchange of opinion, one has to identify the individual analysts who actually exchange their opinions with each other. In the context of institutional investors, Hong et al. (2005) assume that the exchange of opinion only or at least primarily takes place on the city level. In the context of retail investors, Massa and Simonov (2005) state that there are further important characteristics that indicate the exchange of opinion, namely the profession and the former university attendance. In order to go beyond relying on assumptions, I conducted a representative survey among DAX30 analysts to find out with whom analysts actually exchange their opinions.

Within the empirical analysis, I find that when German analysts on average increase their price targets by 1 EUR (1%), an individual German analyst increases his price target by 0.32 EUR (0.15%) *more* than he does when analysts working outside Germany on average increase their price targets by 1 EUR (1%). This corroborates the hypothesis of geographical proximity for German analysts. I show that this result is not related to the fact that DAX30 companies are headquartered in Germany, which one might think to be an informational advantage. Regarding the exchange of opinion, I discover that before the economic crisis an individual analyst's price target is more similar to the price targets of analysts with whom he exchanges his opinion compared to other analysts. Hence, my second hypothesis is affirmed at least for the period before the economic crisis. It is not approved for the period during the

economic crisis which in turn however is consistent with my third hypothesis that analysts strongly align their price targets with the consensus and are less influenced by the exchange of opinion within small groups of analysts in times of a great uncertainty which is generally given during a crisis.
The remainder of this paper is structured as follows. In chapter 3.2, I present the dataset as well as the survey results. Chapter 3.3 serves to outline how this data is used for the empirical analysis. The results are provided in chapter 3.4. An alternative explanation for these empirical results is offered in chapter 3.5. Chapter 3.6 concludes.

3.2 Data

3.2.1 Price Target Data

The empirical analysis of this paper is based on the price targets regarding the stocks of the thirty German companies included in the index DAX30 as of May 31^{st} 2010. In order to avoid confusions in the following, the term company shall always refer to the organisation having issued a stock, whereas firm denotes the organisation an analyst is employed by. The period of analysis comprises the almost five and a half year time window from January 1^{st} 2005 to May 31^{st} 2010 and thus includes the stock market peak preceding the financial crisis in 2007/08 as well as the crisis itself. The price targets are primarily extracted from I/B/E/S, the common database of analysts' estimates provided by Thomson Reuters. This yielded 10,972 values for the period of analysis. Further price targets were collected from analyst reports being published on www.aktiencheck.de[5]. For the same period of time 27,175 reports have been evaluated and 16,821 price targets extracted. Both databases have then been merged as follows. The I/B/E/S database has been used as a basis. Price targets from analysts employed by firms that are not included in I/B/E/S

[5]aktiencheck.de AG is an independent research firm that collects analysts reports and publishes them together with own reports on its webpage.

have directly been added. For those firms that appeared in both databases, the publication dates regarding a specific company have been compared. In the case they were equal, only the I/B/E/S data has been taken.[6] Otherwise, the price target from the analyst report on www.aktiencheck.de has been added. In order to avoid double entries due to differing publication dates, a time window of plus minus five days has been applied. Thereby, a buffer of ten days was generated cancelling out unreal price target updates. Moreover, firms' names instead of analysts' names have been used for this comparison in order to avoid double entries that result from the fact that two analysts of a research team who published one common price target appear with one analyst's name in the first database and with the other analyst's name in the second. Note that data of I/B/E/S is adjusted by stock splits. As the analyst reports published on www.aktiencheck.de represent the original reports as being published at the time, the extracted price targets also had to be adjusted by stock splits to be consistent with the I/B/E/S data. The merger of both databases yielded 25,534 price targets. Dropping all firms that published less than 30 price targets during the whole period of analysis reduced the number of firms by one half and led to a database of 24,893 price targets. The final database resulted by eliminating all entries where only the firm but not the corresponding analyst was known and consists of 17,898 price targets. This database is unique regarding to the following fact: While I/B/E/S primarily contains estimates of investment banks, reports on www.aktiencheck.de also comprise estimates from independent research firms and investment letters. The merger of both databases hence represents a broader spectrum of analysts' price targets. Table 3.1 gives an overview of firms included in the new database. Moreover, the original database and the corresponding number of price target publications are indicated.

In order to analyse the geographic structure of influence, an analyst's work-

[6] Ljungqvist et al. (2009) reported systematic errors in the historical I/B/E/S recommendation database. The comparison of price targets that appear in both databases, however, did not reveal remarkable deviations.

Table 3.1: Overview of the firms included in the new price target database

Firm	I/B/E/S	aktiencheck
ABN AMRO	-	7
AC Research	-	38
Actien-Börse	-	82
Ahorro Corporación Financiera S.V., S.A.	17	-
Banc of America Securities-Merrill Lynch Research	3	302
Banco Sabadell	42	-
Bankhaus Lampe	104	198
Bankhaus Metzler	335	-
Barclays Capital	34	3
Bear Stearns	15	2
Berenberg Bank	46	-
BHF-BANK	359	28
Cheuvreux	595	222
Citigroup	-	625
Collins Stewart	32	2
Commerzbank Corporates & Markets	268	196
Credit Suisse	219	169
Daiwa Securities SMBC Europe Limited	26	-
Der Aktionär	-	189
Der Aktionärsbrief	-	58
Deutsche Bank	269	139
Dexia Securities	5	37
DZ BANK	236	-
equinet AG	163	238
EURO am Sonntag	-	172
Evolution Securities	31	-
Exane BNP Paribas	-	84
FOCUS-MONEY	-	59
Fox Pitt & Kelton	14	-
Frankfurter Börsenbrief	-	84
Fuchsbriefe	-	37
Goldman Sachs	-	281
Helvea	43	20
HSBC	-	106
HypoVereinsbank	-	802
IIR Group	16	16
Independent Research	-	1,507
ING	1	78
J.P. Morgan Securities	-	324
Jefferies & Co	52	7
Jyske Bank	44	22
Keefe Bruyette & Woods	36	9
Kepler Capital Markets	201	64
Landesbank Baden-Württemberg	257	30
Lehman Brothers	53	25
LRP Landesbank Rheinland-Pfalz	217	898
M.M. Warburg & CO	448	143
Macquarie	59	4
Merck Finck & Co.	-	156
Morgan Stanley	-	206
National-Bank AG	-	159
Natixis Securities	143	-
Nomura Equity Research	171	19
Nord LB	112	583
Oddo Securities	117	-
Piper Jaffray	32	7
Prior Börse	-	48
Raymond James	39	14
Sal. Oppenheim	665	108
Sanford C. Bernstein & Co	157	34
Santander	37	-
SEB	-	1,171
SES Research	10	83
Société Générale	235	374
SRH AlsterResearch	20	21
Stockstreet.de	-	30
UBS	-	261
UniCredit Markets & Investment Banking	374	516
WestLB	280	169
	6,632	11,266
	17,898	

The table displays the firms' names and the number of published price targets originating from the two different sources.

ing location has to be known. Although the city is indicated on the analyst reports on www.aktiencheck.de, the data could not be used as it usually only referred to the headquarter of the particular firm and not to the actual place of work of an analyst. Hence, for each analyst in the database the city and the corresponding country have been searched by hand on the internet. Table 3.2 shows the distribution of firms, analysts and published price targets by country and city. Hereafter, an analyst's nationality is used interchangeably with the country where he works. This means for instance that a "German" analyst refers to an analyst who works in Germany although there might be German analysts who work abroad. Most of the firms are Germany based, however, closely followed by UK. London is the city where most of the analysts work and is followed by Frankfurt where less than a half of London based analysts work. German analysts published about 70% of all price targets. The portion of UK based analysts who all work in London equals approximately 20%. Analysts working in Frankfurt published about one third of all price targets.

3.2.2 Survey Evidence

In order to determine the influence resulting from the exchange of opinion among analysts, it has to be known which analysts exchange their opinions with each other. Aiming to get this information, a survey of DAX30 analysts has been conducted. In the period from June 15^{th} to July 8^{th} 2010, all analysts in the price target database have been contacted by email and asked to fill in a questionnaire. Out of 858 analysts in the database 718 could be reached[7] and 195 replied. This corresponds to a response rate of 27.2%, which ensures the representativeness of the survey. The questionnaire consisting of eleven questions is shown in table 3.3.

Concerning analysts' interaction and reciprocal influence from the exchange

[7] The remaining analysts could not be contacted, as they either left their firm or because no or not a valid email address could be found.

Table 3.2: Distribution of firms, analysts and price targets of DAX30 analysts by country and city

country	city	number of firms	number of analysts	number of targets
Belgium	Brussels	2	5	61
China	Hong Kong	1	1	1
Denmark	Silkeborg	1	5	66
Germany	Berlin	1	1	37
	Detmold	1	1	84
	Düsseldorf	6	34	815
	Essen	1	5	159
	Frankfurt	16	153	6,174
	Hamburg	4	25	739
	Hanover	1	17	695
	Cologne	2	4	303
	Kulmbach	1	1	189
	Mainz	2	12	1,152
	Munich	5	32	1,989
	Stuttgart	1	24	250
	Westerburg	1	3	38
France	Paris	13	80	882
India	Bangalore	1	1	3
	Bombay	1	12	32
the Netherlands	Amsterdam	3	5	44
Austria	Vienna	1	1	9
Sweden	Stockholm	1	1	1
Switzerland	Geneva	1	2	27
	Zurich	5	11	120
Spain	Madrid	4	18	94
South Korea	Seoul	1	1	22
UK	London	33	388	3,781
USA	New York	5	13	120
	San Francisco	2	2	11
		117	**858**	**17,898**

The table displays the number of different firms, analysts and price targets on the country and the city level. Please note that firms that are based at different locations are double counted. The same applies for analysts who changed their working location during the period of analysis.

Table 3.3: Questionnaire of the survey

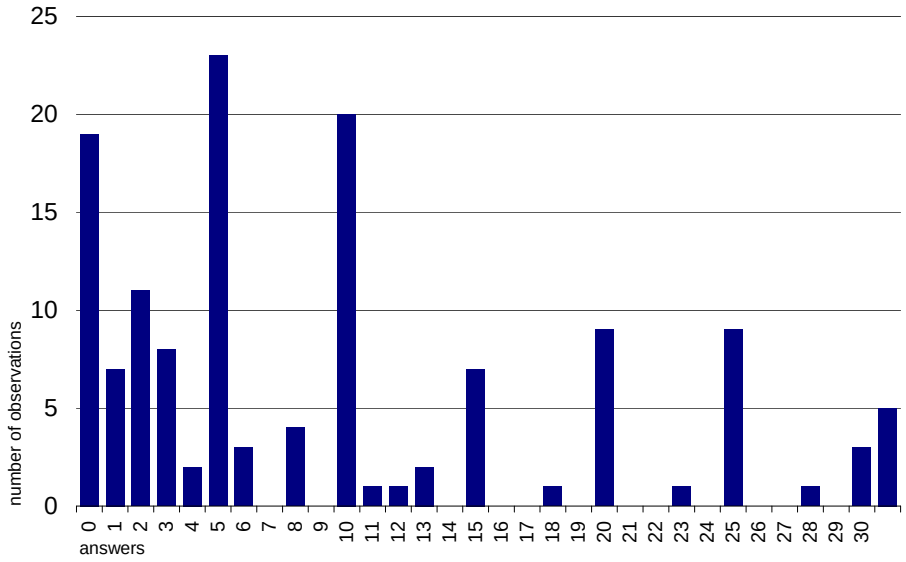
#1	How long have you been working at your firm?
#2	In which city do you work?
#3	Where have you been employed before?
#4	Which university did you attend?
#5	With about how many analysts who cover at least one of the DAX30 companies covered by you, did you already have personal contact?
#6	In which way do you most likely have contact with other analysts (e.g. telephone, meetings, events, lunch dates)?
#7	With how many analysts of question #5 do you exchange your opinion regarding **forecasts**?
#8	How many analysts of question #7 work in the same **country** as you?
#9	How many analysts of question #7 work in the same **city** as you?
#10	How many analysts of question #7 work in the same **firm** as you?
#11	How many analysts of question #7 attended the same **university** as you?

of opinions, the most important questions are #5 and #7 asking for the number of analysts, an analyst had already social contact with and an analyst regularly exchanges forecast results with, respectively. The figures 3.1 and 3.3 show the answers of these two questions. From the data, it can be seen that social contacts are quite numerous. Only 14.0% answered not personally knowing at least one other analyst who covers a common company. Additional comments of the respondents confirm that there is a community of analysts covering a stock wherein the members know each other and most often already had a personal contact. Question #6 asking for the most regular way of contact with other analysts provides the answer to this phenomenon. Analysts meet frequently on events like investors' days or analysts conferences and hence communicate with each other often. The results of question #6 are shown in figure 3.2.

Despite this regular contact, forecast results are not the main topic of conversation. Following question #7, only 34.6%[8] of the analysts exchange their

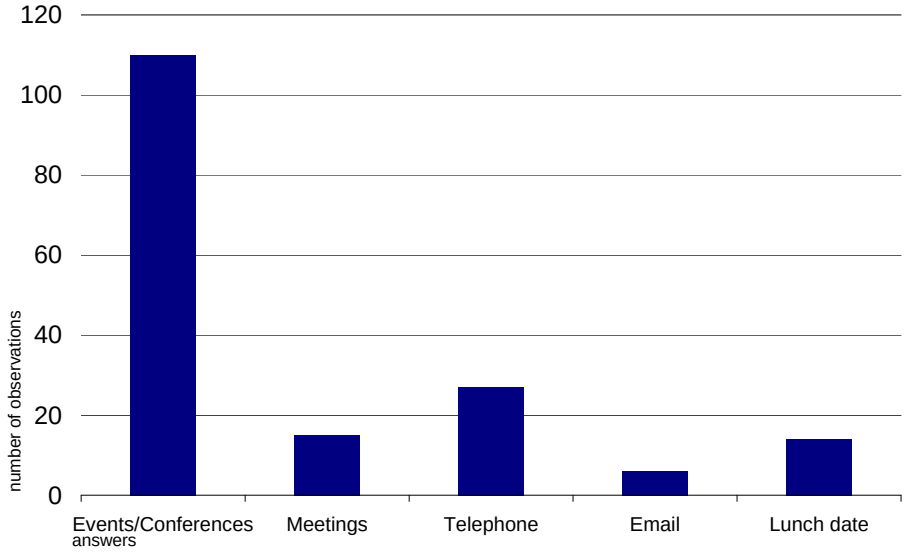
[8]The results of the question #7 to #9 and #11 are adjusted by the number of intra-firm exchanges as being asked by question #10. This is done for two reasons. Analysts in the same firm act as one unity and only publish one result. Furthermore, the exchange of opinion in a research team takes place by definition and does not provide any insight.

Figure 3.1: Histogram of the answers to survey question #5



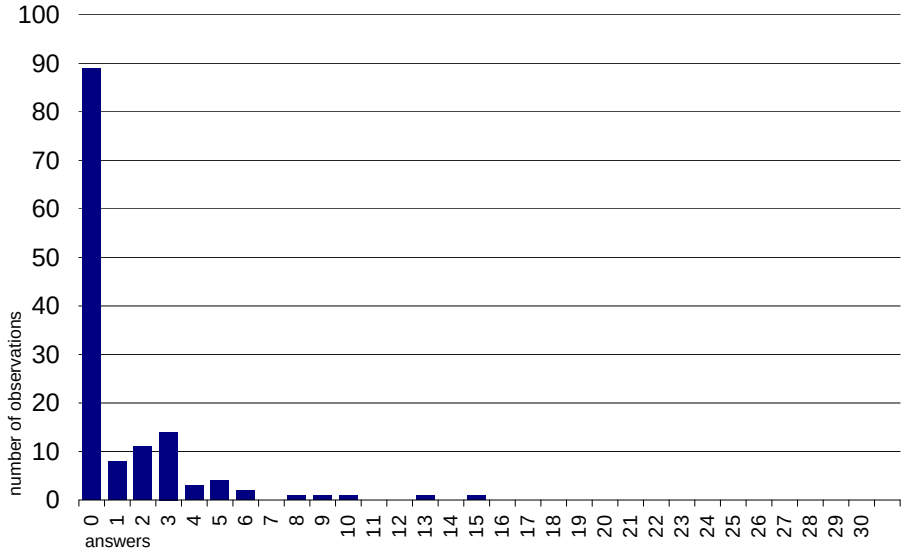
"With about how many analysts who cover at least one of the DAX30 companies covered by you, did you already have personal contact?"

Figure 3.2: Histogram of the answers to survey question #6



"In which way do you most likely have contact with other analysts (e.g. telephone, meetings, events, lunch dates)?"

Figure 3.3: Histogram of the answers to survey question #7



"With how many analysts of question #5 do you exchange your opinion regarding **forecasts**?"

opinions regarding forecasts with at least one other analyst. Note that this question is very delicate. Analysts in this context defined as sell-side analysts[9] are competitors. Hence, no one is interested in giving away his research advantage or to reveal his findings. Formally, firms' policy even obliges analysts not to do so. However, the fact that more than a third admitted to exchange their results shows that there is an informal component that weights stronger than policies or than obvious principles. As stated in the introduction, such behaviour can be beneficial, because an analyst who exchanges his opinion does not only loose a research advantage. Rather, he learns about other an-

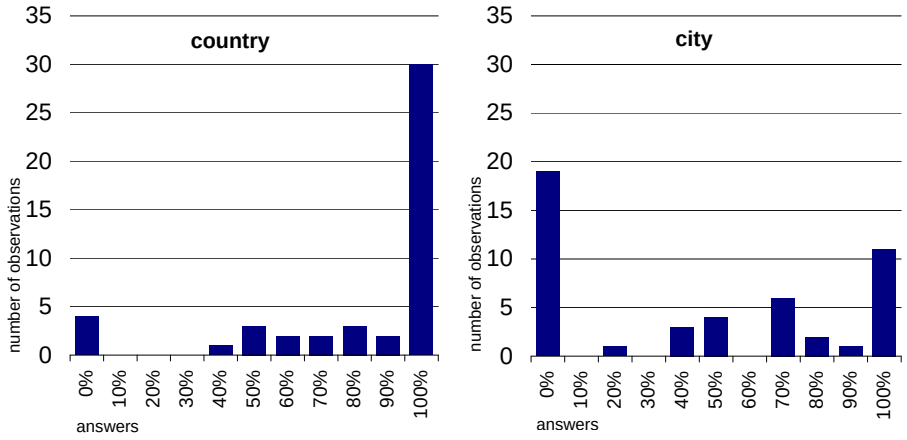
[9]Some respondents annotated that from the formulation of the questions it is not perceptible whether the word analyst refers to sell-side or buy-side analysts. Buy-side analysts are sell-side analysts' clients. Hence, the discussion of forecast results between these two types of analysts is natural and not worth of analysis. The fact that 95% of the answers to question #7 are below or equal to five proves that the questions have been understood as being indented, if one assumes that number of sell-side analysts' clients is usually greater than five. As a precaution, the two answers above 15 have been taken off.

alysts' views which helps him to validate the own results. This is especially relevant for the determination of price targets where also assumptions and valuation methods can be discussed without loosing a specific research advantage regarding an earnings forecast for instance. Indeed, some respondents who denied the exchange of forecast results, as question #7 was formulated, annotated that they nonetheless exchange assumptions and details about valuation techniques. This suggests the actual number of analysts' reciprocal influence from the exchange of opinions to be higher. Another fact that supports this tendency is that because of the question's delicate nature maybe not all answers reflect the actual situation.

The basic intention of the survey was to determine with whom an analyst exchanges his opinion. In order to get an acceptable feed-back ratio, no analyst has been asked for the names of analysts with whom he exchanges his opinion. Instead, I tried to reduce the universe of analysts that might be potential counterparts for the exchange of opinion. This can among others be done by using analysts' working locations. If for instance an analyst does not exchange his opinion with analysts working abroad, then all foreign analysts can be excluded as potential counterparts for the exchange of opinion. Survey questions #8 and #9 have been used in order to relate the exchange of opinion among analysts to their working locations. Figure 3.4 displays the portion of analysts from the same country or city, respectively, with whom a respondent exchanges his opinion. On average, 82% of the analysts who exchange their opinions regarding forecast results work in the same country (median: 100%). This result corroborates the statement in the introduction that geographical proximity (first hypothesis) and analysts' reciprocal exchange of opinion (second hypothesis) are strongly related. This finding is not biased by the fact that all analysts work in the same country as only 56% of the respondents work in the country where most of the respondents work (Germany).[10] Regarding the city level, on average only 44% of the analysts that exchange forecast results

[10]The second and third most respondents come from the UK (22%) and France (10%).

Figure 3.4: Histogram of the normalised answers to survey questions #8 and #9



"How many analysts of question #7 work in the same **country**/**city** as you?" The answers have been divided by the number of analysts with whom a respondent exchanges his opinion regarding forecasts (see survey question #7). The left chart shows for instance that 30 analysts only exchange their opinion with other domestic analysts. Analysts who answered not to exchange their opinions with any other analyst have been excluded.

work in the same city (median: 50%). This number is consistent with the answers of question #6 where only 10% of the respondents answered to use lunch dates as a regular way of having contact with other analysts. However, in the two cities where with 26% and 22% most of the respondents work (Frankfurt and London), this number lies at 65% and 78% respectively.

With Question #11 asking for the number of actual counterparts for the exchange of opinion who formerly attended the same university like the respondent, it was intended to get another criterion to reduce the universe of potential counterparts for the exchange of opinion. I considered this characteristic because it has been used in other empirical studies in the context of the exchange of opinion (see e.g. Massa and Simonov (2005) and Cohen et al. (2009)). However, it turned out not to be adequate, because on average only 1% of the respondents that exchange forecast results attended the same university (median: 0%).

3.3 Methodology

3.3.1 Analysis of heterogeneous influence by using different reference groups

Within the empirical analysis of this paper, I do not determine the absolute magnitude of influence or whether analysts influence each other at all. This has already done in several prior studies (see e.g. Graham (1999), Hong et al. (2000), Welch (2000), Cooper et al. (2001), Zitzewitz (2001), Bernhardt et al. (2006), Krishnan et al. (2006), Kim and Zapatero (2009), Naujoks et al. (2009) and Jegadeesh and Kim (2010)). Instead, I aim to analyse the structure of influence, i.e. an anlyst's individual weighting of other analysts' forecasts. Therefore, I divide the analysts of the database into two reference groups. The composition of these groups varies with the hypotheses to be contrasted. In order to test the first hypothesis, for instance, one group consists of all analysts who work in the same country while the other group is composed of analysts who work in other countries. The resulting basic regression is given by

$$P_{ict} = \alpha\overline{P_{ct}^{(g1)}} + \beta\overline{P_{ct}^{(g2)}} + \epsilon_{ict}, \tag{3.1}$$

where P_{ict} denotes the price target that is published by analyst i regarding stock c at time t. $\overline{P_{ct}^{(g1)}}$ and $\overline{P_{ct}^{(g2)}}$ represent the average price targets of the two different reference groups. The error term is given by ϵ_{ict}. As not all analysts publish their price target on the same day, t has to be understood as a time window. In case the influence among analysts was homogeneous, then the coefficients α and β should not differ significantly.

The variables P_{ict}, $\overline{P_{ct}^{(g1)}}$ and $\overline{P_{ct}^{(g2)}}$ represent time series of price targets. These series could turn out to be non-stationary like in the case of stock prices. In this situation, it has to be verified whether ϵ_{ict} is stationary, such that the

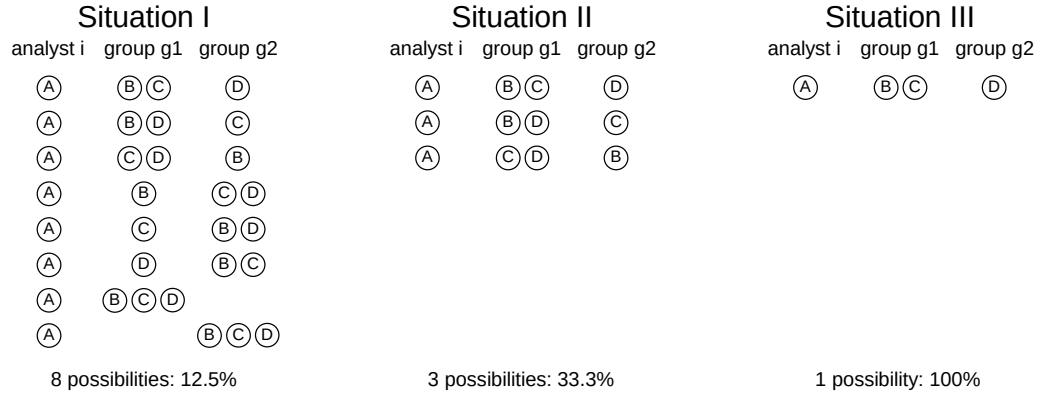
time series in equation 3.1 co-integrate (Engle and Granger, 1987). Otherwise, empirical outcomes have a high risk to be spurious.

3.3.2 Composition of the reference groups

The construction of the two reference groups in order to contrast the effect of geographical proximity is straight forward, because the working locations of all analysts are known. The determination of the effect of the exchange of opinion is somehow more challenging. The first group $g1$ has to be formed by analysts who exchange their opinions with analyst i, while the second group $g2$ has to contain only analysts who don't. As stated above, I do not certainly know which analyst has to be assigned to which group. A solution consists in randomly assigning the analysts to the two groups. Obviously, without further information, the probability of placing an analyst in the correct group equals 50%. This means that if one considers a particular analyst A on the left hand side of equation 3.1 and assumes that there are three other analysts B, C, D who cover the same company (i.e. on the right hand side of equation 3.1), then the probability for a correct overall assignment equals $0.5^3 = 12.5\%$. However, exploiting the survey evidence, this probability can be remarkably increased. If for instance, analyst A answered to exchange his opinion with two analysts who cover the same company, then taking randomly two out of the three remaining analysts B, C, D, from the perspective of analyst A, yields a probability of 100% to place at least one of the other analysts correctly and a probability of 33% to assign all analysts to the correct groups. The latter probability also increases to 100%, if one of these three analysts B, C, D answered not to exchange his opinion with any other analyst. Figure 3.5 displays the different constellations of this example.

Using real data from the survey, it is of course not possible to place all analysts correctly. However, aiming to contrast the influence that results from the exchange of opinion, it is not necessary reconstruct analysts' underlying communication network with a probability of 100%. Hereafter, I use the following

Figure 3.5: Examplary use of the survey data for a random group assignment



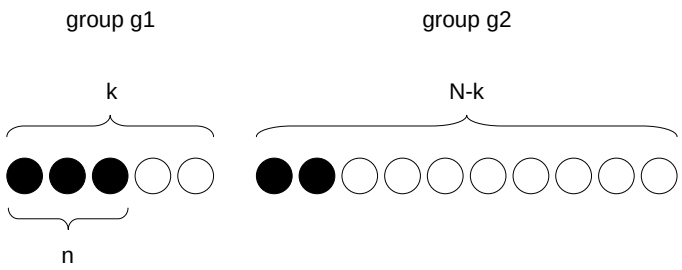
Illustrating the example in the text regarding a random group assignment for the exchange of opinion, the figure shows the possibilities that arise, if one considers a particular analyst A on the left hand side of equation 3.1 and randomly assigns three other analysts B, C, D to the two groups on the right hand side of equation 3.1. All four analysts shall cover the same company. In the first situation, one does not have any further information. In the second situation, one knows that analyst A exchanges his opinion with two other analysts that cover the same company. In the third situation, one additionally knows that analyst D does not exchange his opinion with any other analyst.

null hypothesis h_0 (not to be confused with the hypotheses one to three of this paper): A counterpart for the exchange of opinion has a higher influence compared to other analysts and the influence stemming from different counterparts for the exchange of opinions is equal. Now, if one randomly assigns the analysts to groups $g1$ and $g2$ while considering the information from the survey, then under h_0 the difference $\alpha - \beta$ in equation 3.1 should turn out to be positive, if there are enough analysts who are assigned to the right groups. From the perspective of a particular analyst, the condition for placing enough analysts correctly under h_0 can be expressed as follows:

$$\frac{n}{k} > \frac{k-n}{N-k} \Leftrightarrow n > \frac{k^2}{N}, \tag{3.2}$$

where N denotes the number of analysts who cover the same company and thus could be potential counterparts for the exchange of opinion from the perspective of a particular analyst. The number of analysts with whom a particular analyst actually exchanges his opinion is given by k. While N is determined by the database of price targets, the number k results from the answers of the survey (see survey question #7).[11] The number of analysts

Figure 3.6: Notation for analysts' group assignment



The figure displays an example of a random group assignment for the exchange of opinion. Filled circles represent analysts that are actual counterparts for the exchange of opinion from the perspective of a particular analyst. All other analysts are symbolised by empty circles. Hence, filled circles in the first group and empty circles in the second group stand for randomly correctly assigned analysts.

that are randomly correctly assigned to group $g1$ is represented by n. Figure 3.6 serves to clarify the notation.

Aiming to exploit further survey results (see survey questions #8 and #9), from the perspective of a particular analyst, the k analysts of group $g1$ can be separated into k_1 analysts who work in the same city, k_2 analysts who do not work in the same city but in the same country and k_3 analysts who do not work in the same country. N_1, N_2 and N_3 stand for the corresponding numbers of potential counterparts for the exchange of opinions. The resulting

[11] Using the answers from the survey, it is assumed that if two analysts exchange their opinions then they do so regarding all companies they have in common.

informational gain can be explained as follows. If for instance an analyst answered not to exchange his opinion with foreign analysts, then from his perspective all foreign analysts can be excluded for a random assignment to group $g1$. For each analyst i, the probability that condition 3.2 is fulfilled, i.e. that there are enough analysts who are randomly correctly placed in groups $g1$ and $g2$, such that under h_0 one obtains $\alpha > \beta$ in equation 3.1, is given by

$$P_i(\alpha > \beta|h_0) = P(n > \frac{k^2}{N}) = \frac{\sum_{m=\lfloor \frac{k^2}{N} \rfloor + 1}^{k} \prod_{j=1}^{3} \binom{k_j}{m_j} \binom{N_j - k_j}{k_j - m_j}}{\prod_{j=1}^{3} \binom{N_j}{k_j}} \tag{3.3}$$

$$s.t. \quad k = \sum_{j=1}^{3} k_j$$

$$N = \sum_{j=1}^{3} N_j$$

$$m = \sum_{j=1}^{3} m_j, \; m_j \leq k_j.$$

In the following, the Bernoulli variable I_i takes the value one with a probability of $P_i(\alpha > \beta|h_0)$, if for a particular analyst i inequality 3.2 is fulfilled and is zero otherwise with a probability of $1 - P_i(\alpha > \beta|h_0)$. The overall probability that the sign of $\alpha - \beta$ can be correctly estimated under h_0 is given by

$$P(\alpha > \beta|h_0) = \left(\sum_{i=1} w_i I_i > r \right), \tag{3.4}$$

where r is the percentage of observations in equation 3.1 for which inequality 3.2 has to be fulfilled in order to estimate the right sign of the difference $\alpha - \beta$. For the calculation of $P(\alpha > \beta|h_0)$, r is set equal to 50%, ensuring that inequality 3.2 is fulfilled for the majority of analysts. As not every analyst published the same number of price targets, the weighting coefficient w_i has been introduced.

In order to get an idea about the probability $P_i(\alpha > \beta|h_0)$ that inequality 3.2 is fulfilled for a particular analyst, table 3.4 provides the average values of N_1, N_2 and N_3 as well as of k_1, k_2 and k_3 for the cities where at least one

Table 3.4: Overview of the analysts who regularly exchange their opinions on DAX30 companies with other analysts

country	city	same city N_1	same country ex same city N_2	other countries N_3	exchange city level k_1	exchange country level ex city level k_2	exchange other countries k_3
Germany	Düsseldorf	3.5	36.5	42.0	2.0	0.0	2.8
	Frankfurt	14.7	14.3	50.0	2.3	0.8	3.7
	Hamburg	0.3	34.0	39.0	0.0	2.5	0.3
	Mainz	0.0	23.0	37.0	0.0	7.0	1.0
	Munich	1.3	29.3	33.3	0.3	1.3	0.6
	Stuttgart	0.0	26.5	32.0	0.0	2.2	0.3
France	Paris	3.0	0.0	44.7	0.7	0.0	1.3
Switzerland	Zurich	3.0	0.0	37.0	2.0	0.0	3.0
UK	London	14.0	0.0	43.7	1.3	0.0	1.7
overall		**7.8**	**17.9**	**43.3**	**1.3**	**1.1**	**2.1**

The first three columns of the table provide the average numbers of analysts in the same city N_1, the rest of same country N_2 and abroad N_3 who are theoretically available for the exchange of opinion because they cover the same company at the same time. The second three columns show the average numbers of actual counterparts for the exchange of opinions in the same city k_1, the rest of same country k_2 and abroad k_3 as obtained by the answers of the survey.

analyst participated in the survey. Remember that the numbers of all potential counterparts for the exchange of opinion, defined by the coverage of the same company, come from the price target database, whereas the numbers of actual counterparts for the exchange of opinion are obtained by the survey. Summing up the numbers in the second three columns of table 3.4 yields the size of group $g1$, i.e. the total number of analysts with whom a particular analyst exchanges his opinion irrespective of the working location. The size of the group $g2$ is determined by subtracting this number of actual counterparts for the exchange of opinion from the number of all potential counterparts for the exchange of opinion, which is obtained by summing up the first three columns in table 3.4. On average, the size of group $g1$ equals $k = k_1 + k_2 + k_3 = 1.3 + 1.1 + 2.1 = 4.5$, while the mean size of group $g2$ turns out to be $N - k = (7.8 + 17.9 + 43.3) - (1.3 + 1.1 + 2.1) = 64.5$. Hence, from the perspective of a particular analyst, the size of group $g2$ is generally much greater than the size of group $g1$. As I

always consider group averages, the influence of a singular analyst in group $g2$ is therefore very small. This means that if a counterpart for the exchange of opinion is wrongly placed in group $g2$, his impact is diluted. Hence, under h_0, the estimated influence of group $g1$ still might be higher than the estimated influence of group $g2$, such that the difference $\alpha - \beta$ in equation 3.1 turns out to be positive, if there are enough other analysts correctly placed in group $g1$. Due to the group sizes, it is even sufficient from the perspective of most of the analysts that group $g1$ only contains one properly assigned analyst, in order to fulfil condition 3.2.
The overall probability $P(\alpha > \beta|h_0)$ for estimating the correct sign of $\alpha - \beta$ in equation 3.1 under h_0 equals 73.3%. This means that running 1,000 simulations of a random group assignment while taking the information from the survey into account, the sign of the difference $\alpha - \beta$ in equation 3.1 is expected to be estimated correctly in 733 cases under h_0.

3.4 Results

3.4.1 Geographical proximity

With this paper, I intend to shed light on the structure of the influence among analysts. In this context, I test the relevance of geographical proximity, the impact of the exchange of opinion and the temporal change induced by the economic crisis starting in 2008. Testing different configurations of the augmented Dickey-Fuller test, all price target time series turn out to be stationary. Hence, there is no risk of obtaining spurious results.
I start the analysis on the country level (see table 3.5). Therefore, the construction of the relevant peer groups is straight forward as analysts' working locations are known from the price target database, such that additional information from the survey is not yet needed. From the perspective of a particular analyst, all other analysts covering the same company are divided into those who work in the same country (group $g1$) and those who work in a different

Table 3.5: Regression results for the structure of influence on the country level

	P_{ict}	$\overline{P_{ct}^{(g1)}}$	$\overline{P_{ct}^{(g2)}}$	α	β	const	$\alpha - \beta$	N	R^2
(I)	all	domestic	foreign	0.5600***	0.4148***	1.0081***	0.1452***	12,186	0.8734
				(0.0124)	(0.0123)	(0.2117)	(0.0213)		
(II)	non German	domestic	foreign	0.3130***	0.6868***	0.8089***	-0.3738***	3,946	0.9130
				(0.0194)	(0.0203)	(0.3134)	(0.0343)		
(III)	only German	domestic	foreign	0.6453***	0.3250***	1.0027***	0.3203***	8,240	0.8556
				(0.0160)	(0.0155)	(0.2729)	(0.0271)		
(IV)	only German	domestic	foreign	0.5853***	0.3777***	1.2923***	0.2077***	6,446	0.8306
	without three largest German firms			(0.0191)	(0.0184)	(0.3342)	(0.0322)		
(V)	only German	domestic	foreign	0.6658***	0.3040***	0.9453***	0.3617***	8,673	0.8616
	time window of 45 days			(0.0165)	(0.0160)	(0.2591)	(0.0280)		
(VI)	only German	domestic	foreign	0.6189***	0.3554***	0.9324***	0.2635***	7,192	0.8404
	time window of 15 days			(0.0164)	(0.0159)	(0.3088)	(0.0277)		
(VII)	only German	domestic	foreign	0.4361***	0.2846***	0.3230***	0.1515***	8,240	0.1421
	normalised price targets			(0.0175)	(0.0208)	(0.0251)	(0.0299)		
(VIII)	non German	German	non German	0.5096***	0.4754***	1.3713***	0.0343	3,991	0.9131
				(0.0170)	(0.0166)	(0.3008)	(0.0289)		

The table provides the results of the basic regression 3.1 on the country level. From the perspective of a particular analyst group $g1$ contains domestic analysts, while group $g2$ is build of foreign analysts. This composition of the groups changes in specification VIII where group $g1$ contains German analysts and group $g2$ is constructed by all other analysts. Specification I includes all analysts. For specification II and VIII only analysts who work outside Germany are considered on the left hand side of equation 3.1. Specification III-VII only include Germany based analysts on the left hand side of equation 3.1 (group $g2$ still contains foreign, i.e. non German analysts). A detailed description of the specifications is provided in the text. The significance of coefficients is indicated by stars (* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$). Standard deviations are provided in parentheses.

country (group $g2$). As time window, I consider the thirty days period before the publication of the price target of a particular analyst. This time window is so designed that an analyst can only be influenced by analysts whose price targets were observable prior his own publication. The length of thirty days guarantees that there are enough analysts to be included with their price targets, while the latter however are not too old. Estimating the coefficients of equation 3.1 yields a significant difference of 0.1452 (specification I). This result, however, might be biased by the fact that most of the price targets are published by Germany based analysts. Indeed, considering only analysts working outside Germany on the left hand side of equation 3.1 leads to a negative difference of -0.3738 (specification II). This implies that the difference for German analysts is actually higher than estimated by the first regression. In fact, this difference equals 0.3203 (specification III). This means that an individual German analyst increases his price target by 0.32 EUR *more* when other German analysts on average increase their price target by 1 EUR compared to the same increase of price targets by analysts working outside Germany. In order to provide some robustness checks for this result, several out-of sample regressions have been run. First, the three German firms that provided most of the price targets are excluded. This still leads to a significant difference of 0.2077 (specification IV). Next, the time window has been varied. Considering a time window of 45 as well as 15 days prior the publication of a particular analyst's price target yields significant differences of 0.3617 and 0.2635, respectively (specification V and VI). Finally, I aim to suppress the bias of potential heteroscedasticity. Therefore, I normalised price targets by the market price of the corresponding stock on the day prior the publication. The resulting difference is significant and equals 0.1515 (specification VII). This means that an individual German analyst increases his price target by 0.15% *more* when other German analysts increase their price target by 1% compared to the same proportional increase of price targets by analysts working outside Germany.
After having provided empirical evidence that the intra-country correlation of price targets only applies for Germany based analysts, one might assume that

this correlation is not due to the common country but is caused by the fact that the companies of the examined stocks are also headquartered in Germany. Therefore, German analysts might have or might at least be assumed to have a better set of information such that foreign analysts are more strongly influenced by German analysts than by their domestic colleagues. In order to analyse the influence that is generated by German analysts from the perspective of an analyst working outside Germany, I built up a group of analysts that work in Germany (group $g1$) and a group of all other analysts (group $g2$). The difference between the estimated coefficients equals 0.0343 and turns out to be insignificant (specification VIII). Hence, an analyst who works outside Germany is not more strongly influenced by German analysts than by all other analysts. Nevertheless, a German analyst still might have a better set of information although this is not recognised by analysts working outside Germany. I contrast this alternative hypothesis by comparing the returns an investor would have realised, if he had followed the implicit investment recommendations provided by price targets. The returns are given by

$$r_{ict} = \left(\frac{p_{c,t+365} + d_{ct,t+365}}{p_{ct}} - 1 \right) \operatorname{sgn} \left(P_{ict} - p_{ct} \right), \tag{3.5}$$

where p_{ct} is the market price of stock c at time t and $p_{c,t+365}$ is the stock price one year there after. The dividends that are paid during the period are given by $d_{ct,t+365}$. If an analyst publishes a price target that is higher than the current market price, then he considers the stock to be under valuated and implicitly recommends buying the stock. However, an analyst would not necessarily recommend buying a stock when his price target is only little higher than the prevailing stock price. Therefore, I use several thresholds for my analysis. These are 1%, 3% and 5%. By including dividends in equation 3.5, r_{ict} represents a gross return. For the comparative analysis of German and non German analysts I consider gross as well as net returns, i.e. returns that are calculated by including and excluding dividend payments. The results are displayed in table 3.6. It can be seen that returns that result from the buy and sell recommendations of German analysts are slightly higher. However,

Table 3.6: Average performance of German and non German analysts

	Germany	not Germany	difference
gross return. threshold 1%	6.98%	6.11%	0.87%
	(53.65%)	(51.75%)	
net return. threshold 1%	5.46%	4.43%	1.03%
	(53.79%)	(51.78%)	
gross return. threshold 3%	7.18%	6.36%	0.81%
	(54.28%)	(52.39%)	
net return. threshold 3%	5.62%	4.66%	0.97%
	(54.38%)	(52.38%)	
gross return. threshold 5%	7.46%	6.62%	0.84%
	(54.33%)	(53.06%)	
net return. threshold 5%	5.81%	4.89%	0.93%
	(54.35%)	(53.07%)	

The table shows average hypothetical returns that result from German and non German analysts' implicit recommendation provided by their price targets. The different methods of calculation are explained in the text. Standard deviations are provided in parentheses.

Table 3.7: Regression results for the structure of influence on the city level

	P_{ict}	$\overline{P_{ct}^{(g1)}}$	$\overline{P_{ct}^{(g2)}}$	α	β	const	$\alpha - \beta$	N	R^2
(IX)	all	same city	other city	0.3245***	0.6576***	0.7394***	-0.3330***	10,329	0.8741
				(0.0147)	(0.0150)	(0.2332)	(0.0256)		
(X)	non German	same city	other city	0.3155***	0.6839***	0.8180***	-0.3685***	3,918	0.9123
				(0.0195)	(0.0203)	(0.3145)	(0.0343)		
(XI)	only German	same city	other city	0.3012***	0.6702***	0.6959**	-0.3691***	6,411	0.8510
				(0.0212)	(0.0212)	(0.3228)	(0.0365)		

The table provides the results of the basic regression 3.1 on the city level. From the perspective of a particular analyst group $g1$ contains analysts who work in the same city, while group $g2$ is build of analysts who work in different cities. Specification (IX) includes all analysts. For Specification (X) only analysts who work outside Germany are considered on the left hand side of equation 3.1. Specification (XI) only includes Germany based analysts on the left hand side of equation 3.1 (group $g2$ still contains analysts working in foreign cities). The significance of coefficients is indicated by stars (* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$). Standard deviations are provided in parentheses.

none of the differences are significantly different from zero. Therefore, I can conclude that analysts working in Germany do not have better knowledge about DAX30 companies although they are also headquartered in Germany. This finding is in line with Bae et al. (2008), who show that local information advantage vanishes for large companies that operate globally and have a good disclosure policy.

Now turning to the city level, from the perspective of a particular analyst, all other analysts covering the same company are divided into those who work in the same city (group $g1$) and those who work in a different city (group $g2$). The resulting difference equals -0.3330 (specification IX). Hence, analysts are more strongly influenced by analysts who work in different cities compared to those who work in the same city. This result remains unchanged if only analysts working outside Germany or only German analysts are considered on the right hand side of equation 3.1 (specification X and XI). All regression results based on the city level are shown in table 3.7.

3.4.2 Exchange of opinion

Up to now, I considered the influence stemming from analysts' price targets that could actually have been observed. In the following, I like to determine the relevance of the exchange of opinion among analysts. Therefore, I enlarge the time window to ± 30 days. Hence, an analyst is considered to be also influenced by analysts who published their price targets later in time. The intuition behind is that analysts who exchange their opinions can influence each other without having to observe the finally published price target.

In chapter 3.2, I explained that I do not certainly know an analyst's counterparts for the exchange of opinion. However, the data of the survey can be used to get a good guess, if one randomly assigns the analysts to the group of analysts who exchange their opinions with analyst i (group $g1$) and the group of those who don't (group $g2$). The regression equation 3.1 can only be estimated, if the group $g1$ from the perspective of a particular analyst i is non empty. This comes because there has to be at least one other analyst who could have influence on analyst i by the exchange of opinion, if the resulting impact shall be estimated. In order to ensure this, I dropped all observation where analysts (on the left hand side of equation 3.1) answered not to exchange their opinion with any other analyst or did not participate in the survey at all. Therefore, there are analysts whose price targets appear on the right hand side of equation 3.1, but don't on the left hand side.

Under the null hypothesis h_0 that an analyst is more strongly (with equal intensity) influenced by those analysts with whom he exchanges his opinion, the probability for correctly estimating the sign of the difference $\alpha - \beta$ in equation 3.1 equals 73.3%. This value results, if the probability $P_i(\alpha > \beta | h_0)$ at the level of a single analyst is weighted by all price targets he has published during the period of analysis. However, an analyst might publish a price target in a period of time when no other analyst of those who are randomly assigned to group $g1$ published a price target. In this case, the observation also has to be dropped for the regression 3.1, because group $g1$ would be empty. Hence, the

Table 3.8: Regression results for the relevance of the exchange of opinion

$\overline{\alpha}$	$\overline{\beta}$	$\overline{const}$	$\overline{\alpha-\beta}$	$\overline{N}$	$\overline{P(\alpha>\beta\|h_0)}$	$f_{rel}\,(\alpha-\beta>0)$
0.4496	0.5465	0.8265	-0.0969	679	75.3%	43.0%
(0.3687)	(0.3570)	(1.6738)	(0.7250)			

The table provides the mean results of the simulation with 1,000 point estimates of the basic regression 3.1 that is used to determine the relevance of the exchange of opinion. From the perspective of a particular analyst group $g1$ contains analysts with whom he exchanges his opinion, while group $g2$ is build of other analysts. $\overline{P(\alpha>\beta|h_0)}$ is the average probability that for a random assignment of the groups the sign of the difference $\alpha-\beta$ can be correctly estimated under the null hypothesis. $f_{rel}\,(\alpha-\beta>0)$ is the relative frequency of simulation runs where the difference $\alpha-\beta$ turned out to be positive. Standard deviations of the point estimates resulting from the simulation runs are provided in parentheses.

number of price targets published by this particular analyst is reduced. This in turn changes the weighting coefficients w_i in equation 3.4, which thus depend on the random composition of group $g1$ and $g2$. Therefore, the probability for estimating the correct sign of $\alpha-\beta$ under h_0 varies slightly. Table 3.8 provides the results of 1,000 simulations. It can be seen that the mean probability for a proper assignment equals 75.3%, which is slightly higher than using a naïve weighting with all price targets published by an individual analyst. The average difference $\overline{\alpha-\beta}$ is negative and the point estimate of this difference is positive in only 43.0% of the cases. Given the fact that under h_0, one would expect $\alpha-\beta$ to be greater than zero in 75.3% of the cases, h_0 has to be rejected. Thus, I have to conclude that the exchange of opinion has no or at least less relevance than observation.

3.4.3 Social influence in conjunction with the prevailing financial market environment

All afore presented results are obtained by using the whole database ranging from the beginning of 2005 to mid 2010. This is a time period where financial markets were subject to remarkable fluctuations. There was a bull market until the beginning of 2007 when the U.S. subprime crisis began to develop to a global financial crisis. The consequences for non financial companies arose with the delay of one year, when the financial crisis became an economic crisis. Most of the companies in the DAX30 are non financial companies, such that it is of interest to examine changes in analysts' behaviour before and during the economic crisis. The beginning is marked by the collapse of the investment bank Lehman brothers on September 15^{th} 2008. This date is quite exactly in the middle of the analysed period and thus allows separating the whole database into two sets of data with similar number of observations. In the following, I use these two temporal subsets in order to repeat the analyses on the country and city level as well as regarding the exchange of opinion.

The results referring to the effect of geographical proximity are shown in table 3.9. On the country level, I only consider German analysts, as prior results showed that the relevance of the country only applies for analysts who work in Germany. It can be seen that the difference $\alpha - \beta$ is considerably greater before the economic crisis than during it (specifications XII and XIII). Before the crisis, a German analyst increased his price target by 0.51 EUR *more*, when other German analysts on average increased their price target by 1 EUR compared to the same increase of the price target by other analysts. This difference is 0.34 EUR higher than during the crisis. On the city level, $\alpha - \beta$ is negative before as well as during the crisis (specifications XIV and XV). However, this difference is slightly greater, i.e. less negative before the crisis.

Table 3.10 shows the temporal differences for the exchange of opinion. During the economic crisis the mean difference $\overline{\alpha - \beta}$ is negative and only 33.9% of the simulation runs yielded a positive difference $\alpha - \beta$. This is in line with

Table 3.9: Regression results for the temporal change on the country and the city level

	P_{ict}	$\overline{P_{ct}^{(g1)}}$	$\overline{P_{ct}^{(g2)}}$	α	β	const	$\alpha - \beta$	N	R^2
(XII)	only German	domestic	foreign	0.7414***	0.2354***	1.0673***	0.5060***	2,845	0.9372
	before econmic crisis			(0.0198)	(0.0186)	(0.3542)	(0.0330)		
(XIII)	only German	domestic	foreign	0.5646***	0.4000***	0.9497**	0.1647***	5,328	0.7665
	during econmic crisis			(0.0227)	(0.0226)	(0.3980)	(0.0389)		
(XIV)	all	same city	other city	0.3498***	0.6300***	1.0152***	-0.2802***	4,102	0.9376
	before econmic crisis			(0.0181)	(0.0180)	(0.2965)	(0.0312)		
(XV)	all	same city	other city	0.3189***	0.6658***	0.5414	-0.3469***	6,144	0.7874
	during econmic crisis			(0.0217)	(0.0227)	(0.3553)	(0.0382)		

The table provides the results of the basic regression 3.1 on the country and the city level. In specification XII and XIII, only German analysts are considered on the left hand side of equation 3.1. From the perspective of a particular analyst group $g1$ contains domestic analysts, while group $g2$ is build of foreign analysts. Specifications XIV and XV are based on all analysts. From the perspective of a particular analyst group $g1$ contains analysts who work in the same city while group $g2$ is build of analysts who work in different cities. The dataset is divided into two subsets with price targets being published before (specifications XII and XIV) and during the economic crisis (specifications XIII and XV). The significance of coefficients is indicated by stars (* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$). Standard deviations are provided in parentheses.

Table 3.10: Regression results for the temporal change of relevance of exchange of opinion

	$\overline{\alpha}$	$\overline{\beta}$	$\overline{const}$	$\overline{\alpha-\beta}$	$\overline{N}$	$\overline{P(\alpha>\beta\|h_0)}$	$f_{rel}\,(\alpha-\beta>0)$
before economic crisis	0.5131	0.4173	4.2817	0.0958	262	63.4%	64.8%
	(0.1701)	(0.1737)	(1.7417)	(0.3425)			
during economic crisis	0.4001	0.7015	-3.4232	-0.3014	415	78.7%	33.9%
	(0.8471)	(0.8189)	(2.4488)	(1.6647)			

The table provides the mean results of the simulation with 1,000 point estimates of the basic regression 3.1 that is used to determine the relevance of the exchange of opinion. From the perspective of a particular analyst group $g1$ contains analysts with whom he exchanges his opinion, while group $g2$ is build of other analysts. The dataset is divided into two subsets with price targets being published before and during the economic crisis. $\overline{P(\alpha>\beta|h_0)}$ is the average probability that for a random assignment of the groups the sign of the difference $\alpha-\beta$ can be correctly estimated under the null hypothesis. $f_{rel}\,(\alpha-\beta>0)$ is the relative frequency of simulation runs where the difference $\alpha-\beta$ turned out to be positive. Standard deviations of the point estimates resulting from the simulation runs are provided in parentheses.

the previously obtained results by using the whole dataset. However, looking at the period before the economic crisis, $\overline{\alpha - \beta}$ turns out to be positive. The corresponding probability for correctly estimating the sign of $\alpha - \beta$ under h_0 equals 63.4%. The relative frequency of simulations runs where α is greater than β turns out to be 64.8%. This indicates that the influence from the exchange of opinion plays a considerable role for price targets published before the economic crisis.

3.5 Alternative explanation

The afore-presented results corroborate the hypothesis of local proximity for German analysts and the hypothesis that analysts are more strongly influenced by their counterparts for the exchange of opinion (at least before the economic crisis). However, there might be an alternative explanation for these findings. An often cited caveat in the literature of social interaction (see e.g. Manski (1993), Brock and Durlauf (2001), Moffitt (2001) and Blume et al. (2010)) is that individuals only appear to be influenced by peer group members. In truth, their actions are correlated, because peer group members have similar background characteristics that induce them to act analogously. For the first hypothesis this would mean that price targets of German analysts are only correlated, because all German analysts have for instance the same education and therefore use the same method for the evaluation of the market environment. For the second hypothesis, this would imply that analysts exchange their opinions with only those analysts who have a similar way of thinking about investment opportunities, such that price targets are correlated without any actual influence taking place. There are several aspects that can be used to argue against these alternative explanations. First of all, financial education nowadays follows international standards. There are even uniform certificates

like the Chartered Financial Analyst (CFA)[12]. Therefore, it is not reasonable to assume that German analysts use a different tool box compared to their colleagues working outside Germany. Moreover, the structure of influence has been put in a temporal context. Hence, even if one does not trust the absolute results, there is a significant difference of behaviour before and during the economic crisis. This especially applies for the influence resulting from the exchange of opinion. If one still does not want to believe in the explanations of the structural patterns of influence, then there is at least a clear indicator that the influence among analysts is not homogenous as many authors assumed in their empirical studies.

3.6 Conclusion

The results can be summarised as follows. German DAX30 analysts are more sensitive to price targets of other Germany based analysts than to price targets published by analysts who work in other countries. This effect is not due to the fact that DAX30 companies are also headquartered in Germany. These finding are consistent with the hypothesis of local familiarity. However, on the city level no empirical evidence in favour of this hypothesis could be provided. Comparing the influence of pure observational learning with the influence that results from the exchange of opinion, I cannot find relevance of the latter while considering the whole period from 2005 to 2010. However, dividing the dataset into two subsets with price targets before and during the economic crisis starting in 2008 yields that before the crisis price targets of analysts who exchange their opinions systematically differ from those who don't. This tendency also applies for the analysis on the country level. Before the economic crisis, a German analyst is considerable more responsive to price targets of other German analysts than during the crisis.

Putting the results into perspective, one can draw the following conclusion.

[12]See www.cfainstitute.org for more information.

Before the economic crisis, analysts indented to differentiate from their peers. They tried to use research advantages provided by familiar analysts or those analysts with whom they regularly exchange their opinions. During the crisis in a time of great uncertainty, analysts were afraid of failing by providing estimates that were too far away from other analysts' results. Therefore, they rather aligned their price targets with the consensus such that the geographical influence and the influence from the exchange of opinion were not or at least less relevant.

On balance, I showed that the influence among analysts is dynamic and not homogenous. Therefore, it is reasonable to use an adequate structure of influence for further research of analysts' herding behaviour.

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