SONDERFORSCHUNGSBEREICH 504

Rationalitätskonzepte,
Entscheidungsverhalten und
ökonomische Modellierung

No. 06-12

Individual Investor Sentiment and Stock Returns - What Do We Learn from Warrant Traders?

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October 2006

We would like to thank Anders Anderson, Christian Klein, Alexander Klos, Michael Meffert, seminar participants at the University of Mannheim and the Swedish Institute for Financial Research (SIFR), Stockholm, and participants of the EFM Symposium 2006 in Durham, of the 9th Conference of the Swiss Society for Financial Market Research in Zurich, and of the 12th Annual Meeting of the German Finance Association in Augsburg for valuable comments and insights.Financial support from the Deutsche Forschungsgemeinschaft, SFB 504, at the University of Mannheim, is gratefully acknowledged.

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Abstract

In this paper, we propose a measure of individual investor sentiment that is derived from the market for bank-issued warrants. Due to a unique warrant transaction data set from a large discount broker we are able to calculate a daily sentiment measure and test whether individual investor sentiment is related to daily stock returns by using vector autoregressive models and Granger causality tests. We find that there exists a mutual influence of sentiment and stock market returns, but only in the very short-run (one and two trading days). Returns have a negative influence on sentiment, while the influence of sentiment on returns is positive for the next trading day. The influence of stock market returns on sentiment is stronger than vice versa. Our sentiment measure simultaneously avoids problems that are associated with existing sentiment measures, which are based on the closed-end fund discount, stock market transactions, the put-call ratio or investor surveys.

Keywords: Sentiment, Bank-issued Warrants, Covered Warrants, Individual Investors, Investor Behavior

JEL Classification Code: G1

1 Introduction

What influences the expectations of investors about future stock prices, and do these beliefs predict future stock returns? We shed light on these questions by deriving an aggregated measure of expectations for one group of investors. Our measure is based on the individual holdings of bank-issued warrants by private investors who are customers of a large German online broker.

Traditional models in finance assume that deviations of security prices from their fundamental values can immediately be exploited by sophisticated rational investors. These investors recognize and exploit deviations from fundamental values by buying undervalued and selling overvalued stocks and thus moving prices back to their fundamental values. Less sophisticated investors, or those who trade on other than fundamental information, are classified as irrational or *noise traders*. In the neoclassical framework the above mentioned arbitrage mechanism leads to the conclusion that irrational investors cannot influence equilibrium prices, earn inferior returns, and are thus driven out of the market in the long-run.[1] However, DeLong, Shleifer, Summers, and Waldmann (1990) show that in the presence of noise traders, the mechanism of arbitrage is disturbed. If noise traders create stochastic noise that does not cancel out in aggregate, rational traders are confronted with an additional source of risk because noise traders may move prices even further away from fundamentals. In this situation, arbitrage is no longer risk-free for rational investors with a finite investment horizon. The consequence of this noise trader risk is that deviations from fundamentals can persist in the long-run. Since it is hard to determine what the equilibrium fundamental value of an asset is, noise trader models do not provide us with precise hypotheses regarding the direction and magnitude of the influence of investor sentiment on security prices or how investor sentiment is determined. However, these models imply that stock returns influence investor sentiment and that investor sentiment can influence stock returns. Since it is essential to differentiate between groups of investors, we look at expectations of one special group of investors - namely individual investors from a big German online broker. Usually, those investors fit the definition of a noise trader, because it is unlikely that they have better information than other market partic-

[1] Kogan, Ross, Wang, and Westerfield (2006), however, show that price impact of irrational traders does not depend on their long-run survival and they can have a significant impact on asset prices even when their wealth becomes negligible.

ipants (i.e. institutional investors). They do not have the time or money to obtain, nor the ability to interpret all available information. Thus, they might be especially prone to the usage of heuristics, rules of thumb, or other simplifying decision rules in their investment decisions. Furthermore, various studies have shown that individual investors suffer from different cognitive biases (e.g., the disposition effect or the overconfidence bias). They also demonstrate too much optimism in their expectations about future outcomes of stock prices (e.g. Kahneman, Slovic, and Tversky (1982), Barberis and Thaler (2003), and Glaser and Weber (2004)), which indicates that individual investors are most likely not fully rational. Therefore, the noise within the group of individual investors could be dependent on a non-fundamental variable - the investor sentiment. We investigate whether this sentiment is influenced by stock market returns or whether, in turn, the expectations of private investors influence returns of big and small company stocks.

What exactly do we define as investor sentiment? It is the expectation of investors regarding the price of one or more financial assets that is not based on fundamental information. An additional necessary condition for investor sentiment to influence equilibrium prices is that this sentiment is correlated within a group of investors. One can think of investor sentiment as the way a group of investors thinks about, for example, the future development of stock prices, which is not justified by rationality. In other words, the above mentioned models state that a group of investors whose beliefs are influenced by non-fundamental factors in a correlated way may affect the valuation of assets. There is a large volume of empirical literature, comprehensively discussed in Section 3, that analyzes the mutual influence between stock returns and investor sentiment measures. Empirical studies differ in various dimensions. Most importantly, studies usually differ in the way they measure investor sentiment. This might be one reason why the results concerning the relation between stock returns and investor sentiment measures are mixed. Furthermore, existing sentiment measures are subject to several methodological problems. Individual investor sentiment measures based on stock transactions face the problem that, due to short sale constraints, it is harder to express negative sentiment for a stock through a sale compared to expressing positive sentiment through a purchase. In addition, it is difficult to calculate individual investor sentiment measures based on aggregate transaction data, since it is impossible to disentangle individual investors' transactions from the transactions of other investor groups, such as institutional investors. Survey based sentiment measures

are confronted with the problem that investors might act differently in the market, where real money is at stake, as compared to questionnaire answers. These problems will be addressed in detail later in the paper.

In this paper, we propose a measure of individual investor sentiment that is derived from the market for bank-issued warrants. We compare the number of investors who hold call warrants (positive expectations about the future price of the underlying) to investors who hold put warrants (negative expectations) on an individual level. Analyzing warrant transactions has a clear advantage in terms of inferring investors' expectations by their trading decisions when compared to the analysis of stock transactions.[2] The decision to sell a stock can have several reasons apart from the expectation that the respective stock price will decline in the future. Examples include the demand for liquidity, portfolio rebalancing, or the (irrational) reluctance to sell stocks with a loss.

In contrast, the purchase of a put warrant is a clear sign that investors expect falling prices of the underlying. A obvious counterargument to this revelation of negative expectations could be that another motive for holding a put warrant might be hedging. There are several points that make it unlikely that hedging is the main focus of individual investors in the warrant market. The first is that the median holding period for all warrants in our data set is only 9 days and even less (6 days) for put warrants. In addition, Bartram and Fehle (2003) showed, by looking at the level and difference of bid and ask prices on the warrant and option market, that it is more likely that hedgers trade on the option market, while speculators trade on the warrant market. In a survey of a weekly investor magazine and a German discount broker, 4,345 individual investors were asked for their motives to trade warrants. Only 8% stated that hedging was their main motive to buy warrants.[3] Another point is that a direct hedge[4] was not possible for the DAX[5], since private investors were not able to replicate the DAX in their portfolio.[6] All together,

[2] The sentiment measures that are based on stock transactions compare stock purchases and sales (see e.g. Kaniel, Saar, and Titman (2004) and Kumar and Lee (2002)). They do so because private investors rarely hold short positions in stocks.

[3] See Klotz (2004), p. 16.

[4] "Direct hedge" means holding the underlying and a put on the same underlying.

[5] The DAX is the stock index for the 30 biggest listed German companies.

[6] Today, exchange traded funds give individual investors the opportunity to hold a whole index at relatively low costs. This was not possible in Germany during our sample period.

we think that hedging only plays a minor role, if any at all, in the market for bank-issued warrants. Even if investors buy warrants to hedge their long-term investment in the underlying with a put in the short-run, this means nothing else than that they see an increased possibility of a decline in the price of the underlying in the short-run. This is a change in their short-term sentiment.

Due to a unique warrant transaction data set from a large German discount broker, we are able to calculate our sentiment measure on a daily basis and test whether individual investor sentiment is related to daily stock returns by using vector autoregressive models and Granger causality tests. We argue that our sentiment measure simultaneously avoids the problems mentioned above, which are associated with existing sentiment measures. We find that there exists a mutual influence between sentiment and stock market returns in the very short-run (one to two trading days). Returns have a negative influence on individual investor sentiment, which in turn influences the return of the following day positively. This means that private warrant investors act as contrarians and that their expectations about the underlyings are correct in the short-run. The impact of stock market returns on sentiment is stronger than vice versa. We find no evidence for stronger influence of sentiment on small stock returns than big stock returns as it was suggested by different authors.[7]

The remainder of the paper is organized as follows. In Section 2, we start with a description of the institutional characteristics of bank-issued warrants in Germany. Section 3 provides a comprehensive overview of the literature in the field of investor sentiment. In Section 4, the data set and the methodology are described. Empirical results are reported and discussed in Section 5. Section 6 concludes.

2 Institutional Characteristics of Bank-issued Warrants

Bank-issued warrants[8] (warrants hereafter) securitize the right, but not the obligation, to buy (call) or sell (put) a certain amount of the underlying security for a preconcerted price

[7] See e.g. Kumar and Lee (2002) and Neal and Wheatley (1998).

[8] Sometimes the synonyms *covered warrants* or *third-party warrants* are used.

up to (American-style warrant) or on (European-style warrant) a preconcerted maturity date. The payoff structure of those warrants is the same as for plain-vanilla options, although warrants are legally obligations from the issuer directly to the owner.[9] These typical retail banking products are issued by financial institutions only and are bought (almost) exclusively by individual investors. In contrast, traditional warrants are issued by the same company that issued the underlying of the warrant.[10] Since short-selling (i.e. issuing) warrants is impossible for individual investors, no margin accounts are required and the size of the contracts is much smaller than in the options markets. Typically, the owner of one warrant has the right to buy or sell one-tenth or one-hundredth of the underlying with this contract (expressed by the conversion ratio), resulting in a median price of 1.45 Euro per warrant in our sample. Furthermore, transaction costs are close to those of stocks (median transaction costs per trade are 12.06 Euro), which makes warrants affordable for individual investors. The buying and selling procedure for the warrants is similar to that of stocks. Customers of the online broker trade these warrants within the same technical environment that they are used to from trading stocks. There is no need for an additional (margin) account to trade warrants. The only additional requirement is that you sign a form where you confirm that you are aware of the risks associated with these kind of securities.[11]

Bank-issued warrants are well-known securities in continental Europe, Australia and in some markets in Asia. They are less common in the UK[12] and not existent in the US. By far the largest market for warrants with regard to listed securities (see Figure 1) as well as turnover exists in Germany. In 2000, the premium turnover[13] of warrants on

[9] While in the option market a clearing institution fulfills the obligations of a writer of an option who fails to fulfill his obligation, there is no such institution in the warrant market. Since all issuers in the warrant market are financial institutions this default risk should be small and have only minor price impacts.

[10] Traditional warrants are usually issued in combination with a bond (so called warrant-linked bond). They give the warrant holder the right, but not the obligation, to acquire shares of the issuing company and thus are always call warrants.

[11] This so called *Termingeschäftsfähigkeit* has to be renewed every other year, just by signing the form again.

[12] In 2002 the London Stock Exchange announced to create a special market place for warrants to make them better available for private investors. See McHattie Group (2002), p. 2.

[13] The premium of a warrant is the amount an investor pays for the right to buy or sell the underlying for the strike price. Since warrants are nothing else but the price of this right the premium is equal to the price of the warrant. The turnover data is the sum of all traded premiums within a year and not the sum of the values of the underlyings on which one holds the right.

German exchanges was 83.30 billion Euros, which accounted for approximately 1.5% of total exchange turnover in Germany.[14] Another indicator of the importance of warrants in the German market is the growth of the number of securities. While 100 warrants were listed in different German market places in 1990, this number rapidly increased to 4,500 at the beginning of our sample period in January 1997. At the end of our sample period (mid of April 2001), 23,500 warrants were listed in Germany, and this number grew to 29,000 in August 2005.[15] Why are there so many warrants? Unlike options, warrants are not written on demand, but are rather issued, similar to bonds, on one particular date in a quantity defined in advance. Regardless of whether all warrants are sold at the day of issuance, they can be traded anytime within their lifespan. Furthermore, an issuing institution does not normally offer only one warrant with one strike price on one underlying but rather a whole series of warrants on one underlying. The warrants in a series vary with respect to the type of the warrant (i.e. call or put), the strike price and the maturity date.[16] Every single security that was designed in such a way is listed as a separate warrant with a separate ISIN. As a result, there is a large heterogeneity of securities in the market for bank-issued warrants.

This high degree of diversity of warrants causes some coordination problems that are addressed by a strong market maker structure in this market. The market makers, i.e. the issuing banks, are committed to providing liquidity for their own products, because otherwise, high costs of finding a contract partner within the group of individual investors could cause a market breakdown. They do so by quoting bid and ask prices for their warrants permanently. Although the issuers are free with regard to the level of prices, they are restricted in the maximum bid/ask-spread[17] and the minimum number of securities they are willing to buy or sell for the bid or ask price.[18] The consequence is that individual

[14] See Voirin (2001), p. 2.

[15] In comparison, only 5,800 stocks are listed on the largest German stock exchange in Frankfurt.

[16] Since the option market is much more regulated with respect to contract size and maturity dates less different options exist, resulting in more liquidity for these derivatives.

[17] Often the market makers commit to quote spreads not greater than 2% of the absolute value of the warrant. However, some defined special situations exist where the market makers could deviate from this rule (e.g. if prices are very low in absolute terms and the smallest price unit (usually one cent) is already more than the maximum spread).

[18] Bartram and Fehle (2003) compare bid/ask spreads of similar derivatives on the German warrant and option markets and find that prices are higher but spreads are smaller in the market for bank-issued warrants. They conclude that it is

investors predominately trade directly with the market maker.[19]

The structure of the market for bank-issued warrants implies that investors are not able to issue these assets (i.e. sell them short). That makes arbitrage virtually impossible in this market. This is because the seller of the warrants is always a financial institution. It is very unlikely that they would sell a warrant for less than its theoretical price, and rational investors could only gain from arbitrage, if the warrants would be "too cheap". On the other hand, the issuers can vary the prices freely, including the possibility to raise prices if investors' demand is high for these products. However, since they are committed to a maximum spread, they also have to buy back the warrants for the higher price, making it less attractive for the issuers to quote high prices if the demand is high.[20]

3 Related Literature

As stated before, many empirical investigations with different measures of investor sentiment have been conducted in the last decade. However, the results of these investigations have been mixed. Some studies have found an influence of sentiment on market returns and other studies have not. In that context, a very important question is whether the used proxies for investor sentiment represent appropriate measures. In this section, we first shed light on the advantages and disadvantages of these measures of investor sentiment and report empirical results afterwards. In the next section, we demonstrate how we address the methodological problems and why our measure of investor sentiment can simultaneously circumvent the most severe measurement problems.

more likely that institutional investors (i.e. hedgers) trade on the option while individuals (i.e. speculators) trade on the warrant market.

[19] Both big market places for warrants in Germany, the European Warrant Exchange (Euwax) and the Deutsche Börse Frankfurt, implemented mechanisms that guarantee that buy and sell offers from individual investors are matched if they fall within the quoted spread from the market maker, resulting in a better price than if the individuals would have traded with the market maker directly.

[20] Wilkens, Erner, and Röder (2003) find that for similar products which are traded on the same markets as warrants (i.e. discount certificates and reverse convertibles), prices are too high at the beginning of the lifespan of these products but convert to their fair values as they approach maturity. Their *order-flow hypothesis* states that this is due to that fact that at the beginning of the lifespan the risk that many investors sell back their warrants to the issuer is smaller than at the end of the lifespan, simply because less products are outstanding.

The proxies for investor sentiment used in the literature can be divided into two main categories.[21] One the one hand, there are indicators that are derived from financial markets. They can be subdivided into clientele-specific indicators derived from the behavior of individual or professional investors (e.g. transactions and portfolio holdings) and market-wide indicators. The latter imply micro- (e.g. book-to-market ratio) and macro-economic (e.g. interest rates) data as well as proxies from the fund (e.g. closed-end fund discounts), derivatives (e.g. put/call ratio), and IPO (e.g. IPO volume) markets and other time-series data (e.g. liquidity, momentum).[22] On the other hand, there are direct sentiment measures which are derived from weekly or monthly questionnaire surveys among institutional and individual investors, managers or consumers.[23]

The most prominent proxy for individual investor sentiment is the closed-end fund discount (CEFD) proposed by DeLong, Shleifer, Summers, and Waldmann (1990) and Lee, Shleifer, and Thaler (1991). It is an empirical fact that closed-end funds are, on average, traded with a substantial discount on the net asset value (NAV) of the stocks in their portfolios. Rational reasons that are consistent with the neoclassical theory (e.g. agency costs) seem to be insufficient to explain the magnitude and the time variation of the discount. Since closed-end funds are predominantly traded by individual investors, their sentiment should affect the CEFD.[24] If individual investors become more optimistic (pessimistic) about stocks, they affect prices on the market somehow, depending on the portion of their aggregated demand. The higher the trading volume of individual investors in comparison with professional investors, the higher the influence of these individuals on the stock price is.[25] If the proportion of individual and institutional investors in the whole market and in the market for closed-end funds were the same, the discount would not

[21] One exception from this categorization is the work of Edmans, Garcia, and Norli (2006). They derive sentiment from the results of international soccer matches and show an asymmetric effect on stock returns. Domestic markets decline the next day if the national team looses while there is no significant stock market reaction after a victory.

[22] See Kaniel, Saar, and Titman (2004), Kumar and Lee (2002), Rath, Tebroke, and Tietze (2004), Wang, Keswani, and Taylor (2006), Baker and Wurgler (2004), and Baker and Stein (2003).

[23] E.g. the ZEW Financial Market Survey (for details see http://www.zew.de), surveys by the American Association of Individual Investors (AAII) (for details see http://www.aaii.com), the Ifo Business Climate Index (for details see http://www.cesifo.de), and the Michigan Consumer Confidence Index (for details see http://www.sca.isr.umich.edu).

[24] See Lee, Shleifer, and Thaler (1991), p. 82.

[25] This is why primarily small stocks with low institutional holdings are believed to be influenced by individual investor sentiment.

change if individuals became more optimistic (pessimistic). However, since mainly individuals buy closed-end funds, the discount should decrease (increase) because prices of the assets on the market are undervalued (overvalued) from the perspective of individual investors.[26] Based on these assumptions, Lee, Shleifer, and Thaler (1991) find that the CEFD measures individual investor sentiment and that this sentiment is able to forecast monthly stock returns, especially of stocks that are predominantly held and traded by individual investors, e.g. small stocks, in the years from 1965 to 1985. In a larger sample from 1933 to 1993, Neal and Wheatley (1998) find a positive relation between CEFD and small firm returns but no relation with returns of larger firms. They conclude that the CEFD is able to predict the size premium.[27] They also test other proxies for investor sentiment, namely net mutual fund redemptions and the ratio of odd-lot sales and purchases, with the result that redemptions are also able to forecast the size premium while the odd-lot ratio is not. There are also some critical views on CEFD as a proxy for investor sentiment and the influence on stock prices. For example Swaminathan (1996) finds in the extended data (1965-1990) of Lee, Shleifer, and Thaler (1991) that the CEFD can indeed forecast small stock returns. However, the discount contains fundamental economic information about small firm earnings growth rates and future inflation, and thus, it is not a measure of sentiment but "a proxy of individual investors' rational expectations about future economic conditions and/or their risk aversion to macroeconomic risks".[28] Ross (2002) shows that if one interprets the management fees of closed-end funds as options on the NAV of the respective fund, the level of the discount could be explained within the neoclassical framework.[29] Elton, Gruber, and Busse (1998) find that the CEFD is not an important factor in the stock return generating process at all. Similar results are provided by Doukas and Milonas (2004). They do not find evidence for investor sentiment, measured by the CEFD, affecting the risk of common stocks in the Greek stock and closed-end fund market from 1997 to 2002. Qui and Welch (2004) obtain similar results. In their 1965 to 2003 sample, they can not find forecasting power of the CEFD for retail-stock return spreads,

[26] Note that a measurement of the private investors influence is only possible if one can differentiate the clienteles (e.g. institutional and individual investors) in the market.

[27] The difference between small and large firm returns.

[28] Swaminathan (1996), p. 882.

[29] Although it is unclear how the intertemporal variation of the discount and the empirical fact that in some periods closed-end funds are traded with a negative discount, i.e. premium, could be explained within this theoretical framework.

retail-stock low-trading return spreads, and post-1985 small-stock return spreads. In contrast to the CEFD, the survey-based Michigan consumer confidence index (MCCI) can explain these changes and therefore is preferred by the authors as a sentiment indicator over the CEFD.[30]

The latter study leads to the second category of measures for investor sentiment. Several studies test survey-based proxies for sentiment and their correlation with stock market returns. Otoo (1999) uses the MCCI and finds that in the period of 1980 to 1999 this indicator is influenced by returns of a broad stock market index (Wilshire 5000) on a monthly basis. This is also true the other way around, although the influence of sentiment on stock market returns is much weaker. In two studies, Solt and Statman (1988) and Clarke and Statman (1998) examine a sentiment indicator that is published by *Investors Intelligence (II)* and based on the number of newsletters that are bullish, neutral, or bearish. In the time periods 1963 to 1985 and 1963 to 1995, they find, in weekly measurements, that sentiment does not influence stock market returns[31] over a 4, 26, and 52 week horizon. However, sentiment is influenced by returns that are lagged over these horizons. They attribute the wrong beliefs in the forecasting abilities of newsletter writers to different errors in the cognition of investors (e.g. "hot hand fallacy", "Muller-Lyer illusion", and "illusions of validity").[32] Brown and Cliff (2005) find that the same Investors Intelligence indicator does indeed affect asset values and their deviation from fundamental values in the long-run.[33] They also test other proxies for investor sentiment (e.g. CEFD, fund flows) and find mixed and weak influence. A different survey-based measure of investors expectations and confidence is investigated by Shiller (2000). He asked institutional investors about their bubble expectations and confidence every half year between 1989 and 1999. He shows that there exist rather weak relations between his sentiment indicators and the lagged changes in stock prices.[34] In addition, he investigates the correlation between these and other commonly used sentiment indicators (e.g. CEFD, Investors Intelligence). The

[30] They additionally show that the correlation between CEFD and MCCI is low.

[31] As returns those of the Dow Jones Industrial Average are used.

[32] See Solt and Statman (1988), pp. 50-54.

[33] The authors investigate 6, 12, 24, and 36 month horizons.

[34] See Glaser and Weber (2005) for a comprehensive survey of the related strand of literature that analyzes the link between past returns and stock return expectations.

main result is that the different sentiment measures are not correlated. Fisher and Statman (2000) test three survey-based sentiment measures for different clienteles: (i) mean allocation to stocks in the recommended portfolios of sell-side strategists, (ii) Investors Intelligence indicator, and (iii) small investor sentiment from the American Association of Individual Investors (AAII). They find a high correlation between the two latter measures but hardly any with the first measure. The first and the third measures are reliable contrary indicators for future stock market returns (S&P 500), while the second is not. The sentiment of the second and third group of investors is positively influenced by prior stock market returns, while sell-side analysts are not.

Another common way to measure investor sentiment is to compare buy with sell transactions of individual investors. The usual measure is the difference between bought and sold volume divided by the sum of both. In their closely related studies, Kumar and Lee (2002) and Kumar and Lee (2004) show that over a six year period (1991-1996) the sentiment indicator, based on the transaction behavior of 60,000 individual investors from a major US discount brokerage house, has explanatory power for excess returns of small stocks, value stocks, stocks with low institutional ownership, and low priced stocks, but is uncorrelated with the overall market movement. An additional result of their studies is that the trading behavior of individual investors can explain the comovement in stock returns. In contrast, Kaniel, Saar, and Titman (2004) find little correlation between transactions of individuals across stocks on a daily basis. They show that individuals act as contrarians (e.g. buy after stock price declines) and that sentiment, measured in the way described above, is a predictor of future stock market returns. Additional sentiment measures are provided by Baker and Stein (2003). They measure investor sentiment from 1927 to 1998 (yearly) by the liquidity of the stock market in two ways: (i) turnover[35] and (ii) equity issuance[36]. In their model, they find that these sentiment measures are highly correlated and have predictive power for future market returns.

Three studies that are methodologically close to ours are those of Wang, Keswani, and Taylor (2006), Brown and Cliff (2004), and Dorn, Huberman, and Sengmueller (2004).

[35]Turnover is measured as the ratio of reported NYSE share volume to average shares listed.

[36]Equity issuance is measured as the ratio of common and preferred issues to the sum of these two items plus public and private debt issues.

The first two test various proxies for investor sentiment within a vector autoregressive (VAR) model to investigate the mutual influence between those measures and market variables like returns and volatility. Wang, Keswani, and Taylor (2006) find that sentiment, measured by AAII, II, put-call trading volume, open interest, and ARMS[37], do not Granger-cause stock market returns (S&P 100) or stock market volatility.[38] However, they find influence of the market returns as well as of the volatility on future values of the sentiment measures. Similar results are provided by Brown and Cliff (2004). They first test different sentiment measures[39] and find strong contemporaneous relations between changes in these proxies and near-term stock market returns. Relying on principal component analysis, they elicit their own sentiment indicator to obtain a cleaner measure of investor sentiment. They test the mutual influence of their indicator and stock market returns in a VAR model and show only limited evidence that their sentiment measure forecasts stock market returns. In contrast, they find strong evidence that returns influence the level of as well as changes in the sentiment measure. Dorn, Huberman, and Sengmueller (2004) detect a tendency of herding within a group of individual investors from an online broker measured by the herding measure of Lakonishok, Shleifer, and Vishny (1992). Additionally, they test the forecasting power of a sentiment variable, the buy ratio[40], for stock returns with a VAR model. They find a positive relation between net trading by individuals and returns.[41] Their results are especially strong in the very short-run (daily frequency).

[37] ARMS is defined as number of advancing issues scaled by the number of traded shares of advancing issues divided by the same ratio for declining issues.

[38] An exception is the ARMS index where Wang, Keswani, and Taylor (2006) find some forecasting ability.

[39] They test e.g. the ratio of advancers to decliners, ARMS, the ratio of stocks with new highs to those with new lows, the put/call ratio, the CEFD, fund flows, number of IPOs etc.

[40] The buy ratio is similar to the sentiment measures of Kumar and Lee (2002) and Kaniel, Saar, and Titman (2004) but uses the numbers of investors instead of the volume bought and sold. This makes the measure robust against the behavior of a few wealthy individuals.

[41] This positive relation disappears if limit orders, in addition to the here used market orders, are also considered in the analysis.

4 Sentiment Measures, Data Set, and Methodology

We propose a measure of investor sentiment that is derived from warrant transactions in the market of bank-issued warrants. The underlying assumption is that people reveal their expectations about the future development of the underlyings of the warrants by holding call or put warrants. Since the value of a call tends to rise if the price of the underlying rises and the value of a put rises if the price of the underlying declines, holding a call is regarded as positive expectation, while holding a put is regarded as negative expectation for the underlying. By looking at the holdings of warrants, we can avoid the problem that occurs with sentiment indicators that compare buy with sell transactions.[42] As mentioned earlier, the problem is that buy and sell decisions in stocks differ in some aspects. In theory, informed as well as noise traders are equally likely to make purchases or sales either based on the information available to them or randomly. In contrast, Barber and Odean (2005) show that the buying behavior, especially of individual investors, is influenced by attention grabbing events such as abnormal volume and extreme one day price moves. The underlying idea is that individual investors are not able or willing (because of high transaction costs) to sell stocks they do not already own (short selling). Thus, they face different search problems when making buy or sell decisions. To purchase a stock, they have to choose from a set of several thousand different assets. Due to their cognitive limitations and time constraints, they are not able to analyze all these stocks and thus focus on stocks that recently caught their attention. Furthermore, a robust phenomenon when looking at selling decisions is the so-called "disposition effect".[43] Odean (1998) shows that individual investors are more reluctant to realize their losses than they are willing to sell their winners and that this finding cannot be fully explained by rational reasons like portfolio rebalancing or expectations about future price movements.

If one takes these points into consideration, the elicitation of investor sentiment from the trading behavior in stocks by comparing buy and sell transactions[44] is at least question-

[42] Analogously to the buy ratio of Dorn, Huberman, and Sengmueller (2004), we also calculated a sentiment measure that compares purchases in calls (instead of stock purchases) and puts (instead of stock sales) for every investor in a specific time period. The results (unreported here) are the same with regard to the direction of influence, but we obtain less observations per day, making the results a little less reliable.

[43] See Shefrin and Statman (1985).

[44] See Dorn, Huberman, and Sengmueller (2004), Kaniel, Saar, and Titman (2004) and Kumar and Lee (2002).

able. By looking at the transactions of individual investors in the warrant market, one can overcome these difficulties. This is due to the simple fact that investors can buy call and put warrants for the same transaction costs.[45] Since the holder of a put warrant earns money if the underlying loses its value, buying a put warrant is a kind of "short sale" of the underlying. Our assumption is that an investor who holds a call warrant reveals his positive sentiment about the underlying while the holder of a put warrant shows negative sentiment. Since we do not compare buy and sell transactions, we avoid the problems associated with differences in buying and selling behavior.

Additionally, our sentiment measure has some advantages compared to other proxies of investor sentiment. Due to a data set from a big German online brokerage, we are able to measure sentiment at the individual investor level. Furthermore, the investors are private investors (median buy transaction volume is 1,886 Euros), and we look at transactions in warrants only, which are almost exclusively traded by individuals. Thus, we capture sentiment of individual investors only. It is a lot more difficult to control for the clienteles if one is looking at the CEFD or data from the option market as sentiment measures. The advantage over the CEFD is that rational investors have no incentive to buy warrants, since arbitrage is virtually impossible in this market. This is because the seller of the warrants is always a financial institution. As mentioned before, it is unlikely that the financial institutions would sell a warrant for less than its theoretical price. Rational institutional investors could only gain from arbitrage if the warrants would be "too cheap". If, in contrast, the discount in a closed-end fund exceeds its rationally justified amount, there is a possibility of arbitrage in buying the fund and selling the corresponding portfolio short.[46] This could induce institutional trading in closed-end funds. Other popular sentiment indicators are derived from the option market. They compare the number of (or volume traded in) call and put options or the contracts that are not closed at the end of a time period ("open interest").[47] This is methodologically close to what we are looking at but has one big disadvantage. Similar to the CEFD one cannot distinguish clienteles.

[45] E.g. transactions in warrants on the DAX are in 55.67 % cases call warrants and in 44,33% put warrants.

[46] Lee, Shleifer, and Thaler (1991), p. 83, argue that there are some limitations to arbitrage. Besides the problem of portfolio adjustment and costly short sales, the main argument is that there is a "discount risk" if the time horizon of the arbitrageur is not infinite. The takeover of the whole fund and sale of all assets as ultimative way of arbitrage is also discussed. The authors regard that as unlikely due to managerial resistance and regulatory restrictions in practice.

[47] See Wang, Keswani, and Taylor (2006).

Since warrants are typical retail banking products that are bought by individual investors and because we look at online brokerage accounts we are able to measure the sentiment of the clientele of individual investors. In the option market, it is unclear who sells the contracts to whom. If, for example, only put contracts have been traded in a time period, the put/call-ratio would indicate strong pessimism. Since there are always two parties involved in an option contract it is difficult, if not impossible, to infer investor sentiment. The buyer of the put could be regarded as pessimistic, while at the same time the seller should then be optimistic. To be consistent with theory, the differentiation in clienteles is essential.

There are a couple of sentiment indicators that can precisely differentiate clienteles. They do so by asking people directly in some kind of survey. There are surveys of institutional and individual investors, as well as managers and consumers that are regarded as sentiment indicators by different authors[48]. The problem all these surveys have in common is that they cannot control for what the participants are actually doing. There might be a divergence between what the participants answer and what they actually do in the stock market. There might be incentives not to reveal the true expectations if one knows that this could potentially influence stock prices in an undesired direction. If, for example, somebody owns stocks because he expects prices to raise in the future and he knows that a bullish result in a survey is regarded as contra-indicator, he has an incentive to answer as if he were bearish, even though he is not. Furthermore, Glaser, Langer, Reynders, and Weber (2005) show that stock return expectations are easily influenced by the specific elicitation mode used in questionnaire studies (i.e. whether forecasters have to state future price levels or directly future returns). They find that there is a highly significant framing effect. For upward sloping time series, the return forecasts given by investors who are asked directly for returns are significantly higher than those stated by investors who are asked for prices. For downward sloping time series, the return forecasts given by investors who are asked directly for returns are significantly lower than those stated by investors who are asked for prices.

We derive our sentiment measure from a data set of daily transactions of individual investors who had accounts at a big German online brokerage between January 1997 to

[48]See for some examples Qui and Welch (2004), Shiller (2000), and Fisher and Statman (2000).

April 2001. The data set contains transaction data[49] at the individual level for different groups of securities. While research on individual investor behavior has predominantly focused on stock trades[50], we analyze individual investors transactions in the market for bank-issued warrants. Information about stock market returns and the traded warrants[51] are obtained from different data sources. Returns of the DAX and SDAX are from Datastream. The German online broker reported the warrant information for roughly half of the warrants traded. In addition to this data set, we obtained data from the Euwax[52], which provides data from November 1999 onwards, and from the Karlsruher Kapitalmarkt Datenbank (KKMDB), a capital markets research data base in Germany. The data sets from various suppliers make it possible to double-check our data. We combined the data sets and compared the characteristics of the warrants and did not find any discrepancies.[53] In the category "warrants", the online broker also includes structured retail products like discount certificates and reverse convertibles that are traded on the same market places as the plain-vanilla warrants. We excluded those products (3,868) which are identified as non-plain-vanilla warrants, and these (667) where the necessary information was not available (e.g. no strike price, type etc.). After matching the information about the transactions and the attributes of the warrants, we tested whether the reported total volume traded equals the number of warrants traded multiplied by the trade price. This was not the case in 78 transactions, which we excluded. We also excluded the 415 transactions in warrants that are not quoted in DEM or EUR. The remaining sample of plain-vanilla bank-issued warrant transactions consists of 103,904 transactions in 8,066 warrants from 1,499 investors (see Tables 1 and 2).

[49]The data set contains: the account number of the individuals, the date of the transaction, the security identifier (WKN), the number of securities traded, a purchase or sale indicator, the traded price per security, the transaction costs per trade, the total transaction volume, and the currency of the security.

[50]Examples are Odean (1998), Odean (1999), and Gervais and Odean (2001). Barber, Odean, and Zheng (2000) and Brown, Goetzmann, Hiraki, Shiraishi, and Watanabe (2002) looking at the transactions of individual investors in the market for mutual funds.

[51]The information consists of the type (call or put), the underlying, the strike price, the issuer, the maturity date, the style (European or American), and the conversion ratio of the warrants.

[52]The European Warrant Exchange (Euwax) is the biggest exchange for bank-issued warrants worldwide. More than half of all the warrants are issued in Germany (see Voirin (2001), p. 4) and more than 80% of all trades in Germany were executed on the Euwax (see Euwax (2001)) in 2000.

[53]In a few cases there were differences in the second position after the decimal point. These differences result from imprecise conversion from Deutsche Mark to Euro. We then kept the true value.

We divide these plain-vanilla warrants into five subcategories depending on the type of their underlying. Although the majority of warrants in the sample have a stock as underlying (56.93%), most of the transactions are in index warrants (47.71%). The remaining categories are currency, interest rate and commodity warrants (see Table 2). Since we analyze the influence of individual investor sentiment on stock market returns and vice versa, we exclude all currency, interest rate, and commodity warrants from our analysis. 6,827 warrants with stocks or indexes as underlying, accounting for 90,342 transactions made by 1,455 individuals remain.[54]

We calculate our sentiment measure from the holdings of bank-issued warrants by individual investors from a big German online brokerage. Using daily data, we identify those investors who hold call warrants and/or put warrants or neither of them. We assume that investors who hold call warrants only expect rising prices and thus show positive sentiment. The exclusive holding of puts is regarded as as sign of pessimism, i.e. negative sentiment. Investors who hold call and put warrants simultaneously as well as those who do not hold any warrants on a particular day are classified as neutral. Table 3 shows the mean and median number of investors per day in the three categories for all warrants and warrants on the DAX. We choose to also look at warrants on the DAX separately for three reasons. First, it is the underlying that by far the most warrants are traded on (see Table 4). Second, the DAX, in contrast to other underlyings, cannot be purchased directly on the stock market. Thus, it is a more symmetric decision situation when considering buying a warrant on the DAX. Third, potential insider information, no matter whether it is correct or not, is not very likely to play a role in the investment decision.

[54] 887 individual investors trade index and stock warrants, 209 trade index warrants while 361 trade stock warrants only.

We constructed our sentiment indicator as follows:

$$Sent_t(u) = \frac{Opt_t(u) - Pess_t(u)}{All_t(u)} \tag{1}$$

with $All_t(u) = Opt_t(u) + Neut_t(u) + Pess_t(u)$

and $Opt_t(u) = \sum_{i=1}^{N_t} 1_{\{Call_t(u);NOPut_t(u)\},it}$

and $Neut_t(u) = \sum_{i=1}^{N_t} 1_{\{(Call_t(u);Put_t(u))\vee(NOCall_t(u);NOPut_t(u))\},it}$

and $Pess_t(u) = \sum_{i=1}^{N_t} 1_{\{NOCall_t(u);Put_t(u)\},it}$

where $Opt_t(u)$ $(Neut_t(u); Pess_t(u))$ is the number of optimistic (neutral; pessimistic) individual investors on day t derived from holdings in warrants with u as an underlying $(u\epsilon\{All; DAX\})$. It is the sum of dummy variables that indicate the N investors who hold warrants on day t. The dummy for optimists is equal to 1 if the investor i holds at least one call warrant but no put warrant $(\{Call_t(u); NOPut_t(u)\})$ on day t. For neutral investors, the dummy is 1 if he hold calls as well as puts or if he does not hold any warrants $(\{(Call_t(u); Put_t(u)) \vee (NOCall_t(u); NOPut_t(u))\})$, and it is 1 for pessimists if an investor holds puts but no calls $(\{NOCall_t(u); Put_t(u)\})$. $All_t(u)$ is the sum of all individuals who hold the underlying u at least once during the sample period.[55] $Sent_t(u)$ is constructed as the difference of optimists minus pessimists normalized by the number of all traders in the respective period.[56] The $Sent_t(u)$ values are in the range from -1 to 1. The indicator is 1 if there are only optimists in the market and -1 if there are only pessimists. The existence of neutral investors always moves the indicator closer to 0, ceteris paribus. If the $Sent_t(u)$ is 0.5 it could, for example, mean that in that period 3 times more optimists than pessimists held warrants (no neutral investors), but it could also be that the same number of optimistic and neutral investors (no pessimists) had

[55] We do not report results for a volume-weighted sentiment indicator because the average trading volume per trade and investor is highly positively skewed (median: 1,659; mean: 2,687; STD: 3,659; skewness: 5.76), implying that there are some traders who trade high volumes per trade but many who trade small volumes. The way we specified our sentiment measure is robust against this behavior of a few wealthy individuals (see Dorn, Huberman, and Sengmueller (2004), p. 10.)

[56] This measure is very similar to the buy-ratio of Lakonishok, Shleifer, and Vishny (1992) and is used as sentiment indicator by Dorn, Huberman, and Sengmueller (2004), but they use buy and sell transactions instead of portfolio holdings.

warrants in their portfolio.[57]

The goal of this paper is to analyze the link between stock market returns and investor sentiment derived from the market for bank-issued warrants. As stock market indicators, we use the daily returns of the DAX and the SDAX. The DAX contains the shares of the 30 biggest listed German companies while the SDAX contains small companies that are listed in Germany. We chose the DAX because it is the most important market indicator in Germany and because most of the transactions in warrants have the DAX as underlying. The SDAX was chosen because theory suggests that individual investors have a stronger impact on prices of small firms. We analyze whether returns influence individual investor sentiment or if there is reverse causality indicating that sentiment influences returns. We use three methods to investigate the connection between individual investor sentiment and stock market returns.

The first method investigates whether there is a contemporaneous relation between our sentiment indicators and stock market returns. Four different cases are possible, resulting in four categories: (i) both move up (i.e. positive returns and the sentiment indicator increases), (ii) Sentiment moves up while stock market return is negative, (iii) Sentiment declines while the stock market goes up, and (iv) Sentiment and stock market both decline simultaneously. The analysis is not only carried out for the very same day but also with lags in both of the compared indicators. We include 10 lags.[58] If the sentiment indicator and stock market returns move independently, one would expect that in 50 percent of all time periods, the two indicators move in the same direction (e.g. category (i) and (iv)), while in the other 50 percent of the time periods, the indicators move in the opposite direction (e.g. category (ii) and (iii)). To test this, we create a dummy that takes the value of one if the indicators move in the same direction and zero otherwise and apply a

[57]Because $Sent_t(u)$ states a proportion only (the indicator would have the same value if there are three optimists and one pessimist or if there are 75 optimists and 25 pessimists), we constructed an additional indicator that measures the individual investor sentiment in numbers of investors. It is, in principle, the difference in the number of optimistic and pessimistic investors but adjusted to account for neutral investors. We multiplied the difference by an "adjustment factor" which is 1 if there are no neutral investors in the market and 0 if there are no optimists and no pessimists. It is the sum of optimists and pessimists divided by the number of all investors in period t. Neutrals move the indicator level towards zero. Unreported results for the so specified sentiment indicator are similar to the numbers reported in Section 5.

[58]This lag length choice is motivated by the short warrant holding periods of the investors in our data set. The median holding period is 9 days. Dorn, Huberman, and Sengmueller (2004) also find influence only in the short-run.

two-sided binomial probability test.

As a second method to investigate the relation between the sentiment measures and stock returns we estimate vector autoregressive (VAR) models. Brown and Cliff (2004) also estimate the relation between investor sentiment and near-term stock returns using VAR models. Again, 10 lags are included in our daily investigation. We estimate the following two regressions simultaneously:

$$\begin{aligned} M_t^a &= \alpha_1 + \sum_{i=1}^{P} \beta_{1i} M_{t-i}^a + \sum_{i=1}^{P} \delta_{1i} Sent_{t-i}(u) + \varepsilon_{1t} \\ Sent_t(u) &= \alpha_2 + \sum_{i=1}^{P} \beta_{2i} M_{t-i}^a + \sum_{i=1}^{P} \delta_{2i} Sent_{t-i}(u) + \varepsilon_{2t} \end{aligned} \tag{2}$$

where M^a is the return of the stock market for indicator a ($a\epsilon\{DAX, SDAX\}$) and $Sent^c(u)$ is our sentiment measure. Since Brown and Cliff (2004) showed that the absolute value of a sentiment indicator as well as the change in investor sentiment could be correlated with stock market returns, we decided to test both versions of our sentiment measure. The specification of the VAR model with the change of our sentiment measure is:

$$\begin{aligned} M_t^a &= \alpha_1 + \sum_{i=1}^{P} \beta_{1i} M_{t-i}^a + \sum_{i=1}^{P} \delta_{1i} \Delta Sent_{t-i}(u) + \varepsilon_{1t} \\ \Delta Sent_t(u) &= \alpha_2 + \sum_{i=1}^{P} \beta_{2i} M_{t-i}^a + \sum_{i=1}^{P} \delta_{2i} \Delta Sent_{t-i}(u) + \varepsilon_{2t} \end{aligned} \tag{3}$$

The βs are the coefficients for the lagged stock returns while the δs are the coefficients for the influence of the lagged sentiment indicator on the dependent variable. βs in the first equations and δs in the second equations of the VAR models 2 and 3 are coefficients for autocorrelation. P is the number of lagged periods (P = 10) while t is the respective day.

To get closer insights as to whether sentiment influences returns or returns influence sentiment we also apply Granger-causality tests.[59] The null hypothesis of this test is that all coefficients of the variables that are not lags of the dependent variable in an equation 2 type of regression are jointly zero. This would imply that there is no influence on the

[59] For details see Granger (1969).

dependent variable. Inversely, a variable Granger-causes another if the lags of this variable help to better explain the value of the dependent variable.

5 Empirical Results

5.1 Correlation of Sentiment Measures and Stock Returns

We calculated the sentiment indicators described in section 4 from the holdings of individual investors in warrants with all underlyings and warrants with the DAX alone as the underlying. A correlation analysis[60] shows that the hypothesis that the returns of the market indicators are independent from the level and changes of the sentiment measures can be rejected in most cases. This is especially true if sentiment is measured as the daily change of investors' warrant holdings. The correlation coefficients are negative in all cases, meaning that sentiment is better or changes in sentiment are positive if market returns are negative on the same day. Individual investors hold and buy more call warrants if the value of stocks decline. This is also known as contrarian behavior.[61] Whether this negative correlation exists only contemporaneously or if this is also the case for lagged values of sentiment and returns is subject to the investigations in the next sections. The sentiment measures are highly correlated with each other if both are measured either on the level (Spearman's rho 0.6564) or the change (0.6899) basis. Otherwise, the correlation is low and not significantly different from zero (see Table 5).

5.2 Comovement of Sentiment Measures and Stock Returns

To see whether changes in investor sentiment and stock market returns move in the same direction within the same period and in lagged periods, we classify the movement into the four categories described in Section 4. In Table 6, one can find an example of this classification.

[60] Spearman rank correlation coefficients are reported. We obtain qualitatively similar results when we calculate Bravais-Pearson correlations.

[61] See Kaniel, Saar, and Titman (2004).

Table 6 shows that returns of the DAX and changes in the $\Delta Sent(All)$ (lag 0 = no lag) increased simultaneously on 314 of 1,080 days and decreased together on 208 days, while they moved in different directions on 558 (284+274) days. A two-sided binomial probability test shows that the 522 (558) moves in the same (different) direction are not significantly less (more) than the 540 (1080/2) expected moves for both categories. Thus, the null hypothesis that the movements of the sentiment indicator and the stock market returns are independent cannot be rejected. In Table 7, we present the results of this analysis for all combinations of changes in our sentiment indicators with the different stock market returns. The table shows the number of simultaneous moves in the same period (lag 0) and when lags (lag 1 to lag 10) are used. "Sentiment" lag 1 to lag 10 means that the stock market returns are compared with lag 1 up to lag 10 of the sentiment indicator respectively. Table 7 shows that when market returns are lagged one and two days there exists a significant difference in simultaneous moves and moves in the opposite direction. Since a value smaller than 540 indicates that sentiment and market returns move into different directions, i.e. the correlation is negative, and all significant values are below this barrier, the results are in line with those from the former subsection. This also indicates contrarian behavior of individual investors. With the described method, we do not obtain such a significant relationship in the first two lags if the sentiment measure is the lagged variable. When this is the case, there is only mild evidence that the time series are related. Significant differences only occur if sentiment is measured from holdings in DAX warrants and if SDAX returns are considered. However, altogether the influence of sentiment on market returns seems to be low, and market returns influence changes in investor sentiment with lags of one and two days when the comovement is measured in the univariate way described above.

5.3 Mutual influence of sentiment and stock markets: VAR regression results

To get further insights into the structure of the mutual influence of sentiment and stock market returns we apply the vector-autoregressive (VAR) model described before. In Table 8 we present the results of one VAR model. Here we tested the mutual influence of DAX returns and changes in our sentiment measure that is based on transactions in warrants on all underlyings. The bold coefficients are those we are interested in, because they

show the influence of returns on sentiment and vice versa. The other coefficients are of minor interest, but one need to control for autocorrelation, because otherwise the other coefficients might be overstated. We find a small amount of autocorrelation in the first lag. Since this fact holds for all specifications of our model, for the other VAR models we only show coefficients for the lagged variables, that are no lags of the dependent variable.[62] From Tables 9 and 10 it can be seen that mutual influence is mainly present in the first two lagged periods, meaning that there exists an influence only in the very short-run. The impact from our sentiment measure on returns is significantly positive with a one period lag, no matter how our measure is specified (based on holdings in all warrants or warrants on the DAX and on a level (Table 9) or difference (Table 10) basis) and which market returns (DAX or SDAX returns) are investigated.[63] This means that, in aggregate, investors are right with their expectations, at least for the day following a change in their holdings of warrants. We detect a significantly negative influence in the second lag and thus a reversal compared to the first period, but only if sentiment is measured on the level basis. When we look at the influence of market returns on sentiment, we find that the influence is significantly negative for lags 1 and 2, no matter whether our sentiment measure is specified as level or difference indicator. These results are in line with the contrarian behavior shown in the former subsections and also found by other authors[64]. The p-values are smaller, which indicates that the influence of the returns on sentiment is stronger than it is the other way around. This effect was found by most of the other empirical studies on the comovement of sentiment and stock returns as well.[65] Additionally, we find that investor sentiment is more strongly influenced by market returns when we infer our measure from the holdings in DAX warrants than when it is calculated based on holdings in all warrants. In contrast, the influence of sentiment on market returns is stronger when our sentiment measure is based on all warrant holdings. We obtain similar results if we differentiate between the market returns. The impact of returns on sentiment seems to be slightly higher in absolute numbers but less reliable

[62] We only report βs and δs for the first 5 lags, although the VAR model is specified with 10 lags, for the reasons of lucidity and because we found no systematic significance in higher lags.

[63] Dorn, Huberman, and Sengmueller (2004) and Qui and Welch (2004) find similar results.

[64] See e.g. Kaniel, Saar, and Titman (2004). That there exists mutual influence only in the short-run was also found by Dorn, Huberman, and Sengmueller (2004).

[65] See Brown and Cliff (2004), Otoo (1999), Solt and Statman (1988), and Wang, Keswani, and Taylor (2006).

when SDAX returns are considered. However, sentiment has a stronger influence on DAX than on SDAX returns. This finding does not coincide with the conventional wisdom that individual investors have a stronger impact on small stock returns, at least if company size is a proxy for the ratio of institutional to private holdings of the shares in that company and thus for the influence of individual investors on the stock price.

5.4 Mutual influence of sentiment and stock markets: Granger-causality tests

To gain further insights into the direction and the strength of the relationship between individual investor sentiment and market returns we apply Granger-causality tests for the first two lags of both variables in all specifications.[66] Table 11 shows the results. By looking at the p-values, we find that the influence of market returns on sentiment is always stronger than vice versa. DAX returns always have a stronger influence on sentiment than SDAX returns. The results are mixed if the influence of sentiment on the returns is investigated. Sentiment has a stronger influence on DAX returns when it is measured on a change basis. This is not always the case when we use the level sentiment indicator. In this case we obtain mixed results. Another result is that mutual influence is stronger with a lag of one instead of two periods if our sentiment measure is based on changes in the holdings. The opposite is found if the sentiment is a level indicator.

5.5 Summary of the empirical results

Taking all results together, we find that there is a mutual influence of sentiment, measured as holdings of warrants, and stock market returns in the very short-run. Since warrants are held for a very short time period (median holding period is 9 days for all warrants), it is not surprising that there only exists influence in the days surrounding a change in the holdings. An additional result is that the statistical influence of market returns, especially of the main German index DAX, on sentiment is stronger than vice versa. This is also not surprising, because the main indices receive a lot of attention and thus may strongly influence beliefs of individual investors about future stock prices. However, since private

[66] We did not optimize the lag length by using information criteria, like the Akaike or Schwarz information criterion, because we wanted to investigate the influence on the following two trading days.

investors usually only hold a small portion of the shares outstanding of listed companies, their influence on prices (in comparison to institutional investors), and thus returns, might also be small. Theory suggests that the influence of individuals is greater if they hold relatively more shares in a company. When this amount is approximated by the size of the companies, we cannot confirm this prediction in our data set, because the impact of investor sentiment on DAX and SDAX returns does not differ significantly. Recent related studies show that past market returns have a strong influence on trading activity. Glaser and Weber (2005) show that the effect of past market returns on subsequent trading volume of individual investors is stronger than that of own past realized portfolio returns. Statman, Thorley, and Vorkink (2004) find that "not only does that impact of past market returns on a typical security's trading activity survive the inclusion of lagged security returns in the same regression, it appears that the lagged market return impact is actually larger"[67]. Nicolosi, Peng, and Zhu (2003) also find in their regressions that the impact of past market returns on stock purchases is stronger than the effect of past portfolio returns.[68] All these studies have in common that past returns that are highly visible to investors affect behavior more than returns that are less visible or that have to be calculated by investors themselves, such as own past realized portfolio returns or the returns of some individual stocks. Another finding is that DAX returns influence sentiment more strongly than SDAX returns. It is no surprise that past DAX returns affect trading behavior and thus our sentiment measures. In contrast to the returns of small stocks, which are aggregated in the SDAX, the DAX return is in the news every day.

5.6 Robustness and Discussion

To see whether our results are also valid for sub-samples we conducted some robustness checks. We divided the sample into different periods and repeated the VAR analysis as well as the granger causality tests (see Table 12). First, the sample was separated into a rising and a declining stock market. The bullish market period lasted from the beginning of our sample until March 7th, 2000, when the DAX reached its high with 8,064.97 points at that day's closing bell. The bearish market started the next day and lasted up to the

[67] Statman, Thorley, and Vorkink (2004), p. 22.

[68] See Nicolosi, Peng, and Zhu (2003), Table 2.

end of our sample. We additionally subdivided the sample into the single years.[69] The analysis shows that the results were qualitatively similar in all periods with regard to direction of the influence, but with a much weaker reliability in the bear market and the later years of the sample. The influence of the DAX on sentiment was significant in all periods, while the influence of the SDAX on sentiment was significant in most periods. It was not significant in the bear market, which is mainly due to the weak correlation in the year 2000. The influence of sentiment on market returns, which was weaker in the whole sample, was reliable only in the bull market. In the bear market, sentiment influenced SDAX returns but not DAX returns, which is in line with the theoretical prediction that the influence of individuals is bigger on small stock returns, what we did not find for the whole sample. All together, we found that our results are stronger in upward moving stock markets.

The specification of our sentiment measure, as shown in equation 1, might be another factor that is driving our results. We tested our models with two other specifications of our sentiment measure. First, we changed the definition of the neutral investor. In the new specification the dummy for the neutral investor becomes one, only if the investor holds call and put warrants at the same time. Thus we only consider investors that are invested in warrants on the particular day in time. The second alternative in the calculation of our measure is, that we defined the difference of optimists and pessimists as our sentiment indicator. We chose this measure to investigate whether the absolute number of investors is an important factor in our analysis. The following simple example should support this argument. While our original measure would have the same value if there are 2 optimists and 1 pessimist or if there are 200 optimists and 100 pessimists in the market, the alternative measure would indicate more positive sentiment in the latter case. But the alternative would yield the same sentiment if there are 2 and 1 or if there are 200 and 199 optimists and pessimists. Since we do not know which one is the better definition of sentiment, we modified our measure in the way described above. The VAR models with these two alternative specifications of our sentiment measure show very similar results.

Another concern about the robustness of our results is that only a few traders could drive the results in our study. By looking at the maximum trades per account in Table

[69] The year 2001 is not considered since data only exists up to mid April.

1, one can see that there is at least one person that traded more than twice per day. However, in our measure, these intra-day traders could account for only one data point per day because we are comparing the number of traders and not the volume they trade. That makes our measure less sensitive to the behavior of a few wealthy traders.[70]. We also analyzed a volume-weighted measure and obtained slightly stronger results in the same direction.[71] In addition, investors are classified as neutral if they hold call and put warrants in one period, which is more likely for investors who trade a lot. Since there are on average 531 people for all warrants, and 197 people for DAX warrants are classified as positive or negative investors (see Table 3), these intra-day traders should play only a minor role. To be sure that this is true, we excluded all those traders who trade on average more than once per day. There were 11 trader in that category, accounting for 15,009 transactions which we excluded. The results remained almost unchanged.

6 Conclusions

Several sentiment indicators have been proposed and investigated over the last 10 to 15 years. Overall, the empirical evidence for an influence of these sentiment indicators on stock market returns and vice versa is mixed. Some authors find a significant influence, others do not. In this paper we propose a measure of investor sentiment which is based on the holdings of bank-issued warrants by individual investors. Our findings contribute to the ongoing research in the sentiment literature as well as the literature of the behavior of individuals in financial markets. Additionally, we are (to our best knowledge) the first who empirically analyze investor behavior in the warrant market.

By exploiting the structure of the warrant market, we are able to construct and test a measure of individual investor sentiment. Due to a large data set from a German discount broker we can take a look at the daily individual transactions of private investors. Since warrants are traded by individual investors only, we can precisely specify the clientele we are looking at. Moreover, we can avoid the problems with different motives for buying and

[70] Dorn, Huberman, and Sengmueller (2004) specified their buy-ratio in a similar way (number of traders) while others, Kaniel, Saar, and Titman (2004) and Kumar and Lee (2002) among them, used a volume buy-ratio

[71] Results are not reported here, because we think that looking at the number of investors instead of the volume they trade gives us the better measure of investor sentiment.

selling transactions since call and put warrants can be traded for the same transaction costs, and thus, individual investors can symmetrically bet on rising and falling prices of the underlying. Furthermore, we are looking at actual transactions where the investors put their own money at stake. This is an advantage over survey-based sentiment measures that might be biased since people could have an incentive not to reveal their true beliefs, depending on the interpretation and impact of the sentiment measure on stock prices.

We test the mutual relationship of our sentiment measure with stock market returns in a VAR model and with Granger-causality test. We find that there exists such a relationship, but only in the very short-run (one to two trading days). The influence of stock market returns on sentiment is negative and stronger than it is the other way around where the influence is positive. We only find weak evidence for the hypothesis that sentiment influences small stock returns more strongly than big stock returns as it was suggested by other authors.

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Table 1: Online Investors Warrant Transactions

Observations as well as transactions per account and transactions per warrant are numbers, the other figures are in EUR.

	obs.	mean	std.dev.	median	min.	max.
all transactions						
transactions per account	1,499	69.3	176.8	21	1	2,533
transactions per warrant	8,066	12.9	30.0	4	1	620
transaction costs per transaction	103,904	19.2	21.8	12.2	0	645.3
purchases						
volume per transaction	57,031	4,376.0	10,659.0	1,838.7	5.4	511,937.1
sales						
volume per transaction	46,873	5,198.1	12,062.5	2,060.7	0	295,914.5
call purchases						
volume per transaction	41,881	4,406.7	10,611.7	1,828.7	5.4	281,813.5
call sales						
volume per transaction	33,701	5,405.7	12,352.7	2,113.9	0	237,130.4
put purchases						
volume per transaction	15,150	4,291.2	10,788.4	1,868.8	9.0	511,937.1
put sales						
volume per transaction	13,172	4,666.9	11,269.2	1,941.0	0	295,914.5

Table 2: Warrant Categories

		warrants		transactions	
type of underlying	traders	frequency	percent	frequency	percent
stock warrants	1,248	4,592	56.93	40,772	39.24
index warrants	1,096	2,235	27.71	49,570	47.71
currency warrants	801	1,067	13.23	11,808	11.36
interest rate warrants	117	95	1.18	441	0.42
commodity warrants	167	77	0.95	1,313	1.26
total	1,499	8,066	100	103,904	100

Table 3: Classified Warrant Holders Per Trading Day

		Optimists		Pessimists		Neutrals	
underlying	investors	mean	median	mean	median	mean	median
All	1,455	453.6	441	92.9	90	908.5	912
DAX	944	115.1	114	91.5	83	737.4	738

Table 4: The Ten Most Traded Underlyings (456 Underlyings Overall)

	warrants		transactions	
underlying	frequency	percent	frequency	percent
DAX 30	1,212	17.75	36,734	40.66
S&P 500	173	2.01	3,150	3.47
Commerzbank	238	3.49	2,689	2.98
Dow Jones 30	134	1.96	2,355	2.61
Nasdaq 100	170	2.49	2,282	2.53
SAP	178	2.61	1,804	2.00
Nikkei 225	129	1.89	1,634	1.81
Deutsche Bank	142	2.08	1,612	1.78
Volkswagen	129	1.89	1,491	1.65
Nemax 50	184	2.70	1,415	1.57
total	2,689	39.39	55,166	61.06

Table 5: Spearman Rank Correlation of the Time Series

This table shows Spearman's rho and the respective p-values for the hypothesis that the two time series are independent. * indicates significance at the 10 % level, ** indicates significance at the 5 % level, and *** indicates significance at the 1 % level.

	$Sent(All)$	$\Delta Sent(All)$	$Sent(DAX)$	$\Delta Sent(DAX)$	Return DAX	Return SDAX
$Sent(All)$	1					
$\Delta Sent(All)$	0.0361	1				
	0.2356					
$Sent(DAX)$	0.6564***	-0.0479	1			
	0.0000	0.1155				
$\Delta Sent(DAX)$	0.1100***	0.6899***	0.0474	1		
	0.0003	0.0000	0.1195			
Return DAX	-0.0722**	-0.0856***	-0.0272	-0.2392***	1	
	0.0178	0.0049	0.3725	0.0000		
Return SDAX	-0.0994***	-0.1062***	-0.0637**	-0.1839***	0.4526***	1
	0.0011	0.0005	0.0364	0.0000	0.0000	

Table 6: Example for Categories (DAX Returns; $Sent^d(All)$; lag=0)

lag 0		DAX	
		increase	decrease
$\Delta Sent(All)$	increase	314	284
	decrease	274	208

Table 7: Univariate Comovement of Sentiment and the Stock Market Indicators

This table shows the number of periods (days) in which the change of the sentiment indicators and the returns of the market indicators go in the same direction. The table presents results for the changes in the sentiment indicator based on holdings in all (column 2 and 3) as well as in DAX (column 4 and 5) warrants. Market indicators are DAX and SDAX returns. Lag 0 indicates that we compare the change of the sentiment indicators and the returns of the market indicators on the same day. Lag 1 to lag 10 indicate that we analyze the intertemporal relation between sentiment and market indicators with lags of one to ten days, respectively. Lag 1 to lag 10 of our sentiment measure describe the cases in which we compare current market indicators with the lagged sentiment indicator, i.e. the sentiment indicator one to ten days before. L1 to L10 of DAX and SDAX describe the cases in which we compare current sentiment indicators with lagged market indicators. We test the null hypothesis that the numbers presented are equal to 540 (1080 days divided by 2), using a binomial probability test. * indicates significance at the 10 % level, ** indicates significance at the 5 % level, and *** indicates significance at the 1 % level.

	$\Delta Sent(All)$		$\Delta Sent(DAX)$	
	DAX	SDAX	DAX	SDAX
lag 0	522	511*	454***	483***
Sentiment				
lag 1	543	556	551	524
lag 2	533	534	559	534
lag 3	531	526	517	498**
lag 4	534	529	540	521
lag 5	546	515	539	508*
lag 6	540	541	543	522
lag 7	527	516	548	539
lag 8	548	515	545	534
lag 9	533	548	545	530
lag 10	531	536	553	500**
Market Returns				
lag 1	456***	508*	438***	472***
lag 2	486***	528	446***	502**
lag 3	538	554	520	520
lag 4	564	552	542	528
lag 5	537	550	487***	524
lag 6	563	546	557	530
lag 7	569*	563	541	531
lag 8	548	556	560	550
lag 9	561	565	563	575**
lag 10	534	519	516	521

Table 8: Example for Results of one Vector Autoregressive Model

The reported βs, δs, and p-values are from the VAR model with 10 lags. The dependent variables are the DAX returns and changes in our sentiment indicator, that is based on holdings in all underlyings.

$$M_t^a = \alpha_1 + \sum_{i=1}^{P} \beta_{1i} M_{t-i}^a + \sum_{i=1}^{P} \delta_{1i} \Delta Sent_{t-i}(u) + \varepsilon_{1t}$$

$$\Delta Sent_t(u) = \alpha_2 + \sum_{i=1}^{P} \beta_{2i} M_{t-i}^a + \sum_{i=1}^{P} \delta_{2i} \Delta Sent_{t-i}(u) + \varepsilon_{2t}$$

The bold coefficients show the influence of the lagged value of one indicator on the other indicator. The other coefficients show potential autocorrelation. *** (**, *) indicates significance on the 1% (5%, 10%) level.

	Dependent variable			
	DAX return		ΔSent(All)	
	Coefficient	p-value	Coefficient	p-value
DAX return				
$\beta_{\bullet 1}$	0.051	(0.096)*	**-0.059**	(0.000)***
$\beta_{\bullet 2}$	-0.020	(0.532)	**-0.034**	(0.000)***
$\beta_{\bullet 3}$	-0.014	(0.664)	**-0.012**	(0.096)*
$\beta_{\bullet 4}$	0.015	(0.652)	**0.004**	(0.596)
$\beta_{\bullet 5}$	-0.009	(0.792)	**-0.002**	(0.793)
$\beta_{\bullet 6}$	-0.038	(0.242)	**0.006**	(0.396)
$\beta_{\bullet 7}$	-0.075	(0.020)**	**0.004**	(0.627)
$\beta_{\bullet 8}$	-0.007	(0.822)	**0.005**	(0.466)
$\beta_{\bullet 9}$	-0.034	(0.292)	**0.007**	(0.356)
$\beta_{\bullet 10}$	0.028	(0.380)	**0.001**	(0.890)
ΔSent(All)				
$\delta_{\bullet 1}$	**0.507**	(0.000)***	0.064	(0.038)**
$\delta_{\bullet 2}$	**-0.070**	(0.615)	0.042	(0.180)
$\delta_{\bullet 3}$	**-0.116**	(0.403)	0.042	(0.178)
$\delta_{\bullet 4}$	**-0.152**	(0.273)	0.037	(0.232)
$\delta_{\bullet 5}$	**-0.141**	(0.310)	0.009	(0.785)
$\delta_{\bullet 6}$	**0.087**	(0.530)	-0.023	(0.468)
$\delta_{\bullet 7}$	**-0.175**	(0.207)	0.013	(0.675)
$\delta_{\bullet 8}$	**0.003**	(0.984)	-0.012	(0.700)
$\delta_{\bullet 9}$	**-0.191**	(0.162)	0.014	(0.645)
$\delta_{\bullet 10}$	**0.037**	(0.780)	0.047	(0.114)
Constant	0.001	(0.069)*	0.000	(0.017)**
R2	0.032		0.1168	

Table 9: Vector Autoregressive Model Results - Level

The reported βs, δs, and p-values are from the VAR model with 10 lags. The dependent variables are the market index returns and the level of our sentiment indicator.

$$M_t^a = \alpha_1 + \sum_{i=1}^{P} \beta_{1i} M_{t-i}^a + \sum_{i=1}^{P} \delta_{1i} Sent_{t-i}(u) + \varepsilon_{1t}$$
$$Sent_t(u) = \alpha_2 + \sum_{i=1}^{P} \beta_{2i} M_{t-i}^a + \sum_{i=1}^{P} \delta_{2i} Sent_{t-i}(u) + \varepsilon_{2t}$$

We only report βs and δs for the first five lags for the reason of lucidity. For the same reasons we do not report coefficients for these variables that are lags of the dependent variable. The first two columns specify the combination of the different sentiment measures with the two market return indicators on which the mutual influence is measured by the VAR model. *** (**, *) indicates significance on the 1% (5%, 10%) level.

		Influence Returns on Sentiment					Influence Sentiment on Returns				
Sentiment	Returns	β_{21}	β_{22}	β_{23}	β_{24}	β_{25}	δ_{11}	δ_{12}	δ_{13}	δ_{14}	δ_{15}
$Sent(All)$	DAX	-0.0607***	-0.0348***	-0.0139	0.0027	-0.0035	0.4880***	-0.5756***	-0.0454	-0.0363	0.0105
		0.0000	0.0000	0.0548	0.7136	0.6264	0.0004	0.0043	0.8227	0.8576	0.9586
$Sent(All)$	SDAX	-0.0738***	-0.0346**	0.0122	-0.0253	0.0171	0.1941***	-0.2851***	0.0834	-0.0881	-0.0596
		0.0000	0.0284	0.4426	0.1110	0.2796	0.0016	0.0021	0.3709	0.3440	0.5214
$Sent(DAX)$	DAX	-0.0970***	-0.0543***	-0.0112	-0.0023	-0.0090	0.4536***	-0.4145***	-0.1099	-0.0545	-0.1511
		0.0000	0.0000	0.2784	0.8203	0.3855	0.0000	0.0072	0.4787	0.7255	0.3307
$Sent(DAX)$	SDAX	-0.1215***	-0.0603***	0.0228	-0.0595	0.0148	0.1164**	-0.1406**	0.0078	-0.0639	-0.0522
		0.0000	0.0060	0.3004	0.0069	0.5025	0.0115	0.0455	0.9128	0.3677	0.4612

Table 10: Vector Autoregressive Model Results - Changes

The reported βs, δs, and p-values are from the VAR model with 10 lags. The dependent variables are the market index returns and changes in our sentiment indicator.

$$M_t^a = \alpha_1 + \sum_{i=1}^{P} \beta_{1i} M_{t-i}^a + \sum_{i=1}^{P} \delta_{1i} \Delta Sent_{t-i}(u) + \varepsilon_{1t}$$
$$\Delta Sent_t(u) = \alpha_2 + \sum_{i=1}^{P} \beta_{2i} M_{t-i}^a + \sum_{i=1}^{P} \delta_{2i} \Delta Sent_{t-i}(u) + \varepsilon_{2t}$$

We only report βs and δs for the first five lags for the reason of lucidity and because coefficients with larger lags are not significant. For the same reasons we do not report coefficients for these variables that are lags of the dependent variable. The first two columns specify the combination of the different sentiment measures with the two market return indicators on which the mutual influence is measured by the VAR model. *** (**, *) indicates significance on the 1% (5%, 10%) level.

		Influence Returns on Sentiment					Influence Sentiment on Returns				
Sentiment	Returns	β_{21}	β_{22}	β_{23}	β_{24}	β_{25}	δ_{11}	δ_{12}	δ_{13}	δ_{14}	δ_{15}
$\Delta Sent(All)$	DAX	-0.0591***	-0.0335***	-0.0121	0.0038	-0.0019	0.5071***	-0.0695	-0.1157	-0.1517	-0.1407
		0.0000	0.0000	0.0956	0.5964	0.7932	0.0002	0.6155	0.4027	0.2734	0.3099
$\Delta Sent(All)$	SDAX	-0.0708***	-0.0313**	0.0148	-0.0231	0.0213	0.2024***	-0.0857	-0.0007	-0.0910	-0.1485
		0.0000	0.0470	0.3480	0.1430	0.1785	0.0010	0.1685	0.9908	0.1430	0.0168
$\Delta Sent(DAX)$	DAX	-0.0960***	-0.0531***	-0.0094	-0.0014	-0.0070	0.4542***	0.0410	-0.0697	-0.1236	-0.2758***
		0.0000	0.0000	0.3629	0.8944	0.4959	0.0000	0.6974	0.5080	0.2420	0.0090
$\Delta Sent(DAX)$	SDAX	-0.1179***	-0.0559**	0.0261	-0.0558	0.0202	0.1215***	-0.0236	-0.0124	-0.0805	-0.1272***
		0.0000	0.0109	0.2354	0.0112	0.3603	0.0083	0.6135	0.7901	0.0847	0.0064

Table 11: Granger-causality Tests

This table reports the F-statistics of the Granger-causality test between our sentiment measures and stock market returns. Results in Panel A and Panel B are for lags of one and two periods. Column 1 indicates which warrants are used to calculate the sentiment measure. Column 2 shows the direction of the influence. Column 3 and 5 report the F-statistic and Columns 4 and 6 the respective p-values. "Level" and "Change" refer to the way the sentiment measure is constructed. The tested hypothesis is that the indicator named first in the column "Direction of Influence" does not influence the indicator named after the arrow.

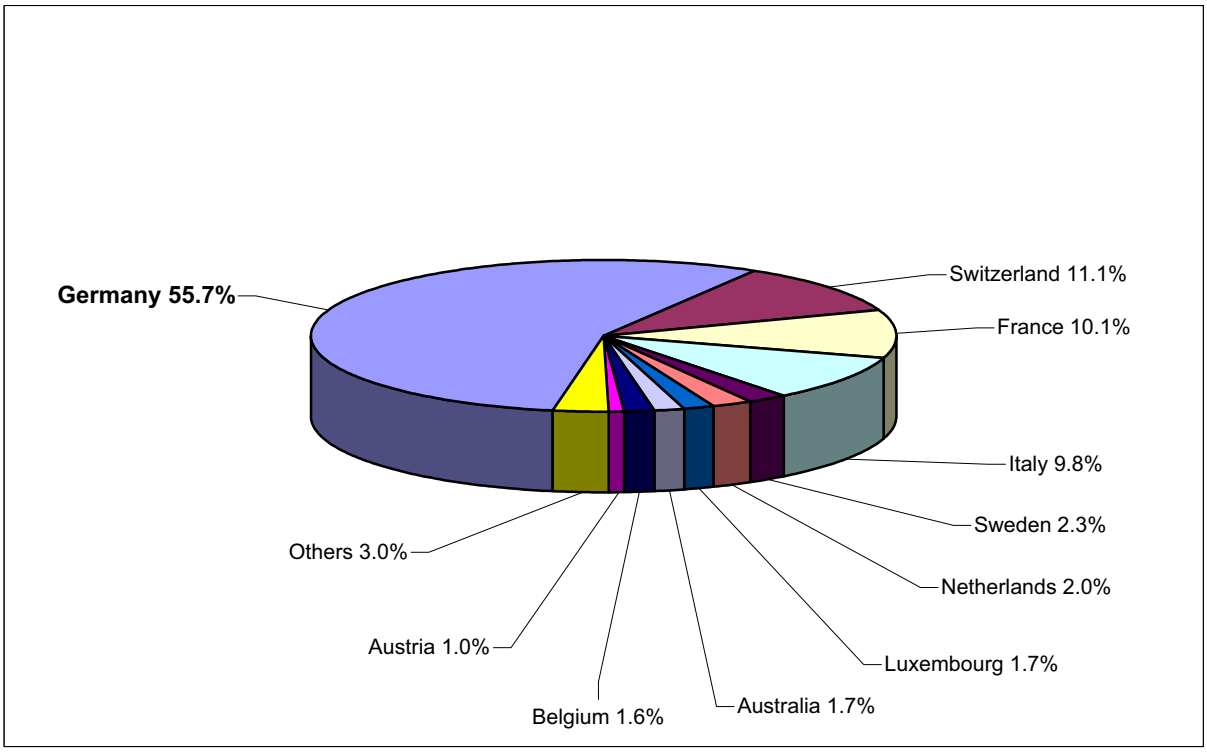
Warrants	Direction of Influence	Level		Change	
Panel A: 1 lag					
All	Sent → DAX	3.03	0.0818	15.44	0.0001
	DAX → Sent	80.69	0.0000	71.29	0.0000
	Sent → SDAX	8.84	0.0030	8.87	0.0030
	SDAX → Sent	31.19	0.0000	22.71	0.0000
DAX	Sent → DAX	0.00	0.9535	22.14	0.0000
	DAX → Sent	121.45	0.0000	93.99	0.0000
	Sent → SDAX	3.10	0.0780	5.38	0.0205
	SDAX → Sent	56.97	0.0000	36.44	0.0000
Panel B: 2 lags					
All	Sent → DAX	8.24	0.0003	6.77	0.0012
	DAX → Sent	49.35	0.0000	49.43	0.0000
	Sent → SDAX	9.06	0.0001	6.30	0.0019
	SDAX → Sent	14.94	0.0000	14.07	0.0000
DAX	Sent → DAX	9.71	0.0001	9.68	0.0001
	DAX → Sent	61.52	0.0000	60.81	0.0000
	Sent → SDAX	4.75	0.0088	3.66	0.0260
	SDAX → Sent	22.17	0.0000	20.91	0.0000

Table 12: Granger-causality Tests Through Time

This table reports the F-statistics of the Granger-causality test with a lag of two periods between the changes in our sentiment measures and stock market returns. Column 1 indicates which warrants are used to calculate the sentiment measure. Column 2 shows the direction of the influence. Under the F-statistic one can find the respective p-values. The results in Columns 3 and 4 are granger causalities for the rising ("bull") stock market from 01/02/1997 to 03/07/2000 and the declining ("bear") market from 03/08/2000 to 04/12/2001. Columns 5 to 8 report results for single years. Year 2001 is not considered since data only exists up to middle of April. The tested hypothesis is that the indicator named first in the column "Direction of Influence" does not influence the indicator named after the arrow.

Warrants	Direction of Influence	Bull market	Bear market	1997	1998	1999	2000
All	Sent → DAX	6.51	0.72	3.38	2.91	3.05	1.10
		0.0016	0.4863	0.0355	0.0563	0.0490	0.3349
	DAX → Sent	43.92	3.46	23.37	13.07	6.12	16.31
		0.0000	0.0327	0.0000	0.0000	0.0026	0.0000
	Sent → SDAX	4.75	3.31	2.63	3.53	0.41	2.53
		0.0089	0.0382	0.0744	0.0307	0.6628	0.0820
	SDAX → Sent	15.73	0.01	6.63	5.73	3.64	0.82
		0.0000	0.9867	0.0016	0.0037	0.0278	0.4404
DAX	Sent → DAX	9.45	1.00	3.84	1.84	6.50	0.67
		0.0001	0.3709	0.0229	0.1613	0.0018	0.5122
	DAX → Sent	45.09	8.36	26.09	19.53	7.23	14.53
		0.0000	0.0003	0.0000	0.0000	0.0009	0.0000
	Sent → SDAX	3.70	4.17	3.18	2.89	0.15	0.73
		0.0252	0.0164	0.0435	0.0577	0.8636	0.4827
	SDAX → Sent	19.54	2.16	5.92	8.13	3.98	1.49
		0.0000	0.1175	0.0031	0.0004	0.0199	0.2276

Figure 1: Listed Warrants on Exchanges Worldwide in the Year 2000



Source: International Warrant Institute (I.W.I.)

Nr.	Author	Title
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