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BEHAVIORAL PREFERENCES FOR INDIVIDUAL SECURITIES: THE CASE FOR CALL WARRANTS AND CALL OPTIONS

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Behavioral Preferences for Individual Securities: The Case for Call Warrants and Call Options

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Abstract

Since 1998, large investment banks have flooded the European capital markets with issues of call warrants. This has led to a unique situation in the Netherlands, where now call warrants, traded on the stock exchange, and long-term call options, traded on the options exchange, exist. Both entitle their holders to buy shares of common stock. We use the long-term call options in order to price the call warrants. Using the model of Black and Scholes (1973), the Square Root model version of the Constant Elasticity of Variance model of Cox and Ross (1976), and the Binomial model of Cox et al. (1979) we find that the call warrants are strongly overvalued during the first five trading days. The average overvaluation is between 25 and 30 percent for all three models. Only a small part of this overvaluation can be explained by rational arguments such as transaction costs. We conclude that the overvaluation can be attributed to a behavioral preference of private investors for call warrants.

1 Introduction

Since 1998 the European capital markets have been flooded with a large number of issues of call warrants. Three large international investment banks, i.e. the American Citibank, the German Commerzbank, and the French Societe Generale Acceptance, have made most of these issues. Call warrants are especially popular in European countries with less developed options exchanges. In March 2000, no less than 8,000 different call warrants were outstanding on German exchanges[1]. According to the Dutch financial newspaper *Het Financieele Dagblad* of January 24, 2002 in October 2001, 830 call warrants were outstanding on Euronext Brussels and even 4,952 on Euronext Paris[2]. The popularity of call warrants is also large in the Netherlands. The last mentioned article in *Het Financieele Dagblad* mentions that in October 2001 no less than 1,047 call warrants were outstanding on Euronext Amsterdam. This is remarkable, since the Netherlands has a very large options exchange that has been operational since the 1970s. In November 2001 the German Commerzbank estimated the total value of call warrants issued on the European exchanges to be more than 200 billion US dollars. This has led to an interesting situation in the Netherlands. Call warrants are traded in a special segment of the stock exchange, Euronext Amsterdam. Besides that, long-term call options are traded on the options exchange of Amsterdam, the Euronext Derivatives Market of Amsterdam. In many cases, the call warrants and the call options entitle their holders to buy the same common stocks. Since the call warrants and the call options are almost identical, they should carry the same prices. However, in the financial press it is regularly suggested that call warrants are overvalued compared to call options on the same stock[3]. We test whether this is really the case by studying the pricing of call warrants given the prices of long-term call options. Furthermore, we study which factors can be responsible for a different pricing of call warrants and call options. The financial press also regularly suggests that investors perceive call warrants being different from call options. This is based on the different image that call warrants have compared to call options. Our null hypothesis is that call warrants and call options are priced efficiently in relation to each other. That is, in so far as there are price differences between call warrants and call options, they can be explained by rational factors such as transaction costs. Our alternative hypothesis is that the price difference between call warrants and call options can be explained by behavioral factors.

Call warrants are series of call options issued by banks on specific underlying values. The name *warrant* is misleading as they are traditionally defined as rights issued by a company to buy a certain number of *new* shares in this company during a specific period (the exercise period) at a specific price (the exercise price)[4]. Another party than the company of the underlying shares

[1] Source the Dutch financial newspaper Het Financieele Dagblad of March 18, 2000.

[2] Euronext Brussels and Paris are the respective stock exchanges of Brussels and Paris that, together with the stock exchange of Amsterdam Euronext Amsterdam, have merged into Euronext.

[3] See e.g. Het Financieele Dagblad of June 20, 1998: "Beurshausse leidt tot te dure warrants" (transl. Bull market leads to overpriced warrants) or Het Financieele Dagblad of June 16, 2001: "Warrant belegger moet op de kleintjes letten" (transl. Warrant investor should watch his steps).

[4] See e.g. Galai (1977).

generally issues call warrants. Moreover they entitle the holder to buy or sell *existing* shares rather than *new* shares. Call warrants are also different from options-exchange call options, from now on to be referred to as call options. Differences include the fact that the number of contracts is fixed, the credit risk is not borne by the clearing house of the options exchange and it is not possible for other parties to write call warrants. In the remainder of this paper we will refer to these call warrants either by the term "call warrant" or simply "warrant". The securities that are traditionally referred to as warrants will from now on by referred to as "traditional warrants".

The history of call warrants in the Netherlands started in 1986 with the issuance of so-called FALCONS Royal Dutch by Robeco[5]. After this first issue they were issued under a number of different names in the Netherlands, such as covered warrants and EAGLES[6]. In the period of 1986 until 1997 only 32 call warrants were issued in the Netherlands[7]. The issuance of call warrants really took off in June 1998 with the issuance of a number of call warrants by the German Commerzbank. The call warrants issued since then have different underlying values. These include large Dutch stocks, large foreign stocks (e.g. Nokia and Amazon.com), national and international indexes (e.g. the DAX index and the Nikkei index), and baskets of stocks. The market for call warrants in the Netherlands is strongly dominated by a few large banks. For example, according to the official newspaper of Euronext Amsterdam, *De Officiële Prijscourant van de Effectenbeurs*, on November 13, 2001 in total 877 call warrants were outstanding. Of these call warrants, 94 (11%) were issued by the Dutch ABN Amro Bank, 85 (10%) were issued by the American Citibank, 291 (33%) were issued by the German Commerzbank and 361 (44%) were issued by the French Societe Generale Acceptance. The remaining 46 (5%) call warrants were issued by a number of smaller parties, mainly other Dutch banks. This underlines the international character of the market for call warrants.

Despite the large extent of the market for call warrants, there is hardly any empirical research available on the pricing of these securities. Veld and Verboven (1995) compare the prices of Dutch equity warrants and long-term call options. They find that the equity warrants are systematically overpriced compared to the long-term call options. However, the equity warrants in their comparison are mostly traditional equity warrants. Only one of the warrants in their sample was a call warrant as described above. Chan and Pinder (2000) compare the pricing of call warrants and call options on the Australian market. They find that warrants are 1.30 to 5.02% overpriced to electronically traded options and that they are 7.50 to 10.63% overpriced compared to floor-traded options. From their empirical analysis they conclude that the overpricing of warrants compared to options can be explained by the liquidity premium in the warrant market.

The most important result of our study is that on the first five trading days, the call warrants were on average overvalued by more than 30%. This result holds for all three models that we test, i.e. the model of Black and Scholes (1973), the Square Root version of the Constant Elasticity of Variance model of Cox and Ross (1976), both corrected for continuous dividend payments, and

[5] FALCONS is an abbreviation of "Fixed Term Agreements for Long Term Call Options on Existing Securities".

[6] EAGLES is an abbreviation of "Euro-issued American-style Geared Letters Exchangeable for Shares".

[7] See Duffhues and Veld (1997) for an overview.

the Binomial model of Cox et al. (1979) with discrete dividend payments. Furthermore, we find that 99% of the warrants are overvalued. A small part of the overvaluation can be explained from the difference in transaction costs. It is not possible to arbitrage the overvaluation away, since it is not possible to short the warrants[8]. However, it still remains strange that investors are willing to pay much more for call warrants than for almost identical call options. We conclude that the overvaluation can be explained by a behavioral preference of private investors for call warrants.

The remainder of this paper is organized as follows. In Section 2 we describe the methodology and the data set. In Section 3 the most important results are discussed. The possible explanations for the overvaluation are presented in Section 4. In Section 5 we present the results of a questionnaire that we have sent to the CentERpanel of CentERdata. This panel consists of 2,000 households in the Netherlands that are weekly surveyed on a variety of subjects. The paper concludes with Section 6 in which the summary and conclusions are presented.

2 Data description and methodology

2.1 Methodology

The methodology that we use in this paper consists of the comparison of model and market prices on the issuance date and the immediate period thereafter of the call warrants. Previous empirical research on the pricing of traditional warrants generally concludes that the model of Black and Scholes (1973) and the Square Root model of Cox and Ross (1976), both corrected for dividend payments, are the most suitable models for the pricing of traditional warrants[9]. Both call warrants and traditional warrants are in fact long-term call options. For that reason it is likely that the models that are suitable for the pricing of traditional warrants are also most fit for the pricing of call warrants[10].

Both the Black/Scholes and the Square Root model are special cases of the Constant Elasticity of Variance model (CEV-model). In the CEV-model, the price of the underlying common stock is assumed to follow a constant elasticity of variance process, which has the form:

$$dS/S = \mu dt + \delta S^{(\Psi-2)/2} dZ,$$

where:

S = price of the underlying stock;
μ = expected rate of return on the stock;
Ψ = elasticity factor;
Z = Wiener process.

[8] The reason for this is that the exchange does not allow short positions in call warrants.

[9] See e.g. Shastri and Sirodom (1995), Lauterbach and Schultz (1990), and Hauser and Lauterbach (1996, 1997). A complete overview of empirical research on warrant pricing can be found in Veld (2002).

[10] An important difference between traditional warrants and call warrants is that the exercise of a traditional warrant leads to the creation of new shares. Research of Schulz and Trautmann (1994) has shown that this effect can be ignored when pricing traditional warrants.

The instantaneous standard deviation of the percentage return (or volatility), σ, is given by the equation:

$$\sigma = \delta S^{(\Psi-2)/2}$$

When Ψ equals 2, the volatility is a constant, δ, and the stochastic process generating returns is a lognormal diffusion process, the process assumed in the Black/Scholes option-pricing model.

Cox and Ross (1976) drop the assumption of a constant volatility and instead focus their attention on the case that: $0 \leq \Psi < 2$. In this case the volatility decreases as the stock price increases. This inverse relationship can especially be explained by financial leverage arguments. As the stock price falls, the market value of the firm's debt will also fall because of an increased perception of bankruptcy. The decrease in the market value of equity will be larger than the decrease in the market value of debt, which produces a rise in the firm's debt-to-equity ratio. This increase in financial leverage causes an increase in the risk of the equity, which leads to a rise in the stock's volatility. According to Beckers (1980) a similar effect can be observed if the firm has almost no debt. Since every firm faces fixed costs, which have to be met irrespective of its income, a decrease in income will decrease the value of the firm and at the same time increase its riskiness.

As a special case of the general CEV-model, Cox and Ross (1976) present the Square Root model, this model has a parameter value Ψ of 1. The formula for the Square Root model can be derived from by substituting the value 1 for the factor Ψ in the general equation of the CEV-model. This model is called the Square Root model because it assumes that the volatility is inversely related to the square root of the stock value.

As mentioned above, we use both the models of Black and Scholes (1973) and the Square Root model of Cox and Ross (1976) for the calculation of call warrant model prices. Given the long maturity of the call warrants we use dividend corrected versions of both models. Dividends are assumed to be paid continuously as first derived by Merton (1973). When we refer to the model of Black and Scholes (1973) or the Square Root model of Cox and Ross (1976) in the remainder of this paper, we mean the versions of these models that are corrected for continuous dividend payments. Both the call warrants and the call options are American that is they can be exercised from the issuance date until the expiration date. Merton (1973) has shown that it can be rational to exercise an American call option (warrant) before an ex-dividend date. This effect is not incorporated in the model of Black and Scholes (1973) and the Square Root model. For this reason we also use the Binomial model of Cox et al. (1979). In the limit case this model converges into the model of Black and Scholes (1973). The advantage of the Binomial model is that it allows the incorporation of discrete dividend payments, thus allowing for the possibility of early exercise.

2.2 Data description

We analyze the prices of call warrants that were issued on Euronext Amsterdam in the period from January 1, 1999 to December 31, 2001. Call warrants are identified from the Dutch financial newspaper *De Officiële Prijscourant van*

de Effectenbeurs, an official publication of the stock and options exchanges in Amsterdam. Information on the warrants expiration date, exercise price and the warrant-ratio (this is the number of warrants that are needed to buy one share of common stock) are all derived from Datastream. The warrants are issued by trade. Therefore, there is no explicit issue price for the warrants. The banks generally publish indicative issue prices, however they do not bind them. The actual issue price is the first trading price of the warrants. In order to avoid our research to be dominated by outliers we use information on the first five days that the warrants are traded. A trading day is defined as a day on which Datastream reports a positive trading volume for the warrant. We restrict ourselves to the analysis of call warrants on individual companies for which there are also long-term call options outstanding on the options exchange in Amsterdam. In the period from January 1, 1999 to December 31, 2001 we identify a total of 275 call warrants for which there are also long-term call options outstanding.

2.3 Estimation of the variables

All three models require six variables. The first four variables are the same for all three models, i.e. (1) the price of the underlying stock (S); (2) the exercise price (X); (3) the remaining time to maturity (T), and (4) the risk-free interest rate (r). Variables (1), (2) and (3) can be observed directly. The fourth variable, the risk-free interest rate can be approximated as the average yield on a government bond with the same maturity as the call warrant. Since all call warrants have a maturity that is around 2 years, we estimate the risk-free interest rate as the average yield on government bonds with a maturity of 2 years[11]. In addition, the model of Black and Scholes (1973) and the Square Root model require the dividend yield. This is also available from Datastream. The Binomial model requires the discrete dividend payment (D) that will be paid during its remaining maturity. We estimate the discrete dividend as the last dividend payment before the first trading date. This discrete dividend is also obtained from Datastream[12]. The final variable that has to be estimated for all three models is the standard deviation of the returns on the underlying stocks, commonly referred to as the volatility. We use the implied standard deviations of long-term call options that are traded on the same stocks in order to estimate this variable. There is a problem here in the sense that usually the maturity and the exercise price of the call warrants are different from the maturity and the exercise price of the long-term call options. This causes a problem because the volatility is different between maturities. Brenner and Subrahmanyam (1988) refer to this phenomenon as the "term structure of volatility". Besides that, Hull (2003, page 334-336) notes that volatilities for equity options are different between exercise prices. In general, the volatility decreases as the exercise price increases. The volatility used to price a low- exercise price option is significantly higher than that used to price a high-exercise price option. In order to calculate

[11] See e.g. Hull (2003, page 247) for a justification of this estimate of the risk-free interest rate. A number of other option pricing studies use the same estimate, see e.g. Roberts et al. (2002).

[12] In reality dividend payments show a growing pattern. However, it is difficult to derive an objective growth rate for the dividend payment. We have experimented with several growth rates and we find that our results are fairly robust if we use a growth rate instead of a constant dividend payment. These results are on request available from the authors.

a useful volatility we use a "volatility surface" in the spirit of Hull (2003, page 336-337). All of the above mentioned variables are acquired from Datastream. The following example illustrates our procedure for the calculation of a weighed implied volatility.

Example:

By means of example we look at the warrant "Ahold". The underlying stock of this warrant is the share "Ahold". The following information is known about this warrant:

Issue date:	March 6, 2000
Exercise date:	March 25, 2002
Exercise price (X):	25 Euro
Number of shares per warrant:	10
Time-to-maturity (T):	2.03 year
First day of trade with positive volume:	March 13, 2000
Closing price on first trading day:	0.47 Euro
Share price (S):	22.8 Euro
Interest rate (r):	4.55%
Dividend yield (g):	2.15%

On March 13, 2000 a large number of call options on the shares of Ahold are outstanding on the options exchange. We select the call options that are closest to the call warrants in terms of the exercise price and the remaining time to maturity. Two of these options have an exercise price that is lower than the exercise price of the call warrants. Two other options have an exercise price that is equal to or higher than the exercise price of the call warrants. At the same time, two of the options have a remaining time to maturity that is shorter than that of the warrants and two others have a remaining time to maturity that is equal to or longer than that of the warrants. With regard to these options we calculate implied volatilities using the model of Black and Scholes (1973):

Call oct01	X1 = 22.70	T1 = 1.60 year	price = 4.70	imp1 vol: 39.12%
Call oct01	X2 = 31	T2 = 1.60 year	price = 1.85	imp2 vol: 35.13%
Call oct02	X3 = 22.70	T3 = 2.60 year	price = 5.95	imp3 vol: 39.57%
Call oct02	X4 = 29.50	T4 = 2.60 year	price = 3.50	imp4 vol: 36.53%

The following equations are used in order to arrive at a weighted implied volatility of the different options:

$$shortvol = \frac{|X1 - X|}{X2 - X1} * imp2 + \frac{|X2 - X|}{X2 - X1} * imp1$$

$$longvol = \frac{|X3 - X|}{X4 - X3} * imp4 + \frac{|X4 - X|}{X4 - X3} * imp3$$

$$wghtimp = \frac{|T1 - T|}{T3 - T1} * longvol + \frac{|T3 - T|}{T3 - T1} * shortvol$$

shortvol represents the calculation of the implied volatility of the short-term options and *longvol* represents the calculation of the implied volatility of

the long-term options, and $wghtimp$ represents the calculation of the weighted implied volatility of the two series.

With regard to the warrants that we are analyzing this means:

$$shortvol = \frac{|22.7 - 25|}{31 - 22.7} * 0.3513 + \frac{|31 - 25|}{31 - 22.7} * 0.3912 = 0.3801$$

$$longvol = \frac{|22.7 - 25|}{29.5 - 22.7} * 0.3653 + \frac{|29.5 - 25|}{29.5 - 22.7} * 0.3957 = 0.3854$$

$$wghtimp = \frac{|1.60 - 2.03|}{2.60 - 1.60} * 0.3854 + \frac{|2.60 - 2.03|}{2.60 - 1.60} * 0.3801 = 0.3823$$

Using this weighted implied volatility we calculated the model price of the warrant. This appears to be 43.21 Eurocents, while the market price is 47 Eurocents. Therefore, we conclude that this warrant is overpriced.

2.4 Sample selection

The selection of the final sample is presented in Table 1.

[Please insert Table 1 here]

The research is restricted to call warrants that were issued in the period from January 1, 1999 to December 31, 2001. Only warrants on underlying shares on which also long term call options are available are taken into account. In total 275 call warrants fulfill this condition. Price data are derived from Datastream. With regard to 35 call warrants no information is available in Datastream. Therefore these warrants are eliminated from our sample. The information on the warrants conditions is also derived from Datastream. This information is verified using the original issuance prospectuses of the call warrants. The latter are available on the website of Euronext Amsterdam (aex.nl) and on the websites of the issuing banks. In five cases we find conflicting information between Datastream and the issuance prospectuses. Since it is not possible to retrieve the correct information at the issuance dates, we eliminate these five observations. A problem that may occur is that the option, warrant and stock markets are not synchronous on the first trading day of the warrant. In other words, the last trade of the warrant, the option and the stock will probably occur at different times. In order to minimize this problem we average the difference between the market and model prices of each warrant for the first five trading days. A trading day is defined as a day on which the trading volume of the warrant is positive. Trading days are only taken into account if at least one call option with a longer maturity and one call option with a shorter maturity than the warrant are traded, i.e. have a positive trading volume. This leads to the elimination of 28 observations. Warrants are only included if during the first 10 trading days at least five days can be found on which the earlier mentioned two options are traded. This leads to the elimination of 96 observations. The final sample consists of 111 observations. It should be noted that four underlying stocks are not included at all in the final sample. This is mostly caused by the fact that there is not enough liquidity in the options. Therefore there are not enough warrant trading days on which also options are being traded.

2.5 Summary statistics

The summary statistics of our sample are presented in Table 2.

[Please insert Table 2 here]

In Table 2 the summary statistics are presented for the different issuers. All call warrants in our sample are issued by either the Dutch ABN Amro bank or by one the following foreign issuers: Citibank, Commerzbank and Societe Generale Acceptance. ABN Amro bank is referred to as issuer A. The foreign issuers are indicated as B to D. The average warrant price in Panel A, based on a warrant-ratio of 0.1, is 0.55. The average maturity of the call warrants is close to 2 years (1.71 years). The average warrant-ratio is 0.13. On the trading days, the warrants are actively traded, with an average trading volume of 7,518 warrants and a median of 4,000 warrants. In Panel B the summary statistics are presented for the warrants that are priced with four options[13]. The results in Panel B are largely the same as in Panel A.

3 Results

The overvaluation of each warrant is calculated as:

$$Overvaluation = ((marketprice - modelprice)/modelprice) * 100\%$$

If the outcome of this calculation is smaller than 0, there is of course no overvaluation, but an undervaluation instead.

The overvaluation is first calculated for the model of Black and Scholes (1973). As mentioned before, this model is corrected for continuous dividend payments according to the method presented by Merton (1973). The overvaluation per underlying share is presented in Table 3.

[Please insert Table 3 here]

In Panel A the overvaluation is presented for the whole sample. From this panel it can be concluded that on average warrants are overvalued with more than 31%. The average overvaluation is significantly different from zero at the 1%-level. It has to be noticed that the overvaluation is not only statistically, but also economically significant. The pricing of the call warrants is not based on some historical estimate for the volatility, but is based on the implied volatility of long-term call options that have similar exercise prices and maturities as the call warrants. In this context an overpricing of more than 31% is very remarkable. If we look at the individual underlying stocks, we see that the overpricing is significantly different from zero at the 1%-level for all stocks for which at least four observations are available. The median overvaluation from Panel A is 26%. This is also significantly different from zero at the 1%-level[14]. In total 110 out of 111 warrants (99%) are overvalued. The total range runs

[13] The sub-sample includes the warrants for which on at least one of the five trading days at least four options are available.

[14] The significance of the medians is tested using the Binomial sign test.

from an undervaluation of 10% to an overvaluation of 138%. The results in Panel A are partly caused by some large outliers. Some of these may be caused by the use of less than four options for the pricing of the call warrants. In such cases, the possibility exists that the warrants are priced using implied standard deviations from options that have much higher or much lower exercise prices. For this reason we present separate results for the warrants that are priced with four options. These results are included in Panel B. The average overvaluation in Panel B is somewhat lower, but is still more than 29%. The median overvaluation drops to 25%. This median is still significantly different from zero at the 1%-level. In Table 4 the overpricing is presented for the Square Root model. This model is also corrected for continuous dividend payments.

[Please insert Table 4 here]

The results for the Square Root model strongly resemble the results for the Black/Scholes model. In Panel A we can see that the average overpricing is more than 38%. The average overpricing is significantly different from zero at the 1%-level. The individual stocks, for which at least four observations are available, are also overpriced. In all cases, the overpricing is significantly different from zero at the 1%-level. The median overpricing is 30% and is significantly different from zero at the 1%-level. The results for the Square Root model show even more variation than the Black/Scholes model for warrants that are priced using less than four options. In Panel B we present the results for the warrants that are valued with 4 options. The average overpricing decreases to 30%. The median overpricing for the sub-sample is 28%.

In order to make sure that our results are not driven by the use of a continuous dividend yield, rather than discrete dividend payment, we have also calculated the overpricing for the Binomial model of Cox et al. (1979). In theses calculations we include discrete dividend payments in the model. The results for this model are included in Table 5.

[Please insert Table 5 here]

The results for both panels in Table 5 confirm the earlier results for the Black/Scholes and the Square Root models. The average overpricing for the whole sample is more than 29%. This overpricing is significantly different from zero at the 1%-level. The average overpricing for the sub-sample of warrants that are priced using four options is 28%. This average is also different from zero at the 1%-level. The median overpricing for the whole sample and the sub-sample are respectively 26% and 24%. Both are significantly different from zero at the 1%-level.

4 Possible explanations for the overvaluation

4.1 The issuer's perspective

The arrangement between the warrant issuing parties and Euronext Amsterdam is such that the issuing parties pay a price of 5 Eurocents to Euronext each time that they change the price of the warrant. The fact that the issuer has to pay Euronext for each price change gives an incentive for the issuing party to keep

their prices constant. Given this need for constant prices it is not surprising that the warrant issuing parties keep fairly high prices for their warrants. This way a potential loss can be avoided. However, this still does not explain why warrant buyers are usually willing to pay higher prices for warrants than for almost identical call options.

We expected a priori that the prices of the foreign issuers would be higher than of the Dutch issuer, because the foreign parties have to make more costs to operate on the Dutch market. This hypothesis is tested in Table 6 where we perform a regression analysis of the overpricing on each of the three foreign issuers.

[Please insert Table 6 here]

The regression analysis in Table 6 is carried out for the overpricing for the Black/Scholes, the Square Root model and the Binomial model. Besides that, we perform the regression analysis for both the complete samples and the sample of warrant prices that are calculated with all four options. In all six cases, we find that the warrants from issuer C are significantly more overpriced than the warrants of the Dutch issuer. For issuers B and D we also find the expected significant coefficient. However, the coefficients for both issuers are only significant in the regressions for the complete samples. The significance completely disappears in the regressions for the sub samples.

A priori we also expected that overpricing would be negatively correlated to the warrant trading volume. The idea being that a larger batch would be sold for a lower price. However, the regression analysis in all six panels shows that the reverse relationship is true. The log of the trading volume is positively related to the overpricing, indicating that a higher trading volume is associated with a higher overpricing. This relationship is significant in five out of the six panels.

4.2 Transaction costs

When trying to explain the overvaluation it is important to keep in mind that the buyers of the warrants are generally private investors. According to the Dutch financial newspaper *Het Financieele Dagblad* of January 24, 2002, more than 70% of the warrant buyers consist of private persons. In the practitioners literature it is often mentioned that for private persons the transaction costs are lower for call warrants than for long-term call options. It is not possible to make a direct comparison of the transaction costs. The reason for this is that they are charged differently for call warrants and call options. Transaction costs for call options are charged per contract. Each contract allows its holder to buy 100 shares of common stock. Transaction costs for warrants are charged in the same way as for shares. That is a (small) fixed amount is charged as well as a percentage of the market value of the order (in Euros). This means that for call warrants there is no direct relationship with the number of shares that can be bought. Both for call warrants and for call options different amounts apply between orders placed by phone and Internet orders.

The independent Dutch Internet company "Belegger.nl" compares transaction costs for a number of large Dutch banks. Based on the information supplied on their web page (per February 19, 2002) we compare transaction costs between

call warrants and call options. The results for this comparison are included in Table 7.

[Please insert Table 7 here]

The minimum order for which transaction costs for shares and warrants are presented on this web page is 1,000. This is the basis for our comparison. In Table 7 we compare transaction costs for four different scenarios. In all scenarios we consider call warrants with a warrant-ratio of 0.1. That is 10 call warrants are needed to buy one share of common stock. We consider four cases: in the first case the warrant price is 0.10 Euro. In the second case it is 0.20 Eurocent, in the third case it is 0.5 Euro and in the fourth case it is 1 Euro.

In scenario 1 we assume that the warrant price is 0.10 Euro. The order size of 1,000 Euros would allow the warrant investor to buy 10,000 warrants. If she would like to take a similar position using options, she would have to buy 10 option contracts. In that case also 1,000 shares can be bought by exercising the option (10 contracts of 100 shares each). The transaction costs for the warrants are presented in columns (2) and (3) of Table 7. The warrant transaction costs vary between 12 and 19 Euro for phone trade and between 10 and 15 Euro for Internet trade. The transaction costs for buying 10 option contracts are presented in columns (4) and (5). The option transaction costs vary between 39 and 71 Euro for phone trade and between 32 and 52 Euro for Internet trade. With regard to these transaction costs it has to be noticed that the actual difference in most cases has to be doubled. Investors first have to buy the warrants or the options and if things go well they have to exercise or sell them. In columns (6) and (7) we present the difference of the transaction costs of the call warrants and the call options as a percentage of the warrant price. From Table 7 it can be concluded that the largest difference is for phone trade by ABN Amro (71 Euro minus 15 Euro is 56 Euro). If this amount is expressed in the price per warrant it is 0.56 Eurocents per warrant. For a round-trip (buy and sell) the amount is doubled and it is 0.0112 Euro (= 1.12 Eurocents) per call warrant. In columns (8) and (9) we present the transaction costs as a percentage of the warrant price. In the example of ABN Amro the difference of 0.0112 Euro is divided by the warrant price of 0.1 Euro, resulting in a percentage difference of 11.2%. Based on this example it could be concluded that the difference in transaction costs between call warrants and call options is large. However, three remarks are in order. First it has to be remarked that the phone trade of ABN Amro is the most extreme case. The difference for both the phone and the Internet trade of Binck is only 26 Euro, which for a round-trip comes down to 0.0052 Euro per warrant, resulting in a percentage difference of only 5.2% per call warrant. Second, it can be noticed that scenario 1 is the most extreme scenario. From Table 2 it can be concluded that the average normalized warrant price is 0.55 Euro, with a median value of 0.47 Euro. Third, even the most extreme transaction cost difference is much smaller than the price difference. Given an average price difference between 25 and 30 percent, the price difference expressed in the price per warrant is between 2.5 and 3 Eurocents.

In scenario 2 we assume that the warrant price is 20 Eurocents. The warrant holder needs 10 warrants to buy one share. Assuming an order size of 1,000 Euro, the investor would buy 5,000 warrants. A similar position can be acquired by buying 5 option contracts. In that case also 500 shares can be bought by

exercising the option. The transaction costs for the warrants remain unchanged. The reason for this is that the order size, which determines the transaction costs, is the same. These transaction costs are presented in columns (2) and (3) in scenario 2 of Table 7. The transaction costs for buying 5 option contracts are presented in columns (4) and (5). As in the previous scenario, the difference in transaction costs per warrant (for a round-trip) are presented in columns (6) and (7). Columns (8) and (9) present the transaction costs difference per warrant as a percentage of the warrant price. The largest difference is for phone trade by ING Bank (34 Euro minus 12 Euro is 22 Euro). If this amount is expressed in the price per warrant it is 0.0044 Eurocents per warrant. For a round-trip the amount is doubled and it is 0.88 Eurocents per warrant. Expressed in the price per warrant this would be 4.4%[15]. The difference in transaction costs between call warrants and call options is still large. However, again it is much smaller than the price difference of 25-30% per warrant.

In scenario 3 we assume that the warrant price is 0.5 Euro. The warrant holder needs 2 warrants to buy one share. Assuming an order size of 1,000 Euro, the investor would buy 2,000 warrants. A similar position can be acquired by buying 2 options contracts. The transaction costs for the warrants remain unchanged. From columns (8) and (9) of scenario 3 it can be concluded that in this case the difference in transaction costs is negligible. In some cases they are even lower for options than for warrants. The same conclusion can be reached from scenario 4.

Although not reported in this paper we have also investigated the transaction costs for larger order sizes in order to see whether the difference in transaction costs diminishes for larger order sizes. We find that this is not the case. The difference in transaction costs remains to be virtually the same[16],[17].

Even though transaction costs cannot explain the full overpricing of the call warrants, it is still possible that they explain a part of the overpricing. In that case we should find a negative relationship between the normalized warrant price and the overpricing. This hypothesis is tested in Table 6. In this table we regress the overpricing on the normalized warrant price. We do indeed find a significantly negative relationship between overvaluation and the normalized warrant price. This significantly negative relationship is found for all three models. In all cases it is confirmed for the whole sample as well as for the sub-sample. An alternative way to test this hypothesis is by regressing the overvaluation on the moneyness (defined as the ratio of the stock price and the exercise price). The hypothesis is that a higher moneyness is associated with a lower overvaluation. This significantly negative relationship is also confirmed in all six regressions. Therefore, it can be concluded that transaction costs can explain a (small) part of the overvaluation.

[15] 0.0088 Euro divided by a warrant price of 0.2 Euro.

[16] These results are available on request from the authors.

[17] The Internet company Belegger.nl does not give information on warrant orders smaller than 1,000 Euros. It may be possible that the transactions cost differences are larger for such orders. However, it will still not explain the full price difference between call warrants and call options.

4.3 Flexibility

Another advantage of warrants for private investors is that is easier to start trading warrants than it is to start trading options. In order to trade options it is necessary to sign a special option agreement with a bank or a broker. This is not necessary for warrants. Warrants are also more flexible, since they allow an investor to trade in small amounts. A single option contract entitles its holder to buy 100 shares. Most warrants that are traded have a warrant-ratio that is lower than 1. For example, one warrant "Ahold", mentioned in the example in section 2, entitles its holder to buy one tenth of a share. This means that warrants make it easier to trade in small amounts. Further, a warrant investor has more flexibility. For example, it is possible for her to buy rights to acquire 150 shares. This is not possible with options. We test whether this flexibility difference affects the overpricing. The hypothesis is that more flexibility, i.e. a lower warrant-ratio, is associated with higher overpricing. In the regressions in Table 6 we find the expected negative relationship between overpricing and the warrant-ratio. However, this relationship is only significant in the regressions for the Square Root model and the Binomial model. It is not significant for the model of Black and Scholes (1973).

4.4 Bid-ask spread of options

Both in the trading of call warrants and call options bid and ask prices are used. In our regressions we only use closing prices, since intraday prices are not available. The closing prices may be bid or ask prices. Since we use information on the first five trading days for the warrants, the closing prices are very likely to be ask prices. In case of the options, the closing price may have been a bid or an ask price. It is highly unlikely that this difference is capable of explaining the overpricing of the warrants. The reason for this is that the standard bid-ask spread for options on Euronext Amsterdam is much less than the overpricing of the warrants of almost 30%. Besides that, it is equally likely that the closing price is a bid or an ask price. Therefore we do not believe that a significant part of the overpricing can be explained from this source.

4.5 No possibility for arbitrage

Even though the warrants are overpriced it is not possible for investors to directly profit from this. The reason is that it is not possible to write the warrants and/or go short in them. Therefore, direct arbitrage is not possible. In this sense the case for call warrants and call options is much like the case described by Lamont and Thaler (2001). They study equity carve-outs in US technology stocks. They find a number of cases in which holders of a share of company A are expected to receive x shares of company B. However, the price of A is less than x times the price of B. Due to short sale constraints this mispricing is not eliminated through arbitrage. Lamont and Thaler (2001) argue that the lack of arbitrage possibilities means that the market is still efficient. However, they argue (page 4): *"Still, this is market efficiency with very wrong prices"*.

4.6 Behavioral motives

Standard finance theory is built on the assumption that investors are indifferent between financial instruments that have the same cash flows. Shefrin and Statman (1993) take a stand against this assumption and argue that some investors prefer one financial product to another because of the way in which identical cash flows are framed. They attribute the success of covered calls to the ability of financial institutions to frame the cash flows of covered calls in such a way that they are appealing to different types of investors. The case that is presented in this paper goes one step further. Call warrants and call options not only give the same cash flows, they are almost identical financial instruments. Yet, they are traded at different prices, because they are labeled differently. The reason for this is most likely that private investors probably perceive warrants being different from options. For example, the financial newspaper *Het Financieele Dagblad of March 16, 2001 writes (translated): "New this year is the large attention for warrants (..). This product, a kind of option, has the advantage that the risk is limited to the original investment. With options, investors have the possibility to engage in the obligation to buy or to sell, which gives an unlimited risk. With this as a given, banks hope to convince investors who do not want to participate on the "dangerous" options exchange".* Sem van Berkel, an important trader on Euronext Amsterdam in the magazine for the options exchange, Rokin 5, already made a similar statement in 1995. Van Berkel wrote (translated): *"Warrants go better with the smart set than options. You can explain as often as you like that options are used to hedge risks, but you still often hear that clients have heard or read something about them that they don't like. It is different with warrants. Apparently it sounds less spooky".* The issuing banks also actively try to establish a different image for call warrants compared to call options. In the Dutch financial newspaper *Het Financieele Dagblad* of March 18, 2000, a manager of one of the warrant issuing banks argues: *"Warrants are for investors who find stocks too boring and options too wild and complicated".* In this context it also has to be remarked that the issuing banks actively advertise investing in warrants. According to *Het Financieele Dagblad* of January 24, 2002 Euronext Amsterdam is also going to start a marketing campaign for investing in warrants. This is probably also caused by the fact that the exchange generates revenues from warrant trading as outlined in the beginning of this section[18]. Since there is hardly any advertising for options, the large popularity of the warrants may also partly be explained by the active marketing of this financial product. Hirshleifer (2001) argues that person-to-person and media contagion of ideas is important. He argues that people tend to conform to the judgments and behaviors of others. At least two of the large banks that are active in the Dutch warrant market are very active in organizing seminars. They both organize their own seminars and they give lectures at investment clubs and at the major exchange "Geldzaken" *("Money Affairs")* that is held annually in the Netherlands. Such places are excellent sources for the contagion of ideas. We consider this contagion to be the most probable explanation for the overpricing of call warrants in relation to call options. The issuing parties

[18] Besides the 5 Eurocents mentioned in the beginning of this section for each price change, the exchange collects 1,000 Euro per listed warrant and 500 Euro for each year that the warrant is listed. Finally, the exchange directly collects transaction costs from parties that buy warrants.

on the warrant market apparently have managed to create an image for call warrants that is different from the image of call options. After the first group of private investors adapted this new instrument it most likely spread to other private persons, thereby creating a niche for call warrants as a *unique* financial instrument.

5 Use of a questionnaire to investigate the possible explanations.

In order to further investigate the possible explanations that were put forward in section 4, we have submitted a questionnaire to the CentERpanel. This panel, which is administered by CentERdata of Tilburg University, consists of 2,000 households in the Netherlands. The members of these households fill in a questionnaire at their home computers every week[19]. The CentERpanel is representative of the Dutch population. In May 2002 we have submitted a questionnaire to this panel on the choice between call options and call warrants. This questionnaire is included in the Appendix. Unfortunately, the number of respondents that were interested in call options and/or call warrants was fairly low. In total 41 respondents indicated that they recently bought and/or were interested in buying call options and/or call warrants. It is useful to notice here that people in the Netherlands are much less interested in investing, outside savings accounts and/or the principal residence, than e.g. people in the United States or the United Kingdom. According to information from CentERdata only 16% of the respondents have investments in stocks.

In the first two questions the respondents were asked whether they either bought call warrants (call options) during the last year or whether they were considering buying call warrants (call options) in the year to come. A total of 39 households answered this question affirmative for call options. A mere 19 households gave a positive answer for call warrants. We asked the households that bought both and/or considered both how the factors described in the previous section influenced their choice. We also asked the persons that indicated only to buy call warrants or call options which factors played a role for them to only buy or consider call warrants (call options) and not to buy or consider call options (call warrants). Since only two respondents for call warrants answered the question, we have not included these results in our paper. The results for the other two questions are included in Table 8.

[Please insert Table 8 here]

The first question in Table 8 deals with the choice between call warrants and call options. This question was directed at the respondents who both bought or were interested in buying call warrants and call options. A score of 4 for one of the factors means that the respondent is neutral for this factor between call warrants and call options. A score lower than 4 means that the respondent has a preference for call warrants and a score higher than 4 means a preference for call options. The average scores for this question are all around 4. Strangely enough, recommendations of friends and acquaintances scores relatively high for

[19] More information on the CentERpanel can be found at http://www.centerdata.kub.nl.

call options (4.25). As can be expected, the flexibility in determining the number of buying rights gives the highest score for call warrants (3.71). However, all scores are very close to the neutral score of 4.

The second question in Table 8 is directed at the respondents that are interested in buying call options, but not in buying call warrants. A relatively high score for this question means that this factor is very important for the respondent in her preference for call options over call warrants. The factor with the highest average score is the price of the product on the market (4.62). This might indicate that the investors in call options realize that call warrants are overpriced compared to call options. Surprisingly, the second highest score is for the risk of the product (4.60). This is remarkable, since we would a priori expect that call options would be associated with a higher risk. Investors in call options indicate that they are not strongly influenced by the publicity in newspapers and magazines (3.14) and recommendations of friends and acquaintances (2.18). This is in line with our expectations, since we would expect these factors to lead to high scores for call warrants (see section 4). The factor transaction costs also gives a low score (2.95). This is also not surprising, since in some circumstances transaction costs are higher for call options than for call warrants. The overall picture is that the questionnaire confirms our results from section 4.

6 Summary and conclusions.

Since 1998 the European capital markets have witnessed a large growth in the number of issues of call warrants. These call warrants are issued by a small number of large investment banks. We study the pricing of call warrants in the Dutch capital market. The reason to choose for the Dutch market is that the options exchange in Amsterdam also features the trading of long-term call options. This allows us to price the call warrants contingent on the pricing of these call options. We find that on the first trading date more than 99% of the warrants are largely overvalued. Only a small part of the overpricing can be attributed to rational factors. For example, we find that transaction costs are lower for call warrants that are relatively cheap compared to other call warrants with the same warrant ratio. However, we also find that this argument only applies to a small part of our sample. Besides that, even in the most extreme cases, the transaction cost difference can only explain an overpricing of 5-11%, while the average overvaluation is between 25 and 30 percent. The lack of arbitrage possibilities explains that the overpricing cannot be arbitraged away. However, this still leaves us with the question why investors are willing to pay more for call warrants than for almost identical call options. We find that the answer lies in behavioral motives. Apparently, financial institutions have managed to create an image for call warrants that is different from call options. This image is responsible for the overpricing of call warrants in relation to call options.

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A Questionnaire submitted to the CentERpanel

1. Did you buy call warrants during the last year or are you considering to buy call warrants in the year to come? (yes, no)

2. Did you buy call options during the last year or are you considering buying call options in the year to come? (yes, no)

   - If the answer to both questions 1 and 2 is yes, you can proceed to question 3.
   - If the answer to question 1 is yes, and the answer to question 2 is no, you can proceed to question 4.
   - If the answer to question 1 is no, and the answer to question 2 is yes, you can proceed to question 5.
   - If the answer to both question 1 and question 2 is no, the questionnaire is finished for you.

3. Suppose that you have a choice between a call warrant and a call option that both entitle to buy the same share of common stock. Can you please indicate on a scale how the following factors influence you choice? (0 = no opinion; 1 = very strong preference for call warrant; 4 = neutral; 7 = very strong preference for call option):

   - transaction costs
   - flexibility in determining the number of buying rights
   - price of the product on the market
   - recommendations of friends and acquaintances
   - risk of the product
   - publicity in newspapers and magazines
   - size of the bid-ask spread

4. How much do the following factors play a role for you in your decision to buy or to consider call warrants, but not to buy or consider call options? Can you please indicate on a scale how the following factors influence you choice? (0 = no opinion; 1 = does not play any role; 7 = plays a very important role):

   - transaction costs
   - flexibility in determining the number of buying rights
   - price of the product on the market
   - recommendations of friends and acquaintances
   - risk of the product
   - not in the possession of an option agreement
   - publicity in newspapers and magazines
   - size of the bid-ask spread

5. How much do the following factors play a role for you in your decision to buy or to consider call options, but not to buy or consider call warrants? Can you please indicate on a scale how the following factors influence you choice? (0 = no opinion; 1 = does not play any role; 7 = plays a very important role):

   - transaction costs
   - price of the product on the market
   - recommendations of friends and acquaintances
   - risk of the product
   - publicity in newspapers and magazines
   - size of the bid-ask spread

Table 1: Sample selection This table presents the selection of call warrants for our sample. The call warrants and the underlying stocks are identified from the official newspaper of the Amsterdam Stock Exchange, De Officiele Prijscourant van de Effectenbeurs. Column (1) presents the underlying stocks. Column (2) presents all the call warrants that were issued on Euronext Amsterdam in the period from January 1, 1999 to December 31, 2001 on underlying shares on which also long-term call options are available. Column (3) gives the call warrants for which there is no price information available in Datastream. The call warrants that are eliminated because there is conflicting information between different data sources are included in column (4). Call warrants for which we do not have at least five trading days available are presented in column (5). Column (6) gives the call warrants for which it is not possible to find at least five days during the first ten trading days of the call warrant on which not at least both a call option with a longer maturity and a call option with a shorter maturity are being traded. Finally, column (7) gives the final sample.

Underlying stock	Original sample	No price information in Datastream	Conflicting issuance information	Less than 5 trading days	Not enough options available	Final sample
(1)	(2)	(3)	(4)	(5)	(6)	(7)
ABN Amro	18	3			2	13
Aegon	17	3			6	8
Ahold	11	1			1	9
Akzo	12	2		2		8
ASML	25	5			8	12
DSM	5	1			1	3
Elsevier	15	1		2	1	11
Fortis	13	2	3	5	3	0
Getronics	23	2		6	7	8
Heineken	8			3	5	0
ING	22	4	2	1	5	10
KPN	26				22	4
Numico	13	2		1	8	2
Philips	24	5		1	9	9
Royal Dutch	13	2		1	2	8
TNT Post	4			1	3	0
Unilever	5					5
UPC	15	2		5	7	1
Wolters Kluwer	6				6	0
Total	275	35	5	28	96	111

Table 2: Summary statistics This table presents the summary statistics of the Dutch call warrants issued between January 1, 1999 and December 31, 2001. Call warrants are only included if they are at least traded during five trading days (these are days with a positive trading volume). Trading days are only taken into account if at least one call option with a longer maturity and one call option with a shorter maturity than the warrant are traded. Furthermore, call warrants are only included if during the first 10 trading days at least five days can be found on which the earlier mentioned two options are traded. The call warrants and the underlying stocks are identified from the official newspaper of the Amsterdam Stock Exchange, De Officiele Prijscourant van de Effectenbeurs. The normalized call warrant price represents the price to buy 0.1 share of common stock. The warrant ratio is the number of shares that can be bought with one call warrant. The moneyness is the ratio of the stock price and the exercise price on the first trading date. The price of the underlying stock, the exercise price, the time to maturity, the trading volume of the warrants, the warrant price and the warrant ratio are derived from Datastream. Issuer A refers to the only Dutch issuing bank (ABN Amro). Issuers B, C, and D refer to the foreign issuers. The information on the full sample is presented in Panel A. In Panel B information is presented on the call warrants that are priced using four call options.

Panel A : full sample	Issuer				
	A	B	C	D	Total
Number of warrants	26	32	41	12	111
Avg. warrant price (norm)	0.55	0.53	0.53	0.69	0.55
Med. warrant price (norm)	0.51	0.44	0.4	0.68	0.47
Avg. maturity	1.41	1.68	2.02	1.33	1.71
Med. Maturity	1.48	1.78	1.65	1.41	1.58
Avg. warrant ratio	0.09	0.11	0.12	0.37	0.13
Med. warrant ratio	0.1	0.1	0.1	0.2	0.1
Avg. trading volume	6516	5966	9717	6314	7518
Med. trading volume	4000	4179	5280	2883	4000
Avg. moneyness	0.9	0.87	0.8	0.89	0.85
Panel B : valuation based on 4 options	Issuer				
	A	B	C	D	Total
Number of warrants	13	19	21	6	59
Avg. warrant price (norm)	0.46	0.55	0.65	0.87	0.6
Med. warrant price (norm)	0.36	0.45	0.65	0.76	0.53
Avg. maturity	1.4	1.7	1.95	1.25	1.67
Med. Maturity	1.39	1.84	1.65	1.38	1.6
Avg. warrant ratio	0.09	0.11	0.09	0.27	0.12
Med. warrant ratio	0.1	0.1	0.1	0.2	0.1
Avg. trading volume	11133	5044	6654	6638	7121
Med. trading volume	7857	4160	3920	2767	4160
Avg. moneyness	0.89	0.87	0.85	0.97	0.88

Table 3: Overpricing of the Dutch call warrants for the Black/Scholes model This table presents the overpricing of the Dutch call warrants issued between January 1, 1999 and December 31, 2001. The overpricing is calculated as the average overpricing over the first five trading days of the warrants. Trading days are only taken into account if at least one call option with a longer maturity and one call option with a shorter maturity than the warrant are traded. Warrants are only included if during the first 10 trading days at least five days can be found on which the earlier mentioned two options are traded. The call warrants and the underlying stocks are identified from the official newspaper of the Amsterdam Stock Exchange, De Officiele Prijscourant van de Effectenbeurs. The overpricing is defined as the difference between the market price of the warrant and the model price divided by the market price. Model prices are calculated using the model of Black and Scholes (1973) corrected for continuous dividend payments. The price of the underlying stock, the exercise price, the dividend yield, and the time to maturity of both the options and the warrants are derived from Datastream. The risk-free interest rate is estimated as the average yield on government bonds with a maturity of 2 years (also from Datastream). The volatility of the warrants is defined as the implied volatility of long term call options on the same stocks. The different implied volatilities are weighted in such a way that the options that are closest to the call warrants in terms of exercise price and time to maturity get the highest weight. The information on the full sample is presented in Panel A. In Panel B information is presented on the call warrants that are priced using four call options. The significance of the averages is tested using a t-statistic. The significance of the medians is tested using the Binomial sign test. *** = significant at the 1%-level; ** = significant at the 5%-level; * = significant at the 10%-level.

Panel A : full sample							
Stock	war.	Average	St.dev.	Min.	Max.	Med.	pos.
ABN Amro	13	29.29***	14.35	3.24	58.13	28.87***	13
Aegon	8	35.35***	15.8	22.16	64.82	27.11***	8
Ahold	9	33.62***	27.15	7.38	95.98	29.41***	9
Akzo	8	17.22***	9.91	1.86	35.67	15.67***	8
ASML	12	23.24***	10.41	8.33	40.91	20.33***	12
DSM	3	6.15	14.76	-9.88	19.17	9.17	2
Elsevier	11	33.70***	21.09	5.18	79.23	31.10***	11
Getronics	8	43.45***	39.84	19.66	138.36	26.04***	8
ING	10	28.97***	13.78	10.05	51.57	28.14***	10
KPN	4	36.36***	24.94	13.01	67.36	24.94	4
Numico	2	69.74*	55.51	30.49	109	69.74	2
Philips	9	29.74***	14.57	12.89	51.85	26.46***	9
Royal Dutch	8	29.91***	21.96	5.84	73.28	26.53***	8
Unilever	5	29.91***	16.09	6.82	46.6	34.75**	5
UPC	1	23.59		23.59	23.59	23.59	1
Total	111	31.35***	20.15	-9.88	138.36	25.55***	110

Panel B : valuation based on 4 options							
Stock	war.	Average	St.dev.	Min.	Max.	Med.	pos.
ABN Amro	9	24.10***	10.47	3.24	35.76	25.44***	9
Aegon	6	36.22***	17.35	23.81	64.82	27.11**	6
Ahold	3	18.44**	12.45	8.5	32.41	14.42	3
Akzo							
ASML	11	23.91***	10.64	8.33	40.91	20.39***	11
DSM							
Elsevier	3	26.39***	9.37	15.83	33.7	29.66	3
Getronics	5	51.16**	49.76	19.66	138.36	28.82**	5
ING	5	25.38***	16.15	10.05	51.57	19.45**	5
KPN	4	36.36***	24.94	13.01	67.36	32.53	4
Numico							
Philips	5	32.70***	11.9	16.75	43.95	39.38**	5
Royal Dutch	2	28.38***	5.08	24.79	31.97	28.38	2
Unilever	5	29.91***	16.09	6.82	46.6	34.75**	5
UPC	1	23.59		23.59	23.59	23.59	1
Total	59	29.71***	19.65	3.24	138.36	24.96***	59

Table 4: Overpricing of the Dutch call warrants for the Square Root model This table presents the overpricing of the Dutch call warrants issued between January 1, 1999 and December 31, 2001. The overpricing is calculated as the average overpricing over the first five trading days of the warrants. Trading days are only taken into account if at least one call option with a longer maturity and one call option with a shorter maturity than the warrant are traded. Warrants are only included if during the first 10 trading days at least five days can be found on which the earlier mentioned two options are traded. The call warrants and the underlying stocks are identified from the official newspaper of the Amsterdam Stock Exchange, De Officiele Prijscourant van de Effectenbeurs. The overpricing is defined as the difference between the market price of the warrant and the model price divided by the market price. Model prices are calculated using the Square Root version of the Constant Elasticity of Variance model of Cox and Ross (1976) corrected for continuous dividend payments. The price of the underlying stock, the exercise price, the dividend yield, and the time to maturity of both the options and the warrants are derived from Datastream. The risk-free interest rate is estimated as the average yield on government bonds with a maturity of 2 years (also from Datastream). The volatility of the warrants is defined as the implied volatility of long term call options on the same stocks. The different implied volatilities are weighted in such a way that the options that are closest to the call warrants in terms of exercise price and time to maturity get the highest weight. The information on the full sample is presented in Panel A. In Panel B information is presented on the call warrants that are priced using four call options. The significance of the averages is tested using a t-statistic. The significance of the medians is tested using the Binomial sign test. *** = significant at the 1%-level; ** = significant at the 5%-level; * = significant at the 10%-level.

Panel A : full sample							
Stock	war.	Average	St.dev.	Min.	Max.	Med.	pos.
ABN Amro	13	38.76***	32.19	3.27	117.02	28.97***	13
Aegon	8	35.75***	16.4	19.13	65.06	27.56***	8
Ahold	9	44.88***	44.31	8.84	152.73	31.07***	9
Akzo	8	38.08***	29.34	3.28	93.84	35.29***	8
ASML	12	27.58***	16.95	8.45	71.15	23.93***	12
DSM	3	12.87*	12.05	-0.57	22.71	16.47	2
Elsevier	11	45.16***	42.17	5.02	157.5	33.94***	11
Getronics	8	41.50***	38.93	17.81	134.17	26.60***	8
ING	10	30.80***	14.79	10.09	51.74	30.81***	10
KPN	4	35.17***	22.92	13.06	61.03	33.29	4
Numico	2	98.26**	68.75	49.65	146.87	98.26	2
Philips	9	37.83***	19.49	15.84	71.35	39.79***	9
Royal Dutch	8	36.26***	34.46	6.04	114.61	28.55***	8
Unilever	5	30.19***	16.49	6.51	46.61	34.77**	5
UPC	1	20.59		20.59	20.59	20.59	1
Total	111	38.25***	30.42	-0.57	157.5	29.65***	110

Panel B : valuation based on 4 options							
Stock	war.	Average	St.dev.	Min.	Max.	Med.	pos.
ABN Amro	9	24.30***	10.5	3.27	35.78	26.41***	9
Aegon	6	36.65***	17.17	24.2	65.06	27.56**	6
Ahold	3	18.65***	12.32	8.84	32.47	14.65	3
Akzo							
ASML	11	28.44***	17.5	8.45	71.16	27.55***	11
DSM							
Elsevier	3	26.52***	9.38	15.98	33.94	29.41	3
Getronics	5	50.38**	47.95	18.67	134.17	29.61**	5
ING	5	26.15***	16.47	10.09	51.74	20.12**	5
KPN	4	35.17***	22.92	13.06	61.03	33.29	4
Numico							
Philips	5	33.50***	12.77	16.83	47.36	39.79**	5
Royal Dutch	2	28.55***	4.89	25.1	32.01	28.55	2
Unilever	5	30.19***	16.49	6.51	46.61	34.77**	5
UPC	1	20.59		20.59	20.59	20.59	1
Total	59	29.92***	19.87	3.27	134.17	27.55***	59

Table 5: Overpricing of the Dutch call warrants for the Binomial model with discrete dividend payments This table presents the overpricing of the Dutch call warrants issued between January 1, 1999 and December 31, 2001. The overpricing is calculated as the average overpricing over the first five trading days of the warrants. Trading days are only taken into account if at least one call option with a longer maturity and one call option with a shorter maturity than the warrant are traded. Warrants are only included if during the first 10 trading days at least five days can be found on which the earlier mentioned two options are traded. The call warrants and the underlying stocks are identified from the official newspaper of the Amsterdam Stock Exchange, De Officiele Prijscourant van de Effectenbeurs. The overpricing is defined as the difference between the market price of the warrant and the model price divided by the market price. Model prices are calculated using the Binomial Model for American type options with estimated dividends. The price of the underlying stock, the exercise price, the realized dividends, and the time to maturity of both the options and the warrants are derived from Datastream. The estimated future dividends are set equal to the realized dividends of the last year before the trading day. The risk-free interest rate is estimated as the average yield on government bonds with a maturity of 2 years (also from Datastream). The volatility of the warrants is defined as the implied volatility of long term call options on the same stocks. The different implied volatilities are weighted in such a way that the options that are closest to the call warrants in terms of exercise price and time to maturity get the highest weight. The information on the full sample is presented in Panel A. In Panel B information is presented on the call warrants that are priced using four call options. The significance of the averages is tested using a t-statistic. The significance of the medians is tested using the Binomial sign test. *** = significant at the 1%-level; ** = significant at the 5%-level; * = significant at the 10%-level.

Panel A : full sample							
Stock	war.	Average	St.dev.	Min.	Max.	Med.	pos.
ABN Amro	13	24.35***	12.47	2.47	50.27	25.30***	13
Aegon	8	33.19***	16.1	18.81	62.91	25.54***	8
Ahold	9	31.75***	26.76	5.11	92.71	28.65***	9
Akzo	8	19.23***	10.59	3.01	38.6	18.39***	8
ASML	12	23.26***	10.34	8.41	40.35	20.67***	12
DSM	3	-0.01	11.17	-11.56	10.75	0.61	2
Elsevier	11	31.95***	20.23	3.98	75.22	30.17***	11
Getronics	8	45.86**	41.58	19.05	141.12	26.39***	8
ING	10	28.31***	14.21	9.39	50.51	28.81***	10
KPN	4	38.56**	26.45	14.03	71.26	26.45	4
Numico	2	65.68	54.46	27.17	105.18	65.68	2
Philips	9	29.37***	14.08	12.86	51.24	27.77***	9
Royal Dutch	8	26.36***	21.41	4.08	69.41	23.53***	8
Unilever	5	26.13**	15.45	7.97	46.29	19.99**	5
UPC	1	19.45		19.45	19.45	19.45	1
Total	111	29.56***	21.37	-11.56	141.12	25.82***	110

Panel B : valuation based on 4 options							
Stock	war.	Average	St.dev.	Min.	Max.	Med.	pos.
ABN Amro	9	19.89***	9.35	2.47	29.16	24.88***	9
Aegon	6	34.18***	17.5	21.04	62.91	25.54**	6
Ahold	3	16.81*	12.43	6.48	30.6	13.36	3
Akzo							
ASML	11	23.94***	10.55	8.41	40.35	21.03***	11
DSM							
Elsevier	3	24.62**	10.65	12.48	32.41	28.97	3
Getronics	5	51.60*	50.97	19.05	141.12	28.11**	5
ING	5	24.00**	16.39	9.39	50.51	18.20**	5
KPN	4	38.56**	26.45	14.03	71.26	34.48	4
Numico							
Philips	5	31.80***	11.75	15.23	43.19	36.79***	5
Royal Dutch	2	23.53***	1.15	22.71	24.34	23.53	2
Unilever	5	26.13**	15.45	7.97	46.29	19.99**	5
UPC	1	19.45		19.45	19.45	19.45	1
Total	59	27.88***	20.29	2.47	141.12	24.03***	59

Table 6: Regression results This table presents the regression analysis of the overpricing of the Dutch call warrants issued between January 1, 1999 and December 31, 2001. The overpricing is calculated as the average overpricing over the first five trading days of the warrants. Trading days are only taken into account if at least one call option with a longer maturity and one call option with a shorter maturity than the warrant are traded. Warrants are only included if during the first 10 trading days at least five days can be found on which the earlier mentioned two options are traded. The call warrants and the underlying stocks are identified from the official newspaper of the Amsterdam Stock Exchange, De Officiele Prijscourant van de Effectenbeurs. The overpricing is defined as the difference between the market price of the warrant and the model price divided by the market price. Model prices in Panels A and B are calculated using the model of Black and Scholes (1973) corrected for continuous dividend payments. Model prices in Panels C and D are calculated using the Square Root version of the Constant Elasticity of Variance model of Cox and Ross (1976) corrected for continuous dividend payments. Model prices in Panels E and F are calculated using the Binomial model of Cox et al. (1979) corrected for discrete dividend payments. The discrete dividend is estimated as the actual dividend in the year before the first trading day. The price of the underlying stock, the exercise price, the dividend yield, the discrete dividend payments, and the time to maturity of both the options and the warrants are derived from Datastream. The risk-free interest rate is estimated as the average yield on government bonds with a maturity of 2 years (also from Datastream). The volatility of the warrants is defined as the implied volatility of long term call options on the same stocks. The different implied volatilities are weighted in such a way that the options that are closest to the call warrants in terms of exercise price and time to maturity get the highest weight. The normalized call warrant price represents the price to buy 0.1 share of common stock. The warrant ratio is the number of shares that can be bought with one call warrant. The moneyness (M.ness) is the ratio of the stock price and the exercise price on the first trading date. The warrant-ratio and the trading volume of the warrants are also derived from Datastream. Issuer A refers to the only Dutch issuing bank (ABN Amro). Issuers B, C and D refer to the foreign issuers. The information on the full sample is presented in Panels A, C and E. In Panels B, D and F information is presented on the call warrants that are priced using four call options. Heteroskedasticity-adjusted standard errors (White) are reported between square brackets. *** = significant at the 1%-level; ** = significant at the 5%-level; * = significant at the 10%-level.

Panel A:	dependent variable : % overpricing (Black/Scholes warrant prices)								
					obs : 111				
Indep. Var.	Interc.	Price (norm)	War. Ratio	B	Issuer C	D	M.ness	Ln(vol)	R2
Coef.	0.41	-0.192							0.1
Std. Err.	[0.043]	[0.051]							
t-test	9.53***	-3.76***							
Coef.	0.435	-0.204	-0.137						0.11
Std. Err.	[0.050]	[0.054]	[0.085]						
t-test	8.70***	-3.77***	-1.61						
Coef.	0.167			0.108	0.26	0.089			0.24
Std. Err.	[0.019]			[0.031]	[0.045]	[0.039]			
t-test	8.79***			3.48***	5.78***	2.28**			
Coef.	0.922						-0.726		0.27
Std. Err.	[0.150]						[0.163]		
t-test	6.15***						-4.45***		
Coef.	0.149							0.023	0.13
Std. Err.	[0.031]							[0.006]	
t-test	4.81***							3.83***	

Panel B:	dependent variable : % overpricing (Black/Scholes warrant prices)								
					obs : 59				
Indep. Var.	Interc.	Price (norm)	War. Ratio	B	Issuer C	D	M.ness	Ln(vol)	R2
Coef.	0.381	-0.141							0.07
Std. Err.	[0.061]	[0.069]							
t-test	6.25***	-2.04**							
Coef.	0.417	-0.147	-0.271						0.08
Std. Err.	[0.076]	[0.071]	[0.191]						
t-test	5.49***	-2.07**	-1.42						
Coef.	0.224			0.016	0.184	0.027			0.18
Std. Err.	[0.019]			[0.031]	[0.061]	[0.047]			
t-test	11.79***			0.52	3.02***	0.57			
Coef.	0.92						-0.71		0.24
Std. Err	[0.300]						[0.325]		
t-test	3.07***						-2.18**		
Coef.	0.178							0.017	0.07
Std. Err	[0.045]							[0.008]	
t-test	3.96***							2.13**	

Panel C:	dependent variable : % overpricing (Square Root model warrant prices) obs : 111								
Indep. Var.	Interc.	Price (norm)	War. Ratio	Issuer B	Issuer C	Issuer D	M.ness	Ln(vol)	R2
Coef.	0.561	-0.341							0.16
Std. Err.	[0.065]	[0.078]							
t-test	8.63***	-4.37***							
Coef.	0.606	-0.362	-0.247						0.17
Std. Err.	[0.075]	[0.083]	[0.131]						
t-test	8.08***	-4.36***	-1.89*						
Coef.	0.191			0.102	0.376	0.134			0.26
Std. Err.	[0.019]			[0.031]	[0.064]	[0.057]			
t-test	10.05***			3.29***	5.88***	2.35**			
Coef.	1.481						-1.299		0.42
Std. Err.	[0.196]						[0.211]		
t-test	7.56***						-6.16***		
Coef.	0.143							0.034	0.14
Std. Err.	[0.040]							[0.008]	
t-test	3.58***							4.25***	
Panel D:	dependent variable : % overpricing (Square Root model warrant prices) obs : 59								
Indep. Var.	Interc.	Price (norm)	War. Ratio	Issuer B	Issuer C	Issuer D	M.ness	Ln(vol)	R2
Coef.	0.387	-0.134							0.06
Std. Err.	[0.059]	[0.067]							
t-test	6.56***	-2.00**							
Coef.	0.43	-0.142	-0.334						0.07
Std. Err.	[0.074]	[0.068]	[0.198]						
t-test	5.81***	-2.09**	-1.69*						
Coef.	0.23			0.014	0.197	0.02			0.21
Std. Err.	[0.020]			[0.031]	[0.061]	[0.048]			
t-test	11.50***			0.45	3.23***	0.42			
Coef.	0.965						-0.75		0.27
Std. Err	[0.286]						[0.309]		
t-test	3.37***						-2.43**		
Coef.	0.206							0.014	0.05
Std. Err	[0.055]							[0.009]	
t-test	3.75***							1.56	

Panel E:	Dependent variable : % overpricing (Binomial model warrant prices) obs : 111								
Indep. Var.	Interc.	Price (norm)	War. Ratio	Issuer B	Issuer C	Issuer D	M.ness	Ln(vol)	R2
Coef.	0.396	-0.193							0.1
Std. Err.	0.043	0.051							
t-test	9.21***	-3.78***							
Coef.	0.425	-0.207	-0.158						0.11
Std. Err.	0.051	0.054	0.076						
t-test	8.33***	-3.83***	-2.08**						
Coef.	0.148			0.11	0.273	0.086			0.26
Std. Err.	0.02			0.031	0.045	0.037			
t-test	7.40***			3.55***	6.07***	2.32**			
Coef.	0.946						-0.77		0.3
Std. Err.	0.15						0.163		
t-test	6.31***						-4.72***		
Coef.	0.137							0.023	0.12
Std. Err.	0.031							0.006	
t-test	4.42***							3.83***	

Panel F:	Dependent variable : % overpricing (Binomial model warrant prices) obs : 59								
Indep. Var.	Interc.	Price (norm)	War. Ratio	Issuer B	Issuer C	Issuer D	M.ness	Ln(vol)	R2
Coef.	0.369	-0.146							0.07
Std. Err.	0.064	0.071							
t-test	5.77***	-2.06**							
Coef.	0.417	-0.155	-0.375						0.09
Std. Err.	0.079	0.073	0.172						
t-test	5.28***	-2.12**	-2.18**						
Coef.	0.208			0.01	0.194	0.013			0.2
Std. Err.	0.02			0.029	0.064	0.043			
t-test	10.40***			0.34	3.03***	0.3			
Coef.	0.959						-0.772		0.27
Std. Err	0.308						0.333		
t-test	3.11***						-2.32**		
Coef.	0.162							0.017	0.07
Std. Err	0.046							0.009	
t-test	3.52***							1.89*	

Table 7: Transaction costs for call warrants and call options Transaction costs (in Euro) for call warrants and call options are presented for three different scenarios. In all scenarios it is assumed that an investor purchases call warrants for a total value of 1,000 Euro. The transaction costs for the warrants are included in columns (2) and (3) of each scenario. Each warrant entitles her to buy 0.1 shares of common stock. It is also assumed that the investor buys call options that entitle her to buy the same number of shares. In scenario 1 the warrant price is 0.1 Euro. Therefore, the investor buys 10,000 warrants. A similar position can be acquired by buying 10 option contracts (each allowing her to buy 100 shares). See columns (4) and (5) for the option transaction costs of scenario 1. In scenario 2 the warrant price is 0.2 Euro, allowing the investor to buy 5,000 warrants. The transaction costs are the same as in scenario 1 and are included in columns (2) and (3). An equivalent position can be acquired by buying 5 option contracts. The transaction costs for this position are included in columns (4) and (5) of scenario 2. In scenario 3 the warrant price is 0.5 Euro. In this case an equivalent position can be taken by buying 2 option contracts. Finally, in scenario 4 the warrant price is 1 Euro. Here an equivalent position can be acquired by buying 1 option contract. In both scenarios the transaction costs for the option contracts are included in columns (4) and (5). Columns (6) and (7) in each scenario present the difference in transaction costs expressed in the price per warrant. Columns (8) and (9) give this difference as a percentage of the warrant price. The transaction costs are derived from the Internet company "Belegger.nl" on February 19, 2002. P = phone trade. I = Internet trade. N.A. = not available.

Scenario 1 : Warrant price is 0.1 Euro								
Bank	Transaction costs warrants		Transaction costs options		Difference per warrant (in Euros)		Difference per warrant (percentage)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	P	I	P	I	P	I	P	I
ABN Amro	15	10	71	52	0.0112	0.0084	11.2	8.4
Alex	17	12	44	38	0.0054	0.0052	5.4	5.2
Binck	15	15	41	41	0.0052	0.0052	5.2	5.2
ING Bank	12	10	68	N.A.	0.0112	N.A.	11.2	N.A.
Intereffekt	19	N.A.	45	N.A.	0.0052	N.A.	5.2	N.A.
Postbank	19	12	68	49	0.0098	0.0074	9.8	7.4
SNS Bank	15	13	45	45	0.006	0.0064	6	6.4
VEB	13	12	39	32	0.0052	0.004	5.2	4

Scenario 2 : Warrant price is 0.2 Euro								
Bank	Transaction costs warrants		Transaction costs options		Difference per warrant (in Euros)		Difference per warrant (percentage)	
(1)	(2) P	(3) I	(4) P	(5) I	(6) P	(7) I	(8) P	(9) I
ABN Amro	15	10	36	26	0.0084	0.0064	4.2	3.2
Alex	17	12	25	19	0.0032	0.0028	1.6	1.4
Binck	15	15	23	23	0.0032	0.0032	1.6	1.6
ING Bank	12	10	34	N.A.	0.0088	N.A.	4.4	N.A.
Intereffekt	19	N.A.	23	N.A.	0.0016	N.A.	0.8	N.A.
Postbank	19	12	34	25	0.006	0.0052	3	2.6
SNS Bank	15	13	23	23	0.0032	0.004	1.6	2
VEB	13	12	25	20	0.0048	0.0032	2.4	1.6

Scenario 3 : Warrant price is 0.5 Euro								
Bank	Transaction costs warrants		Transaction costs options		Difference per warrant (in Euros)		Difference per warrant (percentage)	
(1)	(2) P	(3) I	(4) P	(5) I	(6) P	(7) I	(8) P	(9) I
ABN Amro	15	10	18	13.5	0.003	0.0035	0.6	0.7
Alex	17	12	17	14	0	0.002	0	0.4
Binck	15	15	13	13	-0.002	-0.002	-0.4	-0.4
ING Bank	12	10	16.5	N.A.	0.0045	N.A.	0.9	N.A.
Intereffekt	19	N.A.	14	N.A.	-0.005	N.A.	-1	N.A.
Postbank	19	12	17	13	-0.002	0.001	-0.4	0.2
SNS Bank	15	13	14	14	-0.001	0.001	-0.2	0.2
VEB	13	12	16	12.5	0.003	0.0005	0.6	0.1

Scenario 4 : Warrant price is 1 Euro								
Bank	Transaction costs warrants		Transaction costs options		Difference per warrant (in Euros)		Difference per warrant (percentage)	
(1)	(2) P	(3) I	(4) P	(5) I	(6) P	(7) I	(8) P	(9) I
ABN Amro	15	10	15	11	0	0.002	0	0.2
Alex	17	12	20	14	0.006	0.004	0.6	0.4
Binck	15	15	11	11	-0.008	-0.008	-0.8	-0.8
ING Bank	12	10	13	N.A.	0.002	N.A.	0.2	N.A.
Intereffekt	19	N.A.	14	N.A.	-0.01	N.A.	-1	N.A.
Postbank	19	12	14	11	-0.01	-0.002	-1	-0.2
SNS Bank	15	13	14	14	-0.02	0.002	-0.2	0.2
VEB	13	12	13	10	0	-0.004	0	-0.4

Table 8: Questionnaire results from the CentERpanel This table contains the most important results of the questionnaire that was submitted to the CentERpanel of CentERdata of Tilburg University in May 2002. This panel consists of 2,000 households in the Netherlands. The members of these households fill in a questionnaire at their home computers every week. The complete questionnaire is included as an Appendix.

Question 3: Suppose that you have a choice between a call warrant and a call option that both entitle to buy the same share of common stock.
Indicate on a scale from 1 (= very strong preference for call warrant) to 7 (= very strong preference for call option).
Total: 17 respondents.

	1	2	3	4	5	6	7	No ans.	avg.
recommendations of friends and acquaintances	1	0	2	8	2	2	1	1	4.25
risk of the product	1	1	2	10	0	1	2	0	4.06
price of the product on the market	2	1	2	8	1	1	2	0	3.94
transaction costs	2	2	1	7	1	1	2	1	3.88
publicity in newspapers and magazines	2	1	0	10	2	2	0	0	3.88
size of bid-ask spread	2	2	1	6	3	0	2	1	3.88
flexibility in determining the number of buying rights	4	0	3	5	2	1	2	0	3.71

Question 5: How much do the following factors play a role for you in your decision to buy or to consider call options, but not to buy or consider call warrants?
Indicate on a scale from 1 (= very important role) to 7 (= does not play any role).
Total: 22 respondents.

	1	2	3	4	5	6	7	No ans.	avg.
price of the product on the market	3	2	2	0	2	10	2	1	4.62
risk of the product	1	2	2	3	5	5	2	2	4.6
size of bid-ask spread	2	4	2	5	2	2	1	4	3.61
publicity in newspapers and magazines	4	7	3	2	2	4	0	0	3.14
transaction costs	5	6	3	3	0	4	0	1	2.95
recommendations of friends and acquaintances	8	8	3	1	1	1	0	0	2.18