The Impact of Option Listing on the Underlying Securities

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# Contents

## Introduction

1 The relationship between option listing and underlying stocks. 4
   1.1 The choice of our studies 4
   1.2 The price effect of option introduction 5
      1.2.1 A price increase in the underlying security 5
      1.2.2 An increase in the market value 7
      1.2.3 A quicker price adjustment to new information 7
   1.3 Effect of option introduction on the observed return volatility 8
      1.3.1 American case 8
      1.3.2 German case 14
   1.4 Effect of option introduction on the trading activity 15
   1.5 The effect of option listing on information and liquidity 16
      1.5.1 Option trading and the bid-ask spread of the underlying stocks 17
      1.5.2 Liquidity and information 18
   1.6 A new approach: taking the reasons behind the option listing decision into account 20
      1.6.1 Introduction 20
      1.6.2 Selection bias and endogeneity problem 20
      1.6.3 Criteria used for option listing and the Logit model 21
      1.6.4 Option listing effects: study using control samples 23
      1.6.5 Results 24
      1.6.6 Conclusion 24

2 Index option listing effects on the underlying market 25
   2.1 The S&P 100 example 26
      2.1.1 The method 26

3 OTC stock option listing effects 30
   3.1 Introduction 30
   3.2 Review of the literature 30
   3.3 Conclusion 31
CONTENTS

4 Stock Option Delisting Effects on the Underlying Market 33
Conclusion 34
References 35
Introduction

It was not so long ago, 1973 to be precise, that options were first introduced in the market. The Chicago Board of Exchange was created and started trading options on 16 underlying stocks. April 26 was the first day of trading with 911 option contracts traded. Since then the option market literally exploded and today options are financial tools of capital importance, with over 1 million contracts traded every day.

Options provide new trading strategies to risk averse investors, to speculators and arbitrageurs. More informed market participants can more effectively trade due to the higher leverage that options provide. Risk averse investors can more effectively hedge against market movements. Options do prove to be very useful tools for investors.

But how does the introduction of options influence the underlying security? Does option listing have an impact on underlying values and variables such as price, volatility, volume and liquidity? Several academics have tried to answer these questions, most of them agreeing that option listing reduces volatility of the underlying, increases its volume and has positive effects on liquidity. Option listing increases trading volumes, since more risk averse investors start buying securities because they now have the possibility to hedge with options. Bid/Ask spreads decrease due to competition in the options market and less asymmetrical information, hence the liquidity of the underlying is increased. Volatility also tends to decrease after option listing.

But recent studies suggest that this might not always prove to be the case, arguing that the methods of some previous studies omitted causalities such as the reasons behind listing options on certain stocks and not on others. Indeed, many of these underlying variables influence one another (such us the fact that a decrease in volatility leads to a decrease in Bid/Ask spreads) and therefore some conclusions of the effects of option listing may be misleading. Although studies that focus on exchange traded securities are plentiful, ones on OTC (Over the Counter) securities are scarce often due to the lack of data or interest.

The focus of this paper is to summarize and compare these studies as well as others such as one that focus on the impact of option volumes on future prices and volatility. We will start by introducing the effects of option listing on exchange traded options. We will then broaden our perspective on the issue by covering other papers that focus on OTC stocks and index derivatives and compare the influence of options on these securities with their exchange traded counterparts.
Chapter 1

The relationship between option listing and underlying stocks.

In the Black-Scholes (1973) model, in a complete and frictionless market, options are redundant securities because their payoffs can be synthesized by taking a position in the underlying security and lending (or borrowing) appropriately at the risk-free rate. So in this model, option introduction can have no price effect on the underlying security. Consistent with this, some studies find no evidence of listing effects and argue that options are redundant. These studies are for example Bollen (1998) and Mazouz (2004). But in fact, the introduction of the option may improve the welfare of previously restricted traders and may be associated with a price effect. Indeed:

- The use of options may allow the investor to take positions in the underlying security which were not possible prior to option introduction. For example, options allow the investor to avoid short sale restriction.

- Options may affect the opportunity sets of investors because of their leverage aspect. For example, an out-of-the-money option has a high leverage effect.

So, in the following we concentrate on papers which argue against the redundancy of options listings and which present evidence of an impact on the underlying securities in conjunction with option introduction. We will see this lead to think that options aid in the completion of financial markets.

1.1 The choice of our studies

First, it is important to know on which type of papers we worked on, to understand our thinking on the subject and the interpretations we make. Indeed there are a lot of empirical analyses, which are sometimes non-consistent depending on the date at which the study has been done and of course on which exchange (American exchange, German exchange, or OTC) the study focuses on. To illustrate this we will see for example that the volatility of returns
on common stocks after option listing declines in the American market but increases in the
German market. Furthermore, with respect to the access we had on different papers, we tried
to concentrate on more recent studies and reject early studies on the topic. This because in
the early studies, sometimes no test of significance is provided and more importantly they
contain few independent observations because of the small size of the sample and the fact
that all measurements are performed over the same short sample period.

Moreover some notions, like the fact that the liquidity concept changes in the different
studies\(^1\), so a choice between models has to be made.

So in the following discussions, we first explore the papers of Conrad (1989), Skinner
(1989), Detemple and Jorion (1990), Damodaran and Lim (1991), Fedenia and Grammatikos
(1992), Kumar, Sarin and Shastri (1998) and a more recent one Jubinski and Tomljanovich
(2007). They all construct sample on the main american exchange option listing, like the
Chicago Board Options Exchange (CBOE), the American Stock Exchange (AMEX) and/or
New York Stock Exchange (NYSE). However in the section treating the volatility effects of
option introduction, we will also focus on Heer, Trede, and Wahrenburg’s (1997) paper based
on a sample construct on German exchange.

1.2 The price effect of option introduction

We see in this section what different authors find concerning the evolution of the price in the
underlying security and in the market value surrounding the listing date of these options.
We also see that Damodaran and Lim (1991) find that prices adjust much more quickly to
new information after the listing of options.

1.2.1 A price increase in the underlying security

Conrad (1989) examines the price effect of option introduction from 1974 to 1980. Using a
sample of 96 stocks, she finds a permanent increase in the price of the underlying security.
Moreover, this positive price effect appears to be more closely associated with the listing date
than with the announcement of the introduction. This is consistent with the hypothesis of
a learning phase during which investors progressively realize the implications of the opening
of new option markets.

A part of the variation in the price increase can be explained by the positions that can
take traders who anticipate acting as a dealer in the new option and using the security to
hedge. For example, a trader/dealer who anticipates writing calls may purchase the security
immediately before option introduction to satisfy his or her anticipated hedging demand

\(^{1}\)Fedenia and Grammatikos (1992) developed an empirical model of spread behavior stemming from the
Cohen et al. (1981) model, where the liquidity is defined as the degree of market thinness (a security’s
thinness is measured by the inverse of the order arrival rate). Liquidity is inversely related to thinness and
thinner securities, ceteris paribus, are shown to have larger equilibrium market spread, so in their model
they choose the spread before listing proxy for the inverse of liquidity. While in the Grossman and Miller
(1988) model, irrespective of the bid-ask spread, the larger the proportion of transactions effected initially
through market makers, the more liquid the market.
and facilitate trading. Here, since early option introductions involved only call options, the hedging argument in these cases must imply that the dealers supply calls to investors and simultaneously purchase the stock. Thus, this implies that dealers or other traders partially cause the price increase by purchasing securities in anticipation of their level of activity in the option. Consistent with this Conrad finds a positive correlation between the abnormal price increase and the opening day volume for each individual option. However she concludes that there is still a great deal of variation in the price increase left unexplained.

De Temple and Jorion (1990) use a larger sample of 300 securities on which options have been introduced between 1973 and 1986. Like Conrad’s study they find a highly significant increase in the price of an optioned stock taking place around the listing date. The effect yields abnormal returns of the order of 0.6% on the listing day and 2.9% in the two weeks surrounding the listing date (more precisely, over a 11-day window around the listing date). This is consistent with the model that De Temple and Selden (1987) provide, analyzing the interactions between the stock and the option market. Indeed they give an example of a one-period general equilibrium with a single risky asset where two classes of investors have diverse beliefs about the risk of the stock payoff. The option is traded once introduced. Investors with a high risk assessment take a long position in the option and sell some of their endowed shares of the stock while the second class of investors exhibits the reverse behavior. As the reaction of this latter class of investors has a greater magnitude, the total demand for the stock increases. And then the stock price increases (to reestablish equilibrium). More precisely than Conrad (1989) they also construct two portfolios of stocks classified according to size. They of course find positive abnormal returns for large stocks and small one (consistent with the above results) but note that over the 11-day window there is a higher increase for small firms than for large ones. The abnormal returns are 3.24% for small stocks and 2.48% for large ones. So small firms seem to be more affected than large ones. However the difference is not significant. For the first time, De Temple and Jorion (1990) also analyze the opposite effect, a price decrease in the underlying security is associated with option delisting. In this case they find a negative abnormal return but not significant. More on option delisting effects is covered in Chapter 4.

However, in contrast with Conrad who finds a permanent increase in the price of the underlying security, they found that this price effect appears to be weaker, becomes insignificant after the introduction of index options in 1982. This is not in contradiction with Conrad’s study since her sample stops in 1980, but reflects maybe a characteristic change in the market. This what De Temple and Jorion (1988) show while demonstrating the existence of cross-effects on stock that are correlated with optioned stocks. In their model heterogeneous investors with diverse constant relative risk-aversion parameters invest in a financial market with two risky assets in which options are successively introduced. The introduction of the first option increases the price of the optioned stock, even when it is in small supply.

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2They use four test statistics based on a mean-adjusted model and market-adjusted model, with and without assuming cross-sectional independence.

3The effect of option listings on other stock categories of the same type of firm.
relative to the other stock, which in this case can be interpreted as the market. Since options create hedging possibilities not only for the underlying stock but also for the other correlated securities, the price of this latter stock increases as well. This demonstrates the presence of a cross-effect. The introduction of an option on the second stock also produces a positive effect on the newly optioned stock, but, the size of the increase is relatively smaller than for the first option. Therefore this suggests a dissipation of the option introduction-price effect as the market becomes more complete. Furthermore, once an option on the market has been introduced, the direct price impact of further option listings becomes negligible. Empirically, Detemple and Jorion (1990) found results that are consistent with this theoretical model, where the effect of price increase in the optioned stock seems to fade away over time, as the markets become progressively more complete. That were the case in 1982, when index options, which complete the markets, were introduced. Indeed, for options listed between 1982 and 1986, they find that the cumulative abnormal returns are not statistically different from 0 (while it was between 1973 and 1982).

1.2.2 An increase in the market value

De Temple and Jorion (1990) also test for an effect on the market. They construct a time-series of portfolio returns for the market around the listing date, the price impact on the market is graphed in Fig. 1.1. They find that over a 11-day window around the listing date, the abnormal return is significant. The increase found was 1.15% with a t-statistic of 2.59 at the usual 5% level. Moreover, the magnitude of this effect appears to be positively related to the number of options introduced at any given date. Thus the introduction of options seems to have a positive effect on the stock market as a whole. The reason that the index is affected at all is consistent with the theory which suggests that cross-effects, in addition to direct effects, take place. To test for the presence of these cross-effects, they construct industry indices which are adjusted so as to remove the direct effects. And they still find abnormal returns of the order of 1.5%, confirming the importance of the cross-effects. That is again consistent with the theoretical model they developed in 1988.

1.2.3 A quicker price adjustment to new information

Damodaran and Lim (1991) concentrate on 200 stocks which had options listed on them any time between 1973 and 1983 and find that prices adjust much more quickly to new information after the listing of options. To reach this conclusion they extend a simple model of price adjustment, where the observed return variance in the pre-listing and post-listing periods is broken down into three components. One of these components is the price adjustment that captures the effect of an imperfect price adjustment process. This model is based on one developed by Amihud and Mendelson (1988) and we will be presented it in the next section because it illustrates a post-listing decline in the observed return variance, while an increase in the price adjustment component. Hence this shows the idea that prices adjust much more quickly to new information after the listing of options. Relating to this, the authors attempt to explain the speedier price adjustment in the post-listing period by
1.3. EFFECT OF OPTION INTRODUCTION ON THE OBSERVED RETURN VOLATILITY

![Market value of optioned stocks: cumulative proportion of the value of the market covered by options](image)

Figure 1.1: Market value of optioned stocks: cumulative proportion of the value of the market covered by options

looking at shifts in the information structure. In particular, they find evidence that more information is collected and disseminated to investors after the listing of options. This latter effect will also be discussed in the section treating the links between the options listing and information based on Damodaran and Lim’s result and R. Kumar, A. Sarin, K. Shastri’s (1998) paper.

1.3 Effect of option introduction on the observed return volatility

First of all we consider the repercussion of option introduction on the variance in daily returns on the underlying stocks on the American exchanges. We will see that a lot of literature is concordant on the point that the stock return variance declines after options listing.

In a second step we will focus on the German market, where we empirically observed the inverse effect (an increase in the stock return variance after options listing), to emphasize that there can not be suitable theoretical model predicting a decrease in the stock return variance as soon as options are introduced on these stocks.

1.3.1 American case

Skinner

An important and famous first paper on the matter is the one of Skinner (1989). This study uses a sample of 304 CBOE and AMEX option listings from 1973 to 1987. Skinner forms a
variance ratio for each firm by dividing estimated variance after listing by estimated variance before. So, a ratio smaller than one indicates a decline in measured return variance after listing. Skinner also takes into account that when examining changes in stock return variance, it is important to consider changes in the volatility of the return on the market through time. Indeed, the observed change (or not) in variance around the time of options listing can be due to contemporaneous changes in market volatility. So in order to address this possibility, Skinner standardizes the daily stock return data by dividing each daily return by an estimated contemporaneous standard deviation of the market return\textsuperscript{4}. Using the usual statistical tests he finds an evidence for a decline in the return variance after options are listed on stocks. Comparing the variance ratios with and without the adjustment for market volatility, he also finds that changes in market volatility appear to explain part, but not all, of the variance decline. Indeed, we can write the following inequality stemming from Skinner’s result,

\[ \text{variance-ratio} < \text{adjusted-variance-ratio} < 1 \]

We note that the results are significant and that the median of the \textit{adjusted-variance-ratio} is close to 0.90, showing a volatility shift of around 10% that remains after controlling for changes in market volatility. Skinner also tests two possible explanations for the decline in variance: on the one hand changes in trading activity and, on the other hand, changes in trading noise. Empirically, Karpoff (1987) who establishes empirical association between trading volume and volatility, finds a rise in stock volatility if stock market trading activity increases after option introduction. Consistent with this, Skinner finds that the decrease of stock return volatility after option listing was significant only for those stocks that experienced volume changes below the sample median value. Analyzing the autocorrelation structure of stock returns before and after listing of the options he finds little support for the hypothesis that the changes in variance are related to changes in trading noise.

Conrad

Consistent with Skinner’s study, Conrad (1989) finds that the variance of individual underlying security returns declines following option introduction. To this matter, she estimates the market model over a period of 200 days outside the event window which comprises 30 days prior and after the listings of the option. She also finds no evidence that the systemic risk\textsuperscript{5} changes.

De Temple and Jorion

In the same trends, De Temple and Jorion (1990) also find that a significant volatility decrease takes place when new options are listed. To illustrate this point (see on Fig. 1.2), they present squared returns around the listing dates, where these returns are cross-sectional

\textsuperscript{4}See in his paper to have more information on the estimate of daily market volatility he used [from French, Schwert, and Stambaugh (1987)]

\textsuperscript{5}systemic risk as measured by the beta of the market model.
averages of individual squared stock returns which have been standardized by their average squared return over the whole sample period. In mathematical terms, they present

$$\mathbb{E}(R_t^2)$$ for $t \in [-60, 60]$,

where $t = 0$ is the listing date,

$$R_t^2 = \frac{\sum_{i=1}^{n} r_{i,t}^2}{\sum_{i=1}^{n} \sum_{t=-60}^{60} r_{i,t}^2},$$

and $r_{i,t}$ is the return of stock $i$ at time $t$. Present $\mathbb{E}(R_t^2)$ to illustrate changes in the volatility makes sense because $\text{var}(R_t)$ approximately equals $\mathbb{E}(R_t^2)$ for short measurement intervals. The adjustment ensures that stocks with large and small variances are given the same weight. By construction, the time-series of these squared returns should average to one. FIG. 1.2 clearly indicates that average normalized squared returns tend to be above one before the date of listing, and below one thereafter. This suggests that returns are less volatile after the option listing date.

Figure 1.2: Impact of listing on variance: time-series of average standardized squared returns

All these results are consistent with a model developed by De Temple and Selden (1987, 1988) providing a theoretical rationale for the post-listing reduction in volatility. For this matter, they model the interaction between stock and option markets when investors have diverse beliefs. And in their model, options provide significant welfare benefits to investors.

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6This was proposed by Merton (1980), where the daily variance of an asset can be approximated by taking squared returns, i.e. by setting the average return equal to zero, which is a valid approximation for short time intervals: $\text{var}(R_t) = \mathbb{E}(R_t^2) - (\mathbb{E}(R_t))^2$. 

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10
with greater risk assessments who move out of the stock into the option market. However (as we will see in the German case) and in contradiction with this, the option markets also allow speculators to take highly leveraged stock positions which increases market volatility (Hardouvelis, 1988).

**Damodaran and Lim**

Damodaran and Lim (1991) reach the same conclusion as the other authors mentioned above. First using excess return and raw return measures, they find that for the overall sample, the variance in daily returns is about 20% lower after the listing of option on stocks. However, they also find that in their sample, a significant fraction of the firms do have increases in variance. So based on previous work done by Ma and Rao (1988), and to explain the post-listing decline in variance, they advance the hypothesis that exchanges may list options on firms whose shares have recently experienced a rise in variance. Indeed Ma and Rao (1988) find that there is a differential market impact of options on underlying stocks; with volatile stocks becoming more stable after listing because of hedging behavior by uniformed traders, and stable stocks becoming more volatile after listing because of increased speculation in the options markets by informed traders.

Second extending a simple model of price behavior developed by Amihud and Mendelson (1988), Damodaran and Lim try to examine the reasons for the overall decline in volatility as well as for the increases in variances reported by some firms. This model consists in breaking down the observed variance in the pre-listing and post-listing periods into three components:

- an intrinsic variance proportion that can be attributed to the volatility of the underlying business,

- a price adjustment that captures the effect of an imperfect price adjustment process, and

- a noise term that is the result of information noise and bid-ask spread.

They start with the simple model of Amihud and Mendelson, which distinguishes between the intrinsic value $V_t$ and the observed price $P_t$ by allowing for both market-structure related information noise as well as imperfect price adjustments to values changes.

$$P_t - P_{t-1} = g(V_t - P_{t-1}) + u_t,$$

where $V_t$ and $P_t$ are in logarithms and $g$ is the price adjustment coefficient ($0 < g < 2$). The last term $u_t$ is a noise term, the magnitude of which is determined by information-related factors (such as noisy information and liquidity trading) and market-structure related factors (such as the bid-ask spread and discreteness of stock prices). With this they decompose the

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7 As mentioned in Section 1.2.2, the sample consists of 200 stocks which had options listed on them any time between 1973 and 1983 (on the CBOE and the AMEX).
observed return variance as follows,

\[ var(R_t) = v^2_{\text{intrinsic variance}} + 2\sigma^2_{\text{noise}} + \left[ \left( \frac{g}{2-g} - 1 \right) v^2 + \left( \frac{2}{2-g} - 2 \right) \sigma^2 \right]_{\text{price adjustment effect}}, \]

where they define \( v^2 \) to be the variance of the intrinsic value process and \( \sigma^2 \) to be the variance of the noise term. The rest of the model where they derive analytical formula for \( v^2 \), \( \sigma^2 \) and \( g \) that depend on the data can be found in their paper. What we would like to stress here is that a market overreaction to news (if the price adjustment coefficient \( g \) is relatively big, \( g > 1 \)) will lead to higher observed return variances (the price adjustment effect will be positive) but if the price adjusts slowly to information we will observe the opposite impact. Indeed,

\[ f(g) = \left( \frac{g}{2-g} - 1 \right) v^2 + \left( \frac{2}{2-g} - 2 \right) \sigma^2 \]

is an increasing function in \( g \), \( f'(g) > 0 \), and \( f(1) = 0 \). However an increase price adjustment coefficient could also explain a part of the reduction in variance if it is accompanied by a decline in information noise. Using their data three interesting findings emerge.

1. There is little evidence of a shift in intrinsic variance after the option listing.

2. On average, for small intervals around the listing date, the option listing seems to increase the price adjustment coefficient \( g \). Meanwhile there is a little discernible impact of the option listing in the coefficient for longer return intervals, and the price adjustment coefficients are not significantly greater than one for any of return intervals in the pre- and post-listing period.

3. There is evidence of a decline in the noise term after the option listing. We will discuss that this can be attributed to a decline in either the bid-ask spread or in the noise in the information process (which is related to the quality of private information produced and disseminated) in the section treating the links between the options listing and information. The noise term increases marginally for firms which reports increases in variance and decreases significantly for firms which report declines in variance. To the extend that speculation increases the noise in the price process, this is consistent with the hypothesis developed in Ma and Rao (1988) that volatile (stable) stocks become more stable (volatile) after option listing because of increased activity on the part of hedgers (speculators).

**Jubinski and Tomljanovich**

Jubinski and Tomljanovich (2007) extends over the presented studies by separately analyzing 1,576 individual companies between 1973 and 1996 (using CBOE data). To investigate the effect of options listings on underlying equity securities, they construct a control sample on which the 1,576 are matched on a one-to-one basis for each listing date. The effects of
option listing are compared across firm specifics including size, volatility, and trading volume. They define the best match as the control firm with the smallest difference in market value (size), share turnover (trading volume), or volatility relative to a listed firm, depending on the variable tested. Given this matched sample, they examined the short-run implications of options listings by estimating\(^8\) the model for 250 days on either side of the option listing date. Their main result is that smaller firms have stronger evidence of a listing effect than their large counterparts.

Studying the volatility, these control companies are incorporated in order to separate changes in volatility caused by options listings from changes due to other factors. The authors find that for a significant majority of both sets of companies, the volatility of individual-firm equity returns either decreases or remains unchanged after the associated derivative is introduced. These findings are consistent with those found by the above presented studies. In the same manner than De Temple and Jorion (1990) they sort firms by market value (size of the firms) and reveal that for small firms with high turnover and listing dates after 1982, a significant impact on the volatility asymmetry coefficient and other volatility coefficients occurs. The results therefore indicate that for a particular subset of firms, individual equity options not only impact the level of equity volatility, but the distribution of volatility as well. Moreover equity securities for large firms appear to be generally unaffected by listing of options. These findings are approximately in line with what De Temple and Jorion (1990) find.\(^9\) This nonuniform nature of options listings effects across the different types of firms is again consistent with Ma and Rao (1988). In this line, Jubinski and Tomljanovich also classified the firms based on their volatility for the 250 trading days immediately preceding the option listing date. Naturally, high-volatility firms were those with average volatility above the median level of volatility, and low-volatility firms were those with average volatility below the median. So consistent with Ma and Rao, they find that highly volatile firms were more significantly impacted by the listings, relative to their control counterparts, than firms with low volatility. Further and consistent with the two latter results, concerning the size of the firms and the volatility of their underlying securities, they also find that it is the small firms that exhibit high volatility which show the largest statistically different effects than the control sample.

In terms, with all these presented studies we can say that in average in american financial markets, the development of an option market appears to have a stabilizing effect on the financial market to the extent that it reduces the volatility of the underlying securities. These stabilizing forces in the markets could be the result of an increasing level of information available to market participants and thus enhancing market efficiency, by reducing information asymmetries and allowing investors to more effectively hedge risk. All these information aspects will be discussed later in Section 1.5. Meanwhile, as found Ma and Rao (1988) this effect can depend on the nature of the stock (whether it is a volatile one or a

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\(^8\)They use GJR-GARCH specification for daily volatility.

\(^9\)We mentioned in Section 1.2.1 that De Temple and Jorion (1990) find that small firms seem to be more affected than large ones when options are introduced but that difference was not too significant. Here it is.
1.3. EFFECT OF OPTION INTRODUCTION ON THE OBSERVED RETURN VOLATILITY

stable one) but also on the size of the firm and other factors we will mentioned at the end of this section.

1.3.2 German case

Heer, Trede and Wahrenburg

Heer, Trede and Wahrenburg (1997) illustrate the debate of the impact of option trading on stock market volatility. Unlike other studies focused on the American financial markets they conduct their empirical investigations for the German derivatives exchange Deutsche Terminbörse (DTB).

Like in Jubinski and Tomljanovich (2007), they form two samples. A basic one which is composed of optioned stocks and, a control one composed of non-optioned stocks, which are subjected to a precise selection in order to approximately exhibit the same size and industry structure as the basic DTB sample. Using a quite similar method as Skinner (1989), they calculated the variance ratio for each stock of both samples. $T_{DTB}$ and $T_{NON}$ represent respectively the random sample values of the DTB sample and the comparison sample. Their empirical results provide significant evidence that $F_{NON}(t)$ does not stochastically dominate $F_{DTB}(t)$, where $F_{NON}(t)$ and $F_{DTB}(t)$ are respectively the distribution of $T_{NON}$ and $T_{DTB}$. That means that they can firmly reject the hypothesis that optioned stocks became less volatile after introduction on the DTB. Meanwhile their empirical results do not allow them to conclude the opposite effect, that $F_{DTB}(t)$ stochastically dominates $F_{NON}(t)$. Nevertheless, they used tests that prove that German stock returns became more volatile after introduction of options at the DTB. Further, they make a distinction, between stocks experiencing large increases in trading volume and those experiencing small changes, which reveals noticeable differences. The more the volume increases the more volatility tends to increase as well, and, their data shows a strong increase in trading volume for option listed stocks while a more smaller increase for non-optioned stocks. So a positive correlation between the trading activity and the volatility is coherent with what they find.

The increase volatility is consistent with what Stein (1987) argues, that derivative markets serve as conduit for new speculators into the spot market that may destabilize prices. This is also consistent with the theoretical approach developed by Grossman (1988) who says that market volatility increases when more traders follow price insensitive trading strategies and market cannot observe the informationless nature of these strategies. Since derivatives trading causes transactions in the underlying stock (from arbitrage activities or hedging activities) it may thus increase stock return volatility. Another argument is that through small requirements options market leads to a migration of the informed and speculative traders from the stock market into the option market, allowing them to take highly leveraged stock positions which in turn increases market volatility.

The empirical positive link they find between trading activity and volatility is consistent with Karpoff (1987) (and so on with the finding of Skinner we mentioned). Karpoff

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We say that a random variable $X$ first order stochastically dominates a random variable $Y$ if: $E(u(X)) \geq E(u(Y)) \forall$ monotone increasing $u : \mathbb{R} \rightarrow \mathbb{R} \Leftrightarrow Y \prec_{fsd} X$. 

14
establishes an empirical association between trading volume and volatility. He indeed finds a rise in stock volatility if stock market trading activity increases after option introduction. And here, since Heer, Trede and Wahrenburg find a strong increase in trading volume for option listed stock, the volatility effect observed in the DTB can partly be explained by this increase. Indeed trading volume on average doubled from 5 months before to 5 months after option introduction and the variance increase is more pronounced for stocks that have experienced above median trading volume increases. The authors interpret this abnormal increase in trading volume as an intervention of international investors. Indeed the latter seem to prefer option listed stocks for investment purposes. The hedging opportunity created by the DTB apparently made by listed stocks became much more attractive to international investors who are responsible for a large fraction German trading volume.

Through all these papers we see that the effect of option introduction on the observed return volatility does not follow a universal law, and depends much more on where, on what and on when the listing happens. On where, we mean on which international exchange (we see the example of the american and german case). On what, we mean on which type of stock, i.e., if it is a relatively stable or volatile stock. Here we refer on Ma and Rao (1988) who, as we already see, conclude that there is no uniform impact of option trading on the underlying securities because of the nature of the stock which may attract different kinds of additional traders. Option listing might lead to increased speculation with stable stocks and, consequently, increase the volatility, whereas traders might hedge in options with volatile stocks and, therefore, returns stabilize after listing. On what, we also mean on the number of optioned-listed-stock which might affect the size of the volatility changes since the trading activity (which appears to be correlated with the volatility) on the both market (stock and option market) will be affected by attracting or not new international (or not) investors. On when, we mean, if the new stock on which we will be introducing options is correlated with other already optioned-stocks, the effect of its options listing may be reducing by a potential existing cross-effects. For the cross-effects we refer on De Temple and Jorion (1988) who demonstrate the existence of a such effect on stock that are correlated with optioned stocks (we already described this effect in Section 1.2.1).

Given all these, we think that taken in account all these parameters and maybe others, we eventually could predict the volatility changes when options are introduced on some stocks.

1.4 Effect of option introduction on the trading activity

The trading activity has already be mentioned in the previous section to be correlated with the volatility (Karpoff, 1987). As there is no uniform trend concerning the effect of option introduction on the observed return volatility it could become clear that it will also be the case for the effect of option introduction on the trading activity. We present here what reveal our selection papers. Not many of them are discussing these effects since a more

\[11\] We discuss a general increasing trading activity in the next Section.
appealing subject when studying the effect of option introduction on the underlying stock may be to focus on the variation in the price or in the information\textsuperscript{12}. Indeed the latter could lead to a construction of different trading strategies depending on their change and their availability. Nevertheless the changes in trading activity can contribute to the changes of price or information by being connected to other parameters like the volatility or liquidity effects. We will see in the next section that an increase in the trading volume has a positive liquidity effect in the underlying stock because of a fundamental change in the characteristics of the underlying security induced by the introduction of the options (R. Kumar, A. Sarin, K. Shastri, 1998).

A common result that is accepted in the literature is that the overall trading volume of the underlying asset is positively affected by the opening of an option market. Indeed options markets are associated with a hedging and arbitrage demands of traders, and that lead to an increase in the trading activity in the stock market. This time, this is true for the american financial markets like for the german derivatives exchange (DTB)\textsuperscript{13}. As a consequence, the market depth (number of shares that the market maker is willing to trade) increases, which has an impact on the noise and the volatility of the return process. We let the impact of the trading activity on the liquidity be discussed in the next section. In this section we just stress on that Skinner’s (1989) empirical research lead him to find a significant increase in the trading volume in the underlying security following the listing of options. These findings are consistent with other studies and in particular with a more recent one; Shastri, Sultan and Tandon (1996) reach the same conclusion. Also Jubinski and Tomljanovich (2007) find similar results which are graphed in Fig. 1.3. The figure presents annual averages of share turnover for the 250 day period prior to the option listing date for both listed and control firms\textsuperscript{14} appearing in the sample. The figure indicates a clear upward trend in the trading activity over the sample period.

1.5 The effect of option listing on information and liquidity

Many papers find evidence of the information role that options provide. So, in this section we see that the introduction of options has a great impact on the information and also on the liquidity of the market. We observe these impacts through different components such as the bid-ask spread, the depth (number of shares that the market maker is willing to trade), weight placed on public information and/or price adjustment process. We first see an empirical evidence of an effect on the bid-ask spread of the underlying stocks when options are introduced (Fedenia and Grammatikos, 1992). Then we focus on the origin of this effect and on the impact it could have on the information and the liquidity of the market (R. Kumar, A. Sarin, K. Shastri, 1998).

\textsuperscript{12}This effect is discussing in the next section.

\textsuperscript{13}For the german case we already mentioned (in previous section) that the variance increase is partially explained by a higher trading volume.

\textsuperscript{14}The meaning of a control sample has been introduced in Section 1.3.1
1.5. THE EFFECT OF OPTION LISTING ON INFORMATION AND LIQUIDITY

1.5.1 Option trading and the bid-ask spread of the underlying stocks

For Fedenia and Grammatikos (1992), stock spreads reflect, among other things, the degree of information heterogeneity among traders. Therefore, changes in stock spreads following the listing of options may provide insights about the importance of options for the allocation of information in financial markets. Several studies suggest that spread is negatively related to trading volume and price level and positively related to volatility. So from the results we discussed about volatility and trading activity, we could wait to see, on average, a decrease in the spread after the listing of option. However we see that the signs of volatility changes are not always the same. So, if we refer on Ma and Rao (1988) who say that volatile (stable) stock become more stable (volatile) after option listing, we could wait to see the same variation in the stock spread. Consistent with this, Fedenia and Grammatikos identify a trade-off between the benefits of increased liquidity and the cost of informational externalities. Indeed, they find that highly liquid stocks tend to have spread increases, while illiquid stocks experiencing spread decreases. Their findings go further showing that, although volatility changes affect spreads around options listings, there appears to be a distinct effect on stock spreads due to the options listings.

Origin of the changes in the cost of trading

Skinner (1989) attributes two reasons why options listings may be associated with a decline in the cost of trading the underlying securities.

1. Options written on common stocks are similar to highly levered positions in the stock. For this reason, options are a relatively more attractive investment vehicle than un-
1.5. THE EFFECT OF OPTION LISTING ON INFORMATION AND LIQUIDITY

Deriving stocks for informed investors. Therefore, it is plausible that options listings is associated with movement by informed traders out of the stock market and into the market for options written on stock\textsuperscript{15}. As a result, market-makers are less likely to trade with investors who possess information superior to their own and, in equilibrium, will lower the bid-ask spread.

2. The existence of options markets and the associated hedging and arbitrage demands of traders will increase trading activity in the stock market. So with respect to the negative relation between the trading volume and the bid-ask spread, the latter should decline.

We see in Section 1.3.1 Damodaran and Lim (1991) find that the noise component of the variance declines after the listing of options. They trace the reduced noise after the listing to a decline in the bid-ask spread after option listing. What is interesting is that they explain this decline partially because of increased competition from market-makers on the option market and partially because of increased institutional interest in the stock after listing. Indeed there are two reasons why increased institutional interest is associated with lower bid-ask spreads.

1. Institutions trade on larger quantities than individuals do, and the generally negative relation between the trading volume and the bid-ask spread concludes.

2. Institutions are much more likely to take their trades to other markets if they can get lower transaction costs from market-makers in those markets. This increases the competitive pressures on market-makers on the underlying stock, especially after the opening of option markets.

1.5.2 Liquidity and information

By the fact that the bid-ask spread reflects, among other things, the degree of information heterogeneity among traders, a change in it should affect the information. As we will see in this part this is the case for R. Kumar, A. Sarin and K. Shastri (1998). They also show that the size of the bid-ask spread has an impact on the liquidity. In fact, they examined the impact of the listing of options traded on the main American exchanges (Amex, CBOE, NYSE, PSE, PHLX) in the period 1983 to 1989. They found that this impact is beneficial on the market quality for the underlying stocks in terms of higher liquidity, lower information asymmetry, and greater pricing efficiency.

By higher liquidity they mean a lower bid-ask spread and higher depth. To examine the impact of option listing on these parameters they use a method similar to that used for the

\textsuperscript{15}This is consistent with the idea developed by John, Koticha and Subrahmanyam (1993) saying that informed traders migrate from the stock market to the option market on the listing of options because of the leverage aspect of the options and their ability to avoid short sale restrictions. This is also consistent with what Anthony (1988) observes, to know that trading volume on options leads trading on stocks with a one-day lag (which suggest that informed investors are more likely to trade on the option than on the stock market).
examination of the volatility impact in Skinner (1989). They estimate for each day the daily relative bid-ask spread as the weighted average of all relative spreads in a day, where the weight is the amount of time the quote is valid. The relative bid-ask spread is the difference in the ask and the bid prices divided by the average of the bid and ask prices. Then the bid-ask spread ratio for a particular stock is defined as the ratio of the median daily relative bid-ask spread in the post-period divided by the median daily relative bid-ask spread in the pre-period. They form depth ratios in an identical manner using an average of quoted depths at the bid and the ask. Like in Skinner (1989), a ratio greater than one implies an increase in the observed variable, whereas a ratio smaller than one implies a decrease. So observing these ratios they find a statistically significant decrease in the spread and a significant increase in depth. These results allow them to conclude to an evidence of an improvement in liquidity in the underlying stock market. Naturally these results can lead to think of an associated increase in the trading volume. Indeed a decrease in the bid-ask spread could lead to higher trading frequency (average number of trades per day), and an increasing depth to higher transaction size (average number of shares sold/purchased in a transaction). In other words larger trades could be executed at lower transaction costs after option listings. That is exactly what the authors verified by distinguishing three variables and comparing their pre-listing and post-listing values: the standardized trading volume, the trading frequency, and the transaction size. The increase of the trading volume, being a combined result of the two latter variables cited above, provides further confirmation of the hypothesis that the liquidity in the underlying stock improves because of a fundamental change in the characteristics of the underlying security induced by the introduction of the options.

By lower information asymmetry and/or decrease in the level of informed trading in the underlying stock they think of a reduction in the adverse selection component of the bid-ask spread by the market maker. Analyzing again the pre- and post-listing values, they find such reduction that naturally lowers the spread and so improves liquidity. They also observed an increase, after option listings, in the relative weight placed on public information by the specialist in the price revision process. Indeed, they find that after option listings, each new trade conveys less new information to the specialist. So when he computes the expected stock value, which is based on a combination of public information (prior mean) and private information, the market maker places a bigger relative weight on public information. That shows a lower level of information asymmetry. This is consistent with the idea developed by John, Koticha and Subrahmanyam (1993) saying that informed traders migrate from the stock market to the option market on the listing of options because of the leverage aspect of the options and their ability to avoid short sale restrictions. And so this leads to a reduction in the proportion of informed traders in the underlying market lowers the adverse selection cost of the market maker.

By greater pricing efficiency, they mean a decrease in the variance of the pricing error, defined as the difference between the observed price and the efficient price. They observed a significant variance reduction that can be seen as a consequence of the reduction in the information asymmetry and the spread by improving liquidity. A lower variance in the pric-
A new approach: taking the reasons behind the option listing decision into account

1.6.1 Introduction

In this section we will review a relatively new study done by Mayhew and Mihov (2000) that accounts for the endogeneity of the option listing. In other words, they say that stocks that have been chosen for option listing were chosen for a reason, and that those reasons might account for the consequent changes in volume, price, and volatility. They argue that previous studies did not adequately account for the fact that option listing is endogenous. They find that firm size, volume, and volatility are positively related to the probability of listing but that this mostly depended on the subperiod. They gather data with all option listings since 1973 and all the candidates for option listing but that did not get chosen. They then create a control sample with the candidates that were not chosen and compare the effects on volatility, price and volume with the stocks that were chosen for option listing. Their results confirm that the trading volume of the underlying increases but that volatility and price movements are less important and depend on the subperiod chosen.

1.6.2 Selection bias and endogeneity problem

As we have already seen in Skinner (1989) and Damodaran and Lim (1991), option listing tends to bring down volatility. But what if exchanges listed those options because they were experiencing a temporary period of high volatility? In that case, there is room to believe that
1.6. A NEW APPROACH: TAKING THE REASONS BEHIND THE OPTION LISTING DECISION INTO ACCOUNT

Volatility went down not because of the option listing but because the period prior to the option listing was abnormal in terms of volatility. In an attempt to mitigate this problem, some researchers have excluded the period immediately prior to listing, and used earlier data for their pre-listing sample. This we will see, can increase the selection bias even more than not excluding this period. The authors go beyond the simple possibility that listing may be induced by recent high volatility. Listing decisions can be influenced by changing market conditions, temporary or permanent. Criteria such as size, prior volume, prior volatility (long term and short term) influence the option listing decision.

Previous authors were well aware of the endogeneity problem but have made several mistakes whilst attempting to mitigate the problem by excluding the period immediately prior to listing and the period immediately after the listing. They usually assumed that option listing was related to a temporary market condition. It would then be logical to exclude the period immediately prior to the listing. But suppose that a company has recently made a major breakthrough in their manufacturing and marketing and that this has led to an increase in the trading volume. This company would then become eligible for option listing. Now, if we exclude the period immediately prior to the option listing, and instead concentrate ourselves on a time period well before the option listing, we may actually increase the bias. Obviously by comparing that period with the one after option listing (while at the same time excluding the period immediately prior to the listing) we will see a major increase in trading volume. But this would not be due to the option listing but instead to the changes in the company itself. Suppose now that the previous studies were correct, suppose that the listing was related to abnormal temporary market conditions. But what if there was a lag due to administrative reasons between the abnormal period and the actual listing? Including the period immediately before listing would actually be correct, while excluding it and counting the one before it would make things worse. What if the exchanges foresee an event, and decide to list options on a stock prior to the event? We would also have a selection bias.

For these reasons, excluding certain periods does not prove to be a good strategy when attempting to shed light on the effects of option listing on stocks. The authors show us that there is indeed a endogeneity problem.

1.6.3 Criteria used for option listing and the Logit model

The authors investigate the relative importance of firm size, underlying trading volume (short term and long term), and volatility (also short term and long term) in the process of option listing. They test the following hypotheses:

\[ H_1: \text{Exchanges are more likely to list options on larger firms, stocks with higher prior trading volume, and stocks with higher volatility;} \]

\[ H_2: \text{The relative importance of firm size, volume and volatility in explaining option listing decisions has changed over time;} \]

\[ H_3: \text{Long-term (short-term) prior volume and volatility has become a less important (more} \]
1.6. A NEW APPROACH: TAKING THE REASONS BEHIND THE OPTION LISTING DECISION INTO ACCOUNT

important) determinant of option listing over time;

\[ H_4: \text{The apparent effect of option listing on volume and volatility is significantly different for stocks that were actually selected and stocks that appear to be good candidates for listing but were not selected;} \]

\[ H_5: \text{After accounting for the endogeneity of the listing decision, apparent option listing effects have changed over time;} \]

\[ H_6: \text{The apparent abnormal stock return in a window around option listing is significantly different for stocks that were actually selected relative to stocks that appear to be good candidates for listing but were not selected;} \]

\[ H_7: \text{The apparent abnormal stock returns around option listing are cross-sectionally related to changes in the volume and/or volatility of the underlying stock.} \]

Prior volume proves indeed to be a determinant of option listing. Stocks that are chosen for option listing have higher trading volumes than candidates that were not chosen but lower trading volumes than stocks that already have options traded. It therefore seems to be an important criterion for choosing a stock. This is true throughout the whole period where data was gathered (1973-1997). Therefore stocks with high trading volumes are the best candidates for option listing.

Contrary to trading volume preferences, prior volatility (250 days prior to listing) preferences have changed throughout time. In the period before 1980, lower volatility stocks were preferred. The average volatility of stocks that were eligible but not chosen was higher than that of the stocks that were chosen. However in the period after 1980, higher volatility stocks were given an advantage in the decision process. The prior volatility of stocks chosen was higher than the average volatility of stocks eligible but not chosen and than the average volatility of stocks that already had options traded. This might be due to the fact that the exchanges first listed the most actively traded stocks and once these stocks were listed, they started accounting for prior volatility too. High prior volatility therefore seems to be an advantage for option listing.

Market capitalization also proved to be an important criterion prior to the 80s. First, as expected, options tend to be listed on larger stocks first, so that the stocks selected for option listing tend to be considerably smaller than those already optioned. However, once the really large stocks had already been listed, it appears that the firm size becomes less important in the decision process. The selected stocks actually have a market capitalization less than that of eligible but not selected stocks in the late 80s.

The authors then run a regression using data on eligible option listing candidates in different sub-periods to find out how these criteria influence an option listing decision. They call this the logit model,

\[
L(LIST) = \beta_0 + \beta_1 \cdot VOLUME + \beta_2 \cdot STD + \beta_3 \cdot ABVOL + \beta_4 \cdot ABSTD + \beta_5 \cdot SIZE + \epsilon ,
\]
1.6. A NEW APPROACH: TAKING THE REASONS BEHIND THE OPTION LISTING DECISION INTO ACCOUNT

where \( L(\text{LIST}) \) is the log-odds ratio that a stock will be selected for option listing, \( \text{VOLUME} \) is average daily trading volume over the 250 trading days prior to the fifteenth of the month, \( \text{STD} \) is the annualized standard deviation of log returns over the same period, \( \text{ABVOL} \) is the ratio of the 30-day to 250-day average daily trading volume, \( \text{ABSTD} \) is the analogous measure for volatility, and \( \text{SIZE} \) is the market capitalization of the firm. \( \text{ABVOL} \) and \( \text{ABSTD} \) reflect the degree of abnormality in trading volume and volatility in the most recent period. What the authors do not specify is how they obtained the \( L(\text{LIST}) \) values for various stocks. Despite not knowing how they obtained these numbers, it is safe to say that this number reflects the probability for a stock to get picked for option listing. The following table gives us the results:

<table>
<thead>
<tr>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{VOLUME} )</td>
<td>0.0945</td>
<td>0.3351</td>
<td>0.0748</td>
<td>0.0401</td>
<td>0.0894</td>
</tr>
<tr>
<td>( \text{STD} )</td>
<td>0.1531</td>
<td>-0.2203</td>
<td>0.4021</td>
<td>0.2516</td>
<td>0.2577</td>
</tr>
<tr>
<td>( \text{ABVOL} )</td>
<td>0.1677</td>
<td>-0.1529</td>
<td>0.1090</td>
<td>0.1518</td>
<td>0.2439</td>
</tr>
<tr>
<td>( \text{ABSTD} )</td>
<td>0.0429</td>
<td>-0.0528</td>
<td>0.0112</td>
<td>0.0824</td>
<td>0.0002</td>
</tr>
<tr>
<td>( \text{SIZE} )</td>
<td>0.0501</td>
<td>0.0403</td>
<td>0.0921</td>
<td>0.1760</td>
<td>-0.0052</td>
</tr>
</tbody>
</table>

The table hints what we have already seen and predicted. Volume seems to be an important criterium in the 70s, then goes down but still remains positive. Smaller volatility seems to be preferred in the 70s, but after 1980 high volatility stocks are chosen for option listing. This is also the case for volatility 30 days before the eventual listing. Therefore \( H_1 \) is verified. \( H_2 \) and \( H_3 \) are also verified since the results clearly show that the criteria change over time and that the long term values rather than the short term variables gained in importance over time.

1.6.4 Option listing effects: study using control samples

In order to test for the endogeneity of the listing of options on a stock, the authors create three control samples of stocks that were eligible but not selected for option listing. They then compare the option listing effects of the stocks that were listed to the ones in these control samples. The control samples comprise stocks that the authors thought were very good candidates for option listing. So the control samples do not comprise all the eligible stocks. The "good" candidates were selected via the logit model.

The three control samples were constructed in the following way: The first control sample is made of stocks that have a similar size (i.e. market cap) as the ones actually chosen for listing. The second sample chooses the stocks that have the highest probabilities of listing according to the logit model. The third sample matches each chosen stock to a stock that had the same a priori probability of listing according to the logit model.
1.6. A NEW APPROACH: TAKING THE REASONS BEHIND THE OPTION LISTING DECISION INTO ACCOUNT

1.6.5 Results

The results show that there seem to be option listing effects on volatility but that this phenomenon has changed over time. In the period 1973-1980, the median variance of the selected stocks increased less than that of the stocks in the control samples. For the period 1980-1996 the median increase in variance seems to be more for the selected stocks but the effect is statistically indistinguishable. However for the period after 1996, this same result is statically important for all control samples i.e. the volatility of the selected stocks seemed to increase after option listing. This finding, that volatility increases with option listing, at least in some periods, runs contrary to nearly all previous results such as the ones in Skinner (1989). A possible explanation of course is that option listing indeed increases volatility. But then why is this true in some subperiods and not in others? The authors believe that the exchanges were forward-looking i.e. that they listed options on stocks because they anticipated a rise in volatility in the future.

As far as the underlying volume is concerned, the results seem to go along with previous literature. There seems to be a significant increase in trading volume for option listed stocks. The authors attribute this to the fact that option listing leads to increased hedging demand by option traders.

In order to study effects on the price, the authors use ACARs (Average Cumulative Abnormal Returns) and compare them across the control samples. They tend to find the same results as Sorescu (1999), i.e. that there is a negative effect on the price of the underlying. They also find positive returns before 1980, which goes along with Conrad (1989). However, only after 1991 do the returns seem to be significantly more negative than the ones of the stocks in the control samples. Overall, the negative price effect seems to be less pronounced than in Sorescu (1999). However, in the period 1973-1980, the returns are positive and are significantly more positive than the returns of the stocks in the control samples. This confirms Conrad’s (1989) views.

1.6.6 Conclusion

As we have seen, Mayhew and Mihov (2000) account for endogeneity in their quest of determining option listing effects. They do this by first analysing the criteria for stocks to be listed which proved to change over time. Based on these criteria they construct a logit model for each subperiod that evaluates the a priori probability for a stock to be listed. Based on this model, they construct control samples which they compare to the stocks actually selected for option listing. Their results seem to confirm the overall belief that option listing causes an increase in the underlying volume, but find different results as far as volatility is concerned. They also seem to suggest that the negative returns associated with option listing after 1980 are less pronounced.
Chapter 2

Index option listing effects on the underlying market

In this section we will focus on the listing of index options and their effects on the underlying market. We then compare these effects to the ones observed previously. Index options differ from stock options in the nature of the payoff which in this case is cash. Their underlying is as the name suggests the value of the index. This is a particularly useful tool for speculators that have beliefs on the movement of stock prices in general as opposed to the movement of individual stocks. Options provide bigger leverage and therefore speculators might be attracted by such tools. This in return would mean that there would be a decrease in the trading volumes of the underlying stocks, since the informed traders and speculators would migrate to the index options market. Moreover even though index options are used for hedging, empirical results suggest that index options are used less for hedging purposes than stock options. Migration of the informed traders and speculators to the index option market would also theoretically suggest that there would be less information asymmetry in the underlying market and therefore would lead to a decrease in bid-ask spreads. Volatility would also decrease since there would be less noise traders in the underlying market. The last two predictions seem to go along with stock option effects, the only exception being the trading volume.

However, another possible theory predicts that the introduction of index futures or options would lead to a migration of trading volume in general (not only the informed traders) to the futures or options markets. This would lead to lower volumes like previously but would also lead to higher volatility and bid-ask spreads due to the decline in liquidity. It is obvious that these theories can be verified or rejected only through empirical studies. Although there are quite a few papers on this subject, we have chosen to present Liu (2007) which we believe is the most comprehensive study up to date. It is also the most recent and her paper refers to the results seen in previous papers and upgrades the models previously presented.
2.1 The S&P 100 example

Shinhua Liu’s paper (2007) presents a comprehensive empirical study on the effects of the S&P 100 index option on the underlying stocks and not only the index itself. Whereas there are numerous papers that study the effects on the index, only a few studies focused on the effects on the stocks themselves. The S&P 100 index options were introduced in 1983. More or less the same methodology is used as for the study of stock option listing effects. Variables such as price, volatility of returns, volume and bid-ask spreads are measured in the period preceding the option listing and the period after the listing.

2.1.1 The method

Effects on trading volume

A first idea would be to create a sample of non-indexed options whose properties match those of the indexed options. But since the S&P 100 companies are the largest (in market capitalisation), a corresponding matching sample cannot be easily found. The author also explains that there might be spillover effects on stocks that match the indexed stocks because these stocks might be good diversification and hedging tools. Hence the method used for measuring changes in the indexed stocks is calculating the abnormal volume (AVOL) for each S&P 100 stock. The AVOL formula is as following

\[ AVOL_i = \frac{V_{i,evt}}{V_{i,est}} \frac{V_{m,evt}}{V_{m,est}} - 1, \]

where \( V_{i,evt} \) and \( V_{i,est} \) are respectively stock \( i \)'s mean trading volume (as a fraction of its shares outstanding) in the event and estimation period (the period prior to the listing of options), while \( V_{m,evt} \) and \( V_{m,est} \) are the mean trading volumes of the market during the event and estimation periods respectively. We should expect to get 0 if we expect that the listing will not affect the trading volumes. The estimation period is \((-250, -21)\) and there are three event periods: \((+21, +63)\), \((+21, +125)\) and \((+21, +250)\). The author omits the trading period \((-21, +21)\) to avoid documenting noise effects of the listing itself. As we saw in the previous chapter, Mayhew and Mihov highly criticize this kind of approach. But since most stocks in the S&P 100 already had options trading at the time of the listing of the index options, we believe that the endogenous effects of the listing are minimized in this scenario. She gets the following results:

<table>
<thead>
<tr>
<th>Event window</th>
<th>Mean AVOL (p-value)</th>
<th>Median AVOL (p-value)</th>
<th>percent. &lt; 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>(+21,+63)</td>
<td>-0.0962(0.0009)</td>
<td>-0.0921(0.0001)</td>
<td>76.38</td>
</tr>
<tr>
<td>(+21,+125)</td>
<td>-0.1326(0.0001)</td>
<td>-0.1094(0.0001)</td>
<td>76.38</td>
</tr>
<tr>
<td>(+21,+250)</td>
<td>-0.2349(0.0001)</td>
<td>-0.2327(0.0001)</td>
<td>93.06</td>
</tr>
</tbody>
</table>

The mean and median values are tested using the one-sample, two-tailed t-test (Wilcoxon signed rank test). She also computes the percentage of negative long-term abnormal values (percent. < 0) in each of the three periods. As we can see in the above shown table,
there is a significant decline in trading volumes of the indexed stocks. Looking at the last event window (+21, +250) we see a 23% median decline in trading volumes and a decrease in trading volumes for more than 90% of the indexed stocks. This is in contradiction with what Jegadeesh and Subrahmanyam (1993) who also studied the effects of index options on the underlying market. Liu (2007) criticizes their approach pointing out the fact that they didn’t not adjust with respect to the market volume. They do however admit that the volume increase they observe might be due to market changes.

Therefore our hypothesis proves to be correct: there is a significant migration of traders from the underlying market to the index options. Such a decrease in volume can be detrimental for the bid-ask spreads because one can assume that there is less liquidity in the market. We shall therefore look at the effects on the bid-ask spread next.

Effects on the bid-ask spread

The bid-ask spread can be modelled in the following way (Roll(1984)):

$$ s = 2\sqrt{-\text{Cov}(r_{t-1}, r_t)}, $$

where $r_t$ is the close-to-close return for a sample stock over that of the market. To account for potential marketwide movements in spread, the author uses the market-adjusted return (stock return - market return the same day) in the estimation of the bid-ask spread. The bid-ask spreads are estimated before the listing and after the listing. The results she obtains are quite interesting: Despite a great fall in trading volumes, bid-ask spreads drop about 39%. This is disturbing since bid-ask spreads give us a good insight on the liquidity of the stock. Since trading volumes are lower, one would assume that the liquidity of the stock will drop. This is however not the case here. We can therefore assume that only the informed traders and speculators migrated to the index options market thus providing for less informational asymmetry in the underlying market. This then led to lower bid-ask spreads. Another potential explanation was that market makers in the underlying market were facing more competition and therefore had to reduce the spread but the author does not mention this hypothesis. We still have to account for other variables that might have affected this drop. Without that we cannot attribute this drop to the index option listing. The author checks for the robustness of the univariate results by running a multivariate regression controlling factors known to affect bid-ask spread, including price, trading volume and volatility. We call SPRD the bid-ask spread (the dependent variable), while the independent variables are average trading volume (VOL), price (PRC), and return variance (VAR), and a dummy variable (DUM) which is equal to 0 before the listing date and 1 after the listing date. We naturally seek to evaluate the coefficient in front of DUM to see the effect of the listing, in other words $\lambda$ quantifies the effect of the actual listing. The regression model is as follows:

$$ \ln SPRD_{it} = \alpha + \beta \cdot \ln PRC_{it} + \delta \cdot \ln VOL_{it} + \gamma \cdot \ln VAR_{it} + \lambda \cdot DUM + \epsilon_{it}. $$

As predicted, $\lambda$ is negative, therefore the index option listing causes a decline in the bid-ask spread. Moreover, the multivariate regression shows us that this causality is direct. These
2.1. THE S&P 100 EXAMPLE

results go in the same direction as in our previous chapter, i.e., index options seem to bring the same effects on the liquidity of the stock as stock options do.

Impacts on price volatility

The method used to measure changes in price volatility is the same one used for measuring the changes in the trading volume. The author estimates the abnormal variance ratio (AVAR) for each sample stock which is as follows:

$$AVAR_i = \frac{\text{var}_{i,\text{evt}}}{\text{var}_{i,\text{est}}} - 1,$$

where $\text{var}_{i,\text{evt}}$ and $\text{var}_{i,\text{est}}$ are respectively firm $i$’s variance of daily return in the event and estimation period, while $\text{var}_{m,\text{evt}}$ and $\text{var}_{m,\text{est}}$ are respectively the variance of daily return for the market. Therefore the abnormal volatility is standardized. Under the assumption that there are no volatility changes induced by the listing, we would expect AVAR to be 0. The following results are obtained:

<table>
<thead>
<tr>
<th>Event window</th>
<th>Mean AVAR (p-value)</th>
<th>Median AVAR (p-value)</th>
<th>percent. &lt; 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>(+21,+63)</td>
<td>-0.1441 (0.0009)</td>
<td>-0.1617 (0.0001)</td>
<td>83.33</td>
</tr>
<tr>
<td>(+21,+125)</td>
<td>-0.1292 (0.0001)</td>
<td>-0.1485 (0.0001)</td>
<td>80.56</td>
</tr>
<tr>
<td>(+21,+250)</td>
<td>-0.1457 (0.0001)</td>
<td>-0.1619 (0.0001)</td>
<td>86.11</td>
</tr>
</tbody>
</table>

As shown in the table, a significant decrease in volatility is measured. More than 80% of the firms report a decrease in volatility. As we have seen in the previous chapter, stock market volatility varies over time with factors such as stock price and trading volume. Without controlling for these volatility-related variables, we cannot reliably attribute the volatility effects detected through the univariate tests to the launching of the index options. Therefore a multivariate regression needs to be done. We denote VAR the stock volatility, and once again the author introduces the dummy variable DUM. The regression model is as follows:

$$\ln VAR_{it} = \alpha + \beta \cdot \ln PRC_{it} + \delta \cdot \ln VOL_{it} + \lambda \cdot DUM + \epsilon_{it}.$$ 

The results we get are as expected. $\beta$ is quite significantly negative, i.e., higher prices are accompanied with lower volatility, which justifies the need to control. However, $\lambda$ is also significantly negative which confirms that there is an overall decrease in volatility among the stocks in the sample. This finding also goes with the hypothesis that the advent of index options has led speculators and informed traders to migrate from the underlying market to the index options market.

Changes in price and systematic risk

With methods similar to the ones shown above, the author concludes that the systematic risk $\beta$ and price does not change with index option listing. This confirms previous studies.
2.1. THE S&P 100 EXAMPLE

Conclusion

Liu (2007) does a very thorough and consistent study on the subject of index option listing effects on the underlying market. The main difference between her study and previous ones such as Jegadeesh and Subrahmanyam (1993) and Kumar & it. (1995) is that she accounts for the market adjusted variables. The results report a decrease in trading volumes, lower bid-ask spreads and lower volatility on average. The only difference with stock option listing effects is the lower trading volume reported. This is due to a migration of informed traders and speculators to the index option market and a reduced desire to hedge with index options as opposed to stock options.
Chapter 3

OTC stock option listing effects

3.1 Introduction

We have covered up until now the option listing effects of exchange stock option listings and index option listings. In this section we shall cover OTC stock option listings and their effects. OTC stocks as their name suggests are stocks that are traded over the counter and not on exchanges such as the NYSE. These are usually less known and smaller companies. Should there be any difference in the effects when compared to exchange traded stocks? We shall see that, yes, there are differences. OTC stocks have different characteristics from exchange traded stocks in the way they are traded. One of the two main differences are that since OTC stocks are less known and less followed by analysts, so there is more informational asymmetry in the underlying market than for exchange traded stocks. The other difference is that market makers in exchanges are monopolistic, i.e., their actions have to be approved by the exchange, while OTC dealers face no such restrictions. We have seen earlier that option listing results in lower bid-ask spreads in the underlying market because there is less information asymmetry and because market makers face competition from option market makers. However, it is not safe to assume that a monopolistic market maker will react the same way as a competitive market maker. Furthermore, the information asymmetry may not decrease at all, since option trading on OTC stock may attract new traders and thus more noise, which would also increase trading volume and volatility. Few papers have attempted to quantify option listing effects on OTC stock primarily because of lack of interest or lack of data. Nevertheless Fedenia and Grammatikos (1992), Long, D. M., Schinski, M. D., & Officer, D. T. (1994) and Wei, Poon and Zee (1997) have produced interesting studies on the subject.

3.2 Review of the literature

We have already presented most of Fedenia and Grammatikos (1992) views. They focus on the overall study of bid-ask spreads. While they include OTC stocks in their study, it is not the main axis of their study. They find that contrary to their exchange traded
3.3. CONCLUSION

counterparts, OTC stocks experience a slight increase in bid-ask spreads after option listing. They attribute this to the fact that market makers in the OTC already face competition and will not significantly change their behavior after option listing. Wei, Poon and Zee (1997) produce a complete study on option listing effects for OTC stocks.

The authors follow criteria and variables such as insider trading (informed traders), insider holdings, speed of price adjustment, trading volume, and price volatility in order to successfully quantify the effects of the option listing on the OTC stocks. They run multiple multivariate regressions such as the ones seen in previous chapters in order to have a robust result. Their study on bid-ask spreads is inconclusive. There is a slight increase in the bid-ask spread, but it is not statistically significant. This confirms Fedenia’s and Grammatikos’s (1992) views. They attribute this once again to the fact that market makers in OTC markets are already competitive and do not change behavior after the arrival of option market makers. As expected, informed traders migrate to the options market and this thus leads to less information asymmetry in the underlying market. But this effect is off-setted by the arrival of new traders. Indeed, after option listing OTC stock seem to be more attractive, to investors and analysts too. The arrival of new traders increases the trading volume and also contributes to an increase in volatility. Exchange traded stocks experience the same phenomenon but to a lot lesser extent, since they are already actively traded and followed by analysts. Options on these stocks do not attract a sufficient number of new traders, therefore the volatility stays unaffected and even decreases due to increasing liquidity. Fig. 3.1 compares the change in volatility in exchanges and OTC markets. This is however not universally true, as we have seen in the Heer, Trede and Wahrenburg (1997) study. German stocks started attracting new investors from abroad because of the possibility of options trading, thus increasing volatility. We have the same effect here: OTC stocks start attracting more investors after their option listing. Another possible reason for an increase in volatility is the fact that option trading increases the trading strategies available to informed traders, which make information more difficult to infer and the market less stable. This view is strongly supported by Biais and Hillion (1994).

3.3 Conclusion

Empirical results confirm expectations. Bid-ask spreads do not decrease as in exchange traded stocks. This is primarily due to the fact that market makers in OTC markets are already competitive and increased competition (option market makers) does not necessarily lead them to lower bid-ask spreads. Trading volume also increases as expected because of new hedging techniques and mostly because of the arrival of new traders as experienced in the German markets. This new surge of investors accounts (who are mostly uninformed traders) for higher volatility in the underlying market after the listing of options. A decrease in speed-adjustment is also an effect, but an indirect one, since this is caused by the migration of informed traders to the options market. This should indeed lower volatility but it does not do it enough to off-set the higher volatility caused by the arrival of new investors.
3.3. CONCLUSION

Figure 3.1: Cumulative average residual volatility (C-A-R-V) for the NYSE and OTC samples \([-252, +252]\) days around the options listing date
Chapter 4

Stock Option Delisting Effects on the Underlying Market

Up until now we have taken great interest into quantifying and explaining stock option listing effects on the underlying market. Although the literature on delisting is scarce we thought it would be a useful addition to this paper. If option listing causes certain effects, shouldn’t these effects be reversed once a stock is partially or completely delisted? One therefore predicts that delisting should be accompanied with higher variance, lower trading volumes, and higher bid-ask spreads. Research on this subject was quite difficult, therefore we found only one study that approaches the subject, the one done by Chaudhury and Elfakhani (1997) who analyse stock option delisting effects in the Canadian market.

In order to quantify changes in volatility and volume Chaudhury and Elfakhani (1997) use market-adjusted variance and volume ratio, i.e. :

\[
\text{Ratio}_{\text{volume}} = \frac{V_b}{V_a}, \quad \text{Ratio}_{\text{volatility}} = \frac{\text{var}_b}{\text{var}_a},
\]

where \(V_b\) and \(V_a\) are the average trading volumes before and after the delisting event respectively, and \(\text{var}_b\) and \(\text{var}_a\) are the average return variances before and after the delisting event respectively. The predictions imply that \(\text{Ratio}_{\text{volume}}\) should be smaller than 1, and that \(\text{Ratio}_{\text{volatility}}\) should be greater than 1. The hypotheses that the authors tested were the following:

\[H_1: \text{On average, there is no effect for option delisting on the variance of the optioned stock.}\]

\[H_2: \text{On average, there is no effect for option delisting on the volume of the optioned stock.}\]

\[H_3: \text{On average, there is no effect for option delisting on the beta of the optioned stock.}\]

Using the usual statistical tests, the authors cannot reject hypotheses 1 and 3 (the ratios are not statistically different from 1), but were able to reject hypothesis 2 with \(\text{Ratio}_{\text{volume}}\) quite significantly lower than 1. Therefore there is a significant decrease in trading volumes
in the underlying stock which confirms our predictions. However, we have seen that option listing usually decreases volatility, therefore one could assume that option delisting would be accompanied with higher volatility. This appears not to be the case. The authors therefore question previous studies such as Damodaram and Lim (1991) that showed that option listing leads to a decrease in volatility rather than attributing the lack of change to a new phenomenon. Since the beta remains unchanged after option listing (previous studies), one could also assume that it remains unchanged after delisting. This is indeed the case, the systematic risk does not appear to be affected by stock option listing and delisting. Unfortunately the authors do not quantify the effects on bid-ask spreads due to lack of data. They do however predict that these should be higher after delisting, due to lower trading volumes (less liquidity).

All in all, the authors’ results are inconclusive as far as volatility and liquidity are concerned. However, they do measure a significant decrease in trading volumes which confirms expectations. One possible criticism of this paper could be that the authors did not really take into account the endogeneity of the problem as introduced by Mayhew and Mihov (2000), i.e., the authors did not take the reasons behind the listing decision into account. Options on some stock may have been delisted due to several reasons, such as unusually high volatility or abnormal price movements.
Conclusion

Although different studies convey different aspects of option listing effects, all the studies agree on one thing: options are not redundant securities. All the papers we have studied have indicated that are some effects of the listing of options on the underlying market. Most academics agree that options contribute to the stability of the underlying market by increasing liquidity depth through higher trading volumes, lower bid-ask spreads and lower volatility. Exchanges wanting to improve liquidity in some stocks should definitely list options on them, however if they want to reduce volatility it might not always prove to be the right answer with recent studies having a different view as far as the decline in volatility is concerned. This has led us to believe that option listing effects may have changed over time or that we have failed to account for some exogeneous or endogeneous effects on the listing itself. Even if we admit that option listing effects are not always the same, effects whatever their nature do exist. This is a fairly important result and therefore exchanges and companies themselves should pay attention to the studies we have analysed above. Whether we should believe in the stabilizing effects of option listing or not is a more difficult question and should continue to be addressed in the future.
Bibliography


