Examining the Introduction and Expiration Price Effect of Warrants on their Underlying Assets: Evidence from the Johannesburg Stock Exchange

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ABSTRACT

The aim of this paper is to examine the price effect exerted by derivative warrants on their underlying shares around the introduction and expiration days of the warrants. The study is based on the JSE for the period 2008-2012 and employs the event study methodology. The study assesses the effects generally and for puts and calls separately. Overall, it is found that the price effect depends on the type of warrant as well as the warrant's "moneyness". The in the money sample of puts and calls show significant price effects around the listing and expiration days respectively. The out the money sample of puts and calls indicate no price effect. Each of the samples is subjected to further volume analysis in order to assert if the price effects are linked to any changes in trading volume. This paper has implications for the regulation community and warrant investors on the JSE.

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1 INTRODUCTION

1.1 Research Aim and Context

This paper studies the price impact exerted by the introduction and expiration of derivative warrants on the underlying shares. The study focuses its attention on analysing the phenomenon within the context of the Johannesburg Stock Exchange (JSE) in South Africa (SA). The paper has implications for policy makers who want to better understand the connection between derivative instruments and their underlying assets. At the same time, it also has implications for retail investors looking for share price anomalies that they can exploit for profit within a developing market setting.

Although the focus of this paper is on the introduction and expiration effects, it also has the added benefit of shedding some light on the warrants market in South Africa. Considering the fact that the JSE has targeted the instrument at retail investors, it is striking to see how difficult it is to find information on some of the basic dynamics of the instrument such as who the big issuers are and the type of warrants that are usually written. This paper hopes to provide more information on this somewhat illusive instrument.

The study therefore aims to contribute by expanding the global research on warrants. The study also contributes on a more general level by providing some analysis on the price effects of derivatives within a developing market setting since most studies have focused on the United States thus far.

1.2 Contextual Background

It is important to stress that the study assesses the price effect of derivative covered warrants and not equity warrants. Covered warrants differ from equity warrants in that they are issued by a third party, normally a financial institution like a bank, and not by the underlying company itself. Covered warrants are therefore "options" that are issued by banks where the bank issuers also commit to serve as the market makers[1]. Consequently, the theory of warrants is fundamentally based on that of normal exchange options. Warrants are contractually structured much like options in that they give the investor (holder) the right to buy or sell the underlying assets at a predetermined price before a predetermined date.

[1] For the remainder of the paper these bank issued warrants will be referred to simply as warrants

However, globally, academicians have paid little attention to warrants largely because they are not offered within the US markets. The major reasons for their exclusion from the US markets have been pinned on the fact that the USA has a well-developed futures and options market as well as the regulatory difficulty that warrants might impose on the US markets. As such, a number of empirical studies investigating the introduction and expiration effect of futures and options have been conducted but not much has been written about the effect of warrants.

In fact, the price effect of traded options has been at the centre of many policy and research discussions over the past 20 years (Chuang & Chuang, 2005). Some of the studies conducted in the United States for example, Bansal et al (1989), Conrad (1989) and Detemple & Jorion (1990) show that options are linked with an increase in the underlying share prices around the listing date.

However, other studies such as that by Sorescu (2000) appear to show contradicting results for different periods of study. Sorescu (2000) agrees that there are positive abnormal returns from 1973 to 1980 but shows that there are negative abnormal returns to those options listed after 1981 and later in the US. A similar finding of negative returns prior to the listing date is also found by Haddad &Voortheis (1991), who find that there is a general downward pressure in the cumulative abnormal returns around the listing date. The inconclusive results across different studies is probably one of the biggest driving forces towards further research in different markets. It is due to these documented contradictions that it makes sense to study the price effect of derivatives in South Africa specifically.

1.2.1 Difference between Warrants and Options

The contractual and theoretical base for warrants may be based on options but there are still some important differences between warrants and normal traded options globally (Chan & Peretti, 2009). In the context of the JSE, warrants are traded on the equity market whereas options are traded on the derivatives market; warrants are issued by listed firms, whereas options are listed by the exchange; the volatility levels are set by the issuing company for warrants, whereas volatility levels are set by the exchange when it comes to options and warrants also typically have longer expiration periods that can run from 3 months to 8 years on the JSE.

Warrants trade much like shares in that each warrant IPO has a limited and fixed number of warrants that can be issued and traded at any point in time. As such it is not possible to sell the warrant short without actually having it in hand. Thus any obligation to buy or sell the underlying asset will always sit with the issuer, being the bank. The bank will therefore have an incentive to buy back the warrant in order to lock in profits whenever a previously high selling warrant is no longer performing favourably for the investors. This is not the same as options that are issued by exchanges because the exchanges have no vested interest in the performance of the options once they have been issued. Their interest is more in generating volumes so that customers can be charged exchange related fees.

What is important to note as a major difference is that warrants cannot be held short by the retail investor. This is not the case in regular options market where individuals can open up margin accounts and also be involved in the shorting of options without actually holding them. Warrant issuers will therefore typically have a net short position. Due to the fact that the banks are market makers, in conjunction with the fact that retail investors cannot hold short positions, it is clear to see that banks are at the centre of setting the bid and ask prices for warrants because they must always take one side of the transaction (Bartram & Fehle, 2008).

Furthermore, since warrants are sold by profit maximising banks, a very useful warrant issuing strategy is one that attracts the ignorant investor with the possibility of easy gains. Aitken and Segara (2005) support the view that banks usually make profits from warrant issues. In addition to this, Chung and Hseu (2006) also find that banks display a strong ability to select overvalued shares as the underlying assets for call warrants which further demonstrates their profit intentions. This should serve as a caution for the retail investor who decides to take the other side of a warrant issue.

In other words, according to Chung and Hseu (2006), the best warrants would be written on shares that have a good short-term run in the desired direction for the banks, but subsequently reverse momentum before expiration, to the disappointment of the investor. It is this ability to choose these kinds of shares that has made warrants a lucrative business for these banks. Theoretically, there can be an argument posed about the possibility of stock price manipulation by these banks in order to shift the warrants in the desired direction of out the money, which leads to a price effect around important warrant dates.

Another reason for underlying price movements may be due to the selective timing of derivative issuances. Investment banks will tend to be very selective about the timing of the issuances and in some cases may end up choosing the same times to list warrants. This will cause clustering around a certain date and this clustering is likely to exert more price pressure on the underlying assets due to hedging demands.

Legally, in South Africa, there is also an obligation for the issuers to hedge their positions in one way or another. In fact a hedge requirement is imposed on most warrant issuers globally (Whalley, 2011). There are no hedging requirements imposed to any of the market participants within the normal options market as all transactions are secured by some kind of clearinghouse.

Due to the differences in options and warrants, the effects of the two instruments may tend to be different even though they are very similar in their contractual nature. As such there is also a possibility that their price effects on the underlying assets will be different to those documented in the options literature. For example, the fact that warrants have longer expatriation dates intuitively may result in a more gradual effect on prices; the fact that options are listed by banks that need to comply with a certain collateral requirements introduces more possibility of delta hedging induced effects. This is why although options have a strong bearing on warrants, anyone who has serious interest in warrants cannot only rely on the options literature.

1.3 Size and Growth of the Global Warrant Market

Another likely reason for the lack of academic research is that warrants are considered a relatively new trading instrument across the globe. The market for warrants was first developed in Asia and Europe in the 1990's and although warrants have been traded globally for decades, they really only gained global popularity from 2002 onwards. Nevertheless, these instruments have become heavily traded by retail investors in some of the major markets around the world and they now present an important investment alternative for South African retail investors.

Although warrants have gained their popularity largely because they are packaged to be more accessible to smaller investors, in recent times, developing markets such as Hong Kong and Taiwan have seen warrants become serious business for their major financial institutions. (Hsu and Wang, 2003). Globally, the first warrant markets were founded in Frankfurt and Hong

Kong in 1989, which is why these are some of the most mature markets. The first South African warrants were issued only in the late 1990's.

As can be seen below in table 1.1 and 1.2, internationally, the instrument's top issuers have been Hong Kong, Germany, Switzerland and Australia. It is interesting to note that South Africa is still small in a large global market. It makes sense therefore that there has been a gap in the study of the SA warrant market. However at more than USD 51.83 million in vanilla warrants traded in 2013, there is a clear demand for the instrument in SA. The data also shows that there appears to be a drop in demand over the years for vanilla warrants but this is due to exotic issuances becoming more prevalent.

Table 1.1 Value Of Vanilla Warrants Traded By Market (in million USD)

Exchange Name	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Mexican Exchange	32.03	73.36	345.1	311.82	247.88	77.84	14.43	316.16	99.59	184.12	224.74
Australian SE	1877.49	2982.91	4802.3	7617.96	10567.74	5569.38	4764.9	4406.66	3586.21	3465.04	3931.07
Bursa Malaysia	NA	645.64	277.79	968.2	3981.85	355.99	321.7	1077.41	1617.15	1423.65	350.72
Hong Kong Exchanges	34006.41	67476.65	110480	230164.6	611131.9	577154.4	429574	533576.9	577089.4	410222.7	393683.5
Singapore Exchange	14.37	962.07	6520.28	9442.15	20439.04	14586.77	7802.22	4752.2	5603.17	4622.46	3946.55
Taiwan SE Corp.	3064.62	6555.7	4334.74	5372.72	7805.82	8404.38	3327.34	7029.14	9401.9	7965.6	11408.5
Borsa Italiana	14439.71	22866.66	59190.87	94470.02	130626.3	31748.54	NA	NA	NA	NA	NA
Deutsche Borse	50922.81	60294.28	162325.1	298104.7	467220.1	157531.9	91117.53	80943.92	89498.77	66715.36	74189.47
Euronext	11015.39	6214.35	18292.44	41865.86	53917.56	45101.3	33063.56	35410.52	39411.92	24508.9	22571.31
Johannesburg SE	246.23	399.34	649.12	1000.45	401.88	361.23	383.61	237.13	153.26	78.66	51.83
SIX Swiss Exchange	14858.55	21727.12	24557.77	39521.42	66810.14	56245.1	36023.16	42254.64	55494.98	34821.29	34076.57

Table 1.2 Number of Vanilla Warrants Traded By Market

Exchange Name	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Mexican Exchange	3	13	26	22	11	10	10	43	63	109	97
Australian SE	1395	1771	2447	3091	4028	3794	2443	2241	4370	5594	4552
Bursa Malaysia	NA	10	12	33	120	48	137	203	292	477	398
Hong Kong Exchanges	530	863	1304	1959	4614	4325	5059	6212	4928	4961	6335
Singapore Exchange	3	146	455	521	883	365	315	312	246	264	313
Taiwan SE Corp.	272	191	540	694	2085	1714	3573	5695	6869	7742	8159
Borsa Italiana	2594	3021	4076	4647	4408	3192	3289	3393	NA	NA	NA
Deutsche Borse	21431	27297	69457	129954	250720	415474	430341	618362	975717	1152372	1306745
Euronext	3770	4991	5338	NA	12622	15243	11722	18661	24787	24569	32751
Johannesburg SE	239	243	321	315	355	170	145	88	86	91	108
SIX Swiss Exchange	2662	3682	6246	10369	19062	21873	23645	30604	34820	32496	34283

Source: World Federation of Exchanges[2]

The only warrant issuers on the JSE are Standard Bank, Deutsche Bank, Absa Capital, Investec and Nedbank Capital, who may find this study useful for their delta hedging strategies. Standard

[2] Results for JSE agreed with data collected for this study

Bank has the greatest clout in South Africa in terms of the number of warrants written with more than 50% of the written warrants attributable to this institution. Although the above tables have been created based on plain vanilla warrants, the JSE also allows the trading of different kinds of warrants. Table 1.3 below summarises the main features of these different types of warrants. Single equity warrants and compound warrants are by far the most written as shown below.

Table 1.3 Types of Warrants Issued on the JSE

Single Equity Warrants	Single Equity Warrants (Vanilla Warrants) are issued on a single security. They are currently among the most popular type of warrant traded. Settlement is in cash terms or by delivery of the underlying security.
Basket Warrants	These are similar to single equity warrants except the underlying security is a basket of securities rather than a single security. The basket generally includes companies within particular industry
Compound Warrants	These are warrants that are written on warrants. These are targeted at investors who want to compound their leverage on the underlying assets.
Barrier Warrants	These are single equity warrants that have a barrier level into which the price of the underlying is confined. If this level is breached by the underlying security

Source: JSE

Table 1.4 below shows the number of warrants issued according to their type. As can be seen in table 1.4 there have been in excess of 2000 warrants issued on the JSE since 2008. There is a clear indication that vanilla warrants and compound warrant are among the most prevalent on the JSE. This finding is relevant as the study chose to focus only on vanilla warrants. The main reason being that the exotic options, as per their descriptions above, present some isolation difficulties due to their special properties.

Table 1.4 Number of Warrants Issued on the JSE by their Type

(Compiled from data collected)

	2008	2009	2010	2011	2012	2013
Number of individual vanilla stock warrants	170	145	88	86	91	108
Number of Basket Warrants	20	15	18	31	40	30
Number of Compound Warrants	255	170	128	113	105	108
Index warrants	51	71	64	63	50	47
Barrier	0	77	57	47	35	23
Total number of warrants	**494**	**477**	**359**	**341**	**323**	**316**

The exotic options are normally stock uncovered and the vanilla warrants are normally stock covered. Stock covered means that the bank must hold a position in the underlying asset before writing the warrant. Stock uncovered simply means that the issuer does not have to actually hold the underlying asset. However, the bank is required to show that it has a net tangible asset value base of at least R2 billion or provide some other form of guarantee according to section 19 of the JSE listing requirements for warrants.

1.4 The South African Regulation and How It May Impact the Warrants' Price Effect

The JSE has no special regulation on any types of warrants that cannot be issued, in contrast to for example Taiwan, where put warrants are not allowed to be issued (Chan & Jelic, 2007). However, it is worth noting that there are no American put warrants issued on the JSE. The most intuitive reason for this is because of the liquidity strain that an early exercise of American puts may place on the issuing banks.

As mentioned previously, according to section 19 of the listing requirements, all issuers of warrants must either cover their written positions with some kind of stake in the underlying asset or they must demonstrate that they have enough assets to serve as collateral for a possible exercise of the written warrants. It is the constant covering of these net short positions, otherwise known as delta hedging, which could give rise to a price effect. Intuitively, it is expected that this covering will escalate closer to the introduction or expiration of warrants. Of course this implies that the research makes the assumption that most of the banks will choose to cover their short positions with the underlying asset.

There is also a regulation that states that the shares on which warrants are written must be of the highest liquidity. It is therefore assumed that the price effect cannot be caused by reasons related to liquidity as one would expect on a developing market.

However, there is also one regulation that may result in a dilution of the expected price effect. According to section 19.10, uncovered warrants cannot be written on more than 25% of the total issued share capital and covered warrants cannot be issued on more than 10% of the underlying assets' outstanding shares. This is relevant because it has the implication of lowering the amount of trading that would be expected to take place around the event days.

1.5 Research Problem and Objectives

According to some of the literature and the intuitive insights made, it is clear that the price effect of derivatives is quite under studied within a developing market setting. On top of that, warrants have received particularly little academic attention despite their importance for retail investors in many developed and developing markets (including the JSE as shown). The aim of this paper is therefore to contribute to the study of derivatives within a developing market setting by examining the expiration effect of covered warrants that are traded on the JSE. The study aims to answer the following research questions:

1) How do South African covered warrants impact the prices of the underlying assets around their listing dates?

2) How do South African covered warrants impact the prices of the underlying assets around their maturity dates?

The first objective of the study is therefore to examine how warrants impact their underlying assets prices upon their listing. The second objective is to establish the price effect on their underlying assets as they approach expiration.

Applying some of the general findings in the literature and noting the inconsistencies, this study hypothesises the following:
A price effect imposed by warrants around the listing day and expiration day is prevalent. The nature of that impact is related to the "moneyness" and warrant type.

1.6 Brief on methodology

The study used data directly from the Johannesburg Stock Exchange historical database and share price data (closing prices) derived from the McGregor BFA database. The expiration dates and listing dates of all covered warrants from 2008 -2012 were assessed to derive a sample of events that were used to conduct an event study. The event study method is applied by Chen and Wu (2001), Chen and Wu (2010), Chan and Jelik (2007) and Pope and Yadav (1992). Chen and Wu (2001) choose 15 days as their event window, whereas Pope and Yadav (1992) select 5 days as the event window. The choice of the event window is somewhat subjective, but this study uses 5 days as its focus is primarily on the assessment of the short term influences around the introduction and expiration days. An estimation period of 60 days was used for that same reason. Longer periods have been used but the literature shows little benefit from using a longer period of time. Daily stock returns are calculated using this estimation period in order to get the expected/usual returns of the stocks by applying a 3 factor APT model. Brenner (1977) assesses other models that could be applied in the event study and asserts that the market model works as well as the other models. The market model states the following about the expected return of the underlying: R_i = alpha + Beta(R_m). If the returns during the event window differ from the expected returns, we can infer that it is due to the warrant. The standard t-test is used to test the significance at the 5% two tail region. The Wilcoxon Ranked Sign Test is also employed where the t-test results appear to be marginal.

1.7 Conclusion

This Introductory chapter has shown the relevance of this study by showing the growing importance of warrants globally. It is therefore relevant for retail investors as well as for the regulatory community in South Africa. The chapter provided a theoretical background on warrants and how they differ from their options counterpart, and also showed some examples in the options literature that indicates inconsistencies which are prevalent with regards to the occurrence of a price effect. The literature review will provide deeper analysis into some of these contradictions. The chapter also helped to provide some theoretical and intuitive reasons as to why one would expect to see a price effect on the underlying shares. One of the major reasons is the delta hedging pursued by warrant issuers around the introduction and expiration days.

After applying some of the theoretical insights, the study hypothesises that there must be some kind of price pressure exerted by these warrant instruments on their underlying assets and that the impact is dependent on the warrants type as well as its moneyness. In order to prove this hypothesis an event study methodology is used to conduct an assessment of the price influences that these instruments present on the underlying shares. The event study methodology is the suggested methodology that is employed in past literature.

The rest of the thesis is structured as follows: Chapter 2 will provide a detailed literature review in order to build a theoretical framework, after which a presentation of the method is provided in the methodology chapter (Chapter 3). The results and interpretation will follow in Chapter 4, after which the report will close with a conclusion of the results.

2 LITERATURE REVIEW

2.1 Introduction

The following chapter is a review of the theoretical frameworks that have been formulated through past literature. As mentioned in the introduction chapter above, options and warrants are very similar in their contractual mechanics. It therefore makes sense to first assess the literature on options before assessing the literature that is specific to warrants. The literature review will therefore be structured as follows: The review will be split into two. The first section will review all literature related to the expiration effect. The second part will then review all literature related to the introduction effect. Each section will begin by first analysing the options literature, in order to gain a basic theoretical understanding, and then it will move on to analyse the literature related directly to warrants. Finally, the chapter will conclude with a brief summary of the pertinent points found in the literature.

2.2 Expiration Effect Literature

2.2.1 Literature on Options and Futures

From the time that derivatives were introduced in formal markets, there has always been a concern about their influence on the underlying markets, particularly around the maturity date of options. Apart from the gambling argument, the most prominent objection against derivatives trading is that it may adversely affect the price and volume of the underlying shares. One of the earlier worries was that the derivatives would shift demand away from the underlying assets towards the derivatives. Such a movement away from the underlying assets was expected to cause a reduction in the liquidity of the underlying assets and thus cause a boost in the volatility and dealer bid ask spread. The other concern has been that the derivatives trading would shift speculative capital away from small cap investments and IPO's. These were some of the major concerns held by the Securities Exchange Commission (SEC) in the early 70's. This compelled the Chicago Board of Options Exchange (CBOE) to assign R. Nathan and Associates to conduct a study on these underlying concerns. The study is quite dated but this was the first official study on the effect that derivatives have on the underlying assets.

Unfortunately, the nature of a study of that importance is that it is often politically motivated and the results tend to have some level of bias, particularly since the study was commissioned by the CBOE itself. Nonetheless, a summary of the 1970's Nathan Report states: "The Chicago Board Options Exchange has been a useful and promising addition to the capital markets. Our

study has not found any evidence that the CBOE has had an adverse effect on the markets for underlying stocks or on the markets for low-priced stocks or new issues. Rather, during a period of great uncertainty in the capital markets generally, the CBOE has attracted a number of investors to return to equity-type risks through the risk redistribution, risk limitation, and various hedging strategies it makes possible. We believe this has helped improve the efficiency and fairness of the stock market itself." The study therefore found that there is no significant price effect exerted by derivatives on the underlying assets.

However, (Klemkosky, 1978) contradicted the findings of the Nathan report and established that underlying shares exhibited a decline of about 1% in the week before the expiration of the options but depicted a 0.4% gain following the expiration day. Since these two contradictory, but influential studies, and after the crash of 1987, there has been a growing academic interest related to the expiration effect that derivatives exert on their underlying assets (Kabir, 1997). In the US, the last hour of trading on the 3rd Friday of each month has come to be known as the ‘triple witching hour’ (Alkeback & Niclas, 2004). This is because of the large stock volatilities that are expected as futures and options come to expiration.

Since the late 1970's, the expiration effect of options and futures has been investigated by Klemkosky (1978), Stoll & Whaley (1987), Day & Lewis (1988), Chamberlain, et al., (1989), Chen & Williams, (1994), Karolyi (1996), Schlag (1996), along with Diz and Finucane (1998). However, most of these previous studies have chosen to focus their attention on the derivatives' impact on the volatility of the underlying assets and fewer have assessed the price effects.

The previous studies that have focused on the price effect reported mixed results. It appears that the contradiction first found between the Nathan report and Klemkosky (1978) endures to this day. Schlag (1996) reports that there is no significant change in the underlying asset on the expiration day of futures and options within the German market. Chen and Willams (1994) find the same result using much fewer observations in the US. On the other hand, Day and Lewis (1988) and Chamberlain et al (1989) find that there is a statistically significant effect on the mean return of the underlying shares but only when there is a simultaneous expiration of futures and options in the US and Canadian markets respectively.

In terms of the direction of price movements, Day and Lewis (1988) observe an upward movement in share returns immediately prior to the expiration but according to the authors, the

returns reverse almost immediately after expiration. Conversely, outside the US, Pope and Yadav (1992) found evidence in the UK that confirms the initial results of Klemkosky (1978) which is a negative price effect before expiration. This indicates that even among those studies that detect price effects, there is no universal agreement with regards to the direction of stock movements.

Furthermore, Stoll and Whaley (1987) provide an important analysis about the economics of the price effect. Although, their results of a price effect are statistically significant, they question the economic significance and find that after accounting for transaction costs, the price effect is not noteworthy. This is an important point of view because it postulates that even if there is a price effect, a speculator would be unable to make any gains due to the transaction costs.

These mixed results are a cause for concern because they seem to indicate an inability to generalise the expiration effect in all markets. This indicates that there is value in trying to understand the expiration effect that is specific to each market. Apart from differences in methodology, Alkeback & Hagelin (2004) hypothesise that the mixed results could be the consequence of the differences in the regulatory environment of each market. Alkeback & Hagelin (2004) performed their study on the Stockholm Stock Exchange (SSE). They investigated the price effect in 2 regulation periods. The first period was one was when short selling was prohibited and the second period was when short selling was allowed. By looking at periods of different short selling regulation in the SSE, the study showed evidence that the expiration effect was significantly different in the SSE in each of the regulation periods. The evidence found in the SSE gives credence to the idea that the expiration effects may differ from market to market and from time to time depending on the regulatory environment. Once again, there is thus some importance in trying to understand such an effect within the JSE that has a different regulatory environment as the other markets that have been studied to date.

It is also possible to infer from Alkeback & Hagelin (2004) that the biggest cause of the expiration effects could be the transactions which occur around the expiration day as investors attempt to unwind their positions. In a market where this can be done easily (without short selling regulation for example), with low transaction and search costs, one can expect a higher expiration effect. This insight is consistent with the explanation provided by Klemkosky (1978), Klemkosky and Maness (1980), Officer and Trennepohl (1981). They suggest that the expiration effect around the expiration day is caused by these arbitrage and hedging

transactions and suggest that this is why there is no significant effect on the actual expiration day, as many investors and issuers have unwound their positions by then.

Another contrary view by Bhattacharya (1987) is that the effect is not necessarily caused by unwinding of transactions but it is instead caused by some option holders who attempt to manipulate the spot market in order to benefit from the options market. This view has some grounds but it will always be difficult to prove the intentions of market participants. Clearly, there are various reasons as to what may cause a price effect and Whaley and Stoll (1987) summarise all possible reasons as follows: In general the effect may be caused by arbitrage transactions, cash settlement consequences, the depth and liquidity of the market and market manipulation.

Although there has been no general agreement as to the price effects of derivative expirations, there has been a general consensus that expiration days give rise to increases in the trading volume. In fact, almost all studies observe a change in the underlying volume on expiration days of futures and options. The direction of that volume will most likely lead to a price effect and where the direction of trading is ambiguous, there will be no price effect. For this reason, this paper also investigated the changes in volume around the event days.

In summary, the expiration effect of options is somewhat inconclusive. This is possibly because of the differences in regulatory environments. There does however appear to strong consensus that some kind effect does exist. The economics of the price effect is also something that must be considered as statistical significance does not always agree with economic significance. There is also some consensus that changes in volumes are observed. Since warrants are similar in nature to options, one might expect to see similar contradictions within the warrants literature. At the same time one may also expect to see a different effect since warrants have some distinct features.

2.2.2 Expiration Effect Literature for Warrants

As noted by Chan & Wei (2001) and Chen & Wu (2001) the market also views news related to warrants as news that is relevant to the underlying asset. It is therefore reasonable to expect that some kind of abnormal trading should emerge as a consequence of the notice of expiration for warrants. Therefore a study on the expiration effect of warrants is equally as important as that of options.

In the Hong Kong market, Chen and Wu (2001) found a positive effect immediately before, and a downward pressure immediately after expiration days for in-the-money warrants. The study only noted random selling pressure of stocks related to out-the-money warrants and no significant price effect after the expiration day. The findings are quite important because they separate the expiration effect for in-the-money and out-the-money warrants. Even with previous option's literature, this sub-sampling approach is quite unique. It provides an opportunity to assess why these two sub-samples would have different outcomes. The increase in underlying asset prices, for in-the-money warrants, prior to expiration, is likely to be caused by the issuers buying up more stock in order to meet their obligations. The random selling pressure observed with the out-the-money sample could be attributed to issuers unwinding their positions in the underlying assets. Some calls may have been very deep out-the-money and others slightly out. This could be the reason as to why the selling appears to be sporadic. These results are consistent with those found by Chan and Jelik (2007) in Taiwan. Unfortunately, the robustness of the Taiwanese study is somewhat questionable as it was based on a very small sample of 9 warrants. It is also worth mentioning that the results of Chen and Wu (2001) cannot be generalised to all warrant types as the study was based on call warrants only.

A Chinese study conducted by Chen and Wu (2010) found results that were in contrast with those found in the Hong Kong market. The study found that there was a negative price effect experienced by calls prior to expiration and that there was no price effect experienced by put warrants. Further analysis does provide some insight as to what may have caused the inconsistency. Firstly, it is worth noting that the sample size was significantly lower than that in the Hong Kong study. Secondly, there are some stark differences in the Hong Kong market compared to the Chinese market. The major difference is the fact that the issuer in the Chinese market is expected to have 100% of the shares ready for delivery and deposited into the clearing house upon the issue of a new warrant. This means that there are no opportunities for delta hedging in the Chinese market as there are in the Hong Kong market. It is also worth mentioning that this regulation does not exist in the South African market. Nevertheless, the results indicate a strong case for the conclusion found by Alkeback & Hagelin (2004) that the regulatory environment of the market has a large influence on the expiration effect and therefore that it is pertinent to conduct a study for each individual market.

Another important point is that all the puts investigated by Chen Wu (2010) were out the out-the-money. Therefore, the insignificant price effect is in line with the initial finding of Chen and Wu (2001). It is thus still reasonable to infer that the "moneyness" of the warrants may have an influence on the impact of their expiration effect. As with the previous studies on options, there is a general consensus that the change in the trading volume corresponded closely with the price effect.

2.3 Listing Effect Literature

2.3.1 Literature Related to Options

According to Ross (1976) and Arditti & John (1980), introducing options assists to make incomplete markets more complete by allowing investors to have a broader opportunity set. The authors believe that this assists with reduced volatility, increased equilibrium price and improved liquidity. There is also a broad array of empirical evidence that supports the argument of an increased equilibrium price. Within the UK markets, (Watt, et al., 1992) found evidence of positive excess returns, which was later supported by Stucki and Wasserfallen's (1994) in their examination of the Swiss markets. Both these studies also indicated signs of a price reversal after the event date.

Earlier, Conrad (1989) and Detemple & Jorion (1990) also found significant increased prices on the underlying shares by assessing the listing impacts of options on the (CBOE) and American Option Exchange (AOE). Conrad (1989) examined options data in the United States for the period 1973-1980. Her approach is noteworthy because it involved filtering out the earlier observations in order to account for a learning curve that may impact the earliest observations. The results showed a significantly positive price effect on the underlying shares, which began 3 days before the listing day. On top of that the effect showed no sign of reversal. Unfortunately, the author does not provide an analysis of the volume traded and so it is difficult to argue what may have caused the price effect. Conrad argues that dealers create a demand pressure in anticipation for the writing of covered warrants. The argument makes sense but does not hold when assessing the reason from the point of view of puts where it is anticipated that the covering would entail shorting. Conrad does not address this because her data is based on calls. In addition, the assumption made by most authors including Conrad (1989) is that the issuer will hedge using the underlying asset but hedged positions are also possible by applying other strategies including, spreads and straddles that do not require the underlying asset. This must be kept in mind before accepting the demand pressure argument. Once again, the lack of

a volume analysis makes it difficult to accept the argument posed by Conrad (1989). Nonetheless, the results found by Conrad (1989) are consistent with the later studies performed by Haddad & Voorheis (1991). In fact the application of a more advanced research approach by Broughton & Smith (1997) still found similar results. Broughton & Smith (1997) employed an advanced approach that involved removing special effects such as profit announcements and M&A activities.

The results from Detemple & Jorion (1990) are also noteworthy because in their examination of the US market, they not only found an increase in the individual share prices but also found an increase in the general market value which coincided with an increase in the industry index for the optioned shares.

However, the general acceptance that options increase the opportunity set for investors, leads to the possibility of observing different results to the upward price movements found in the previously mentioned studies (Faff & Hillier, 2005). Miller (1977) argues that short sale constraints can create informational inefficiency which disallows investors from incorporating their beliefs by shorting the share. This where derivatives can come to play because they make it easier for investors to take on short positions synthetically, as such options listing should lead to lower prices in the underlying assets. The argument seems intuitive by the laws of supply and demand. Once again, it makes sense that the regulation of the market may have some significant influence on the effect exerted by options.

According to Trennepohl and Dukes (1979) and Klemkosky and Maness (1980) it is also possible that the price movements are caused by the changes in the systematic risks once the warrants have been listed. This argument was however contradicted by Branch and Finnerty (1981), Whiteside, et al. (1981) and Bansal et al. (1989). These authors all find that there is no change in systematic risk following option listings. Therefore, the price changes are not necessarily caused by the change in systemic risk but most likely due to a short term implication of the event such as hedging, execution of arbitrage opportunities or possibly straightforward price manipulation.

In summary, there appears to be a general consensus that options listings are associated with upward movements in the price of the underlying assets. There appear to be some differing

views with regards to the reversal of that price effect after the event and there are also differing theories with regards to what may be causing the effect.

2.3.2 Listing Literature Related to Warrants

As mentioned previously, there are some distinguishing features that are possessed by warrants that could create different impacts on the underlying asset. Of particular note is the timing of warrant listing which may cause clustering and increased demand of the underlying for hedging purposes due to the selective timing of investment banks. In terms of the findings related to warrant listings in developed markets, Alkeback & Hagelin (1998) find that warrant listings have no effect on the underlying assets in the Swedish market. This is line with the initial findings for options from the pioneering Nathan Report.

In another developed market, Australia, Aitken & Segara (2005) actually observe a negative price effect both on the listing days and on the announcement days. These Australian results agree with those documented by Clarke, et al. (2011) based on their study related to Australian warrants listed between 1997 and 2003. Within, Australia, there thus appears to be an effect which is in absolute contrast to the general options literature.

Within a developing market setting, it was found in Hong Kong by both Chan & Wei (2001) and Chen & Wu (2001) that the introduction of warrants is associated with a positive price effect on the underlying shares and that price change is linked with increased volumes. This study therefore gives further credence to the notion that price increases are linked with changes in abnormal trading. It is worth noting though that the studies in the Hong Kong market only focused on call warrants. As such the findings are only relevant to calls.

Chung & Hseu (2006) finds that it is particularly when a consecutive warrant issue on a popular asset is issued where there is the greatest effect on the underlying asset. They attribute this phenomenon to the increased hedging demand by the market issuers. Their finding is quite significant because it gives further evidence to fact that hedging might be at play before the listing day of warrants.

Chuang & Chuang (2005) find that in Taiwan there is also a positive price effect linked to increased trading volumes one day before listing. They therefore associate the increase in price with increased buying pressure. These results were however contradicted by Chan & Chen

(2012) in their study of the Hong Kong and Taiwanese market. These authors find that there is a positive price effect associated with an announcement, which is most likely linked to the hedging movements of the issuers. However around the actual listing dates, they note negative price movements in both markets. Again, in Taiwan, Chung et al (2014) assess the impact that delta hedging has on spot prices. The results show that there is significant trading around the announcement date before the warrants are introduced to the market. This study presents the strongest evidence that there is delta hedging around the listing day. The study finds that the effect is larger when there is a stronger hedging demand, thus when the delta is highest. The results of this study are significant because this is one of the few studies that actually aimed to prove that delta hedging strategies are being applied and according to their results, there is more reason to accept that one of the reasons for the price effect is due to hedging that takes place.

However, more cross-border inconsistencies emerge in Malaysia where Yip & Lai (2009) and Yip & Hooy (2012) explain that there is actually no real effect on the underlying share returns and no change in the trading volumes within that market.

The differences in the price effects of warrants listed in different markets may be linked to an argument posed by Sorescu (2000) in his separate assessment of options that were listing during the period 1973-1980 and those listed after 1980 respectively. The author argues that the possible cause of differences may be linked to a difference in the regulatory environment. This is similar to an argument posed by Alkeback & Hagelin (2004) for the expiration effect of options mentioned previously. The findings of Sorescu (2000) for the options listed in the earlier period showed evidence of an increased price pressure around listing days but the results of the latter set of options in fact showed results of decreased prices. He argued that this difference in effects could be due to the changes in the regulatory environment as well as the introduction of a futures market in 1982. This is somewhat echoed by the results of Mayhew (2000), who observe an indication that the price effect on the UK market has been deteriorating over time.

2.4 Conclusion

In conclusion, the earliest studies on options have indicated a mixed set of results for the price effect on share prices prior to options expiration. Since these earlier studies, the results have continued be quite inconsistent with reports of no significant effect still being reported by some authors. With regards, to warrants, the studies have been few but the results demonstrate the

same problem of inconsistencies. The introduction effect poses the same problem of discrepancies except from the options literature, there appears to be stronger consensus that around listing days there is an upward movement in the share prices. There is no consensus with regards to the reversal of that effect. The literature on warrants reveals more contradictions especially when assessed from a cross-border perspective. There are no clear generalisations that can be made. There is therefore a strong rationale to side with Alkeback & Hagelin (2004) and Sorescu (2000) that the differences in results may be rooted in the variation of market structures such as regulation and transaction costs. Because of the varying results, table 2.1 has been created below to summarize the major findings for each market.

Global generalisation is not necessarily possible and it is valuable to conduct a study which is directly relevant to each market. This study thus attempts to close the gap in the study of derivative expiration and introduction effects with a focus on the in South African Johannesburg Stock Exchange. A study on this particular market has not been conducted. The methodology chapter follows with a detailed description of how this study was approached.

Table 2.1: Summary of Results from Past Literature

Author	Year	Instrument	Country	Listing/Maturity/ Announcement	Price Effect
Options Literature					
Klemkosky	1978	Options	US	Expiration	Negative before, Positive After
Schlag	1996	Options	Germany	Expiration	No significant effect
Chen and Williams	1994	Options	US	Expiration	No significant effect
Day and Lewis	1988	Options	US	Expiration	Positive Before, Negative After
Stoll and Whaley	1987	Options	US	Expiration	Positive Before
Alkeback and Niclas	2004	Options	Sweden	Expiration	Different Effects for different periods
Pope and Yadav	1992	Options	UK	Expiration	Negative Effect before expiration
Nathan Report	1974	Options	US	Listing and Expiration	No significant effect
Chamberlain et al	1989	Options Futures and	US and Canada	Expiration	Upward Effect only when futures and options expire
Bansal et al	1989	Options	US	Listing	Positive

Conrad	1989	Options	US	Listing	Positive
Detemple and Jorion	1990	Options	US	Listing	Positive
Sorescu	2000	Options	US	Listing	positive (1973-1980) negative (1981 onwards)
Haddad and Voortheis	1991	Options	US	Listing	Negative
Watt, et al.,	1992	Options	UK	Listing	Positive Excess Return with reversal
Stucki and Wasserfallens	1994	Options	Swiss	Listing	Positive Excess Return with reversal
Broughton and Smith	1997	Options	US	Listing	Positive with reversal

Table 2.2: Summary of Results from Past Literature continued

Warrants Literature					
Author	**Year**	**Instrument**	**Country**	**Listing/Maturity/ Announcement**	**Price Effect**
Chuang and Chuang	2005	Warrants	Taiwan	Announcement and Listing	Positive
Chan & Chen	2012	Warrants	Taiwan	Announcement and Listings	Negative
Alkeback and Hagelin	1998	Warrants	Swedish	Listings	No Effect
Clarke, Gannon and Vining	2011	Warrants	Australia	Listings	Negative
Chen & Wu	2001	Warrants	Hong Kong	Listings	Positive Effect with increased volumes
Chan and Wei	2001	Warrants	Hong Kong	Listings	Positive Effect with increased volumes
Yip & Lai	2009	Warrants	Malaysia	Listings	No Effect
and Yip and Hooy)	2012	Warrants	Malaysia	Listings	No Effect
Aitken and Segara	2005	Warrants	Australia	Listing	Negative before
Chen and Wu	2010	Warrnts	China	Expiration	Negative Price Effect for Calls, No Price Effect For puts
Chen and Wu	2001	Warrants	Hong Kong	Expiration	Positive Effect Before
Chan and Jelik	2007	Warrants	Taiwan	Expiration	Positive Effect Before and negative afterwards for in the money warrants. No effect for Out the Money warrants

3 RESEARCH METHODOLOGY

The aim of the study is to examine the price impact that warrants have on the underlying asset prices by assessing the price effect on the listing and expiration days of the warrants. The following primary research questions are therefore addressed: Firstly is there a statistically significant price effect exerted by vanilla warrants around the listing days? Secondly is there a statistically significant price effect exerted by vanilla warrants around their expiration days? In order to gather robust results, out the money samples and in the money samples are assessed in isolation. Furthermore abnormal trading volumes are also examined.

The listing and maturity days of warrants can both be considered significant events for the underlying shares. Therefore, the study used the event study methodology to assess the price impacts. This chapter will begin by providing detail on the general sample data and examine how and why the sample data was selected. It will then provide a background on the event study and rationalise further why the event study methodology was a valid and accurate method for the nature of this study. The chapter will then give details on the research procedures implemented by explaining the event study methodology while providing context to the applications made in this study. A discussion of the methodology limitations will then be presented. The chapter concludes with a summary of the main points that have been mentioned.

3.1 Data Collection and Sampling

3.1.1 Data Collection

All warrant listing dates and expiration dates were extracted directly from the JSE historical database as provided by the JSE customer services. An alternative, would have been to look through all SENS announcements in order to find these days but such a process would have proven far too lengthy and riddled with possible errors. Secondly using data directly from JSE allows the study to maintain the accuracy that may be lost if the warrant data was collected from a secondary market data provider.

The study examined all warrants that were introduced and expired between 01 January 2008 to 31 December 2012. As such, all warrants examined for the study have all reached their maturity. A 5 year period was therefore used to gauge for an introduction and expiration effect.

This particular 5 year period allowed the study to maintain relevance while incorporating enough data to make the event study robust.

All closing share price data and volume data was acquired from the McGregor BFA market database. There is no reason to expect that this particular data would have any inaccuracies. The share price data and volume data were used to compute percentage daily returns[3] and volume turnover ratios [4] respectively.

3.1.2 Sample Selection

From the warrant data collected from the JSE, it was found that there was a total of 580 vanilla warrants that were listed on the JSE for the period 01 January 2008 - 31 December 2012. A total of 824 warrants expired for the same period. These observations agree with the data that was received from the World Federation of Exchanges database.

Table 3.1 Total Number of Warrants on JSE and Number of Warrants in Sample

Year	Total Vanilla Warrants Listed in Each Year	Sample Size for Introduction Study	Total Vanilla Warrants Expired in Each Year	Sample Size for Expiration Study
2008	170	18	344	2
2009	145	19	168	18
2010	88	12	140	14
2011	86	16	87	10
2012	91	19	85	5
Total	580	84	824	49

In order to arrive at the final sample, as shown in the table 3.1 above, the following filtering process took place:

Firstly, for each share, it was ensured that there was no event for at least 60 days between each of the event windows for that particular share. For example, if a warrant for a share expired today, the next warrant expiry date that could be included in the sample had to be at least 65 days after the initial warrant expiration (applying a 5 day event window). Thus, if there was a

[3] Daily stock return is calculated: $Rt= (P_t/P_{t-1})-1$, where Pt is the daily closing share price at time t

[4] Turnover is calculated as: (volume traded on day t / number of shares outstanding at day t)

warrant that expired in between those 65 days, that warrant was left out of the sample and the next warrant to be included in the sample had to expire after at least 65 days after the excluded warrant's date. This 60 day period between event windows was used as the estimation period, which is why there had to be a gap that allowed no influence from the next event. If events occurred too close to each other, the first observation was used for the sample.

Secondly, all non-vanilla warrants were excluded from this particular study. The study excluded all exotic options such as barriers, basket, compound and index warrants. Exotic warrants have special attributes which introduced the difficulty of isolating their potential impact on the underlying assets. The study tried to isolate the effect as much as possible and the analysis of vanilla warrants intuitively allowed for a study of the warrants' impact in their purest form. Furthermore, as mentioned in the introduction chapter, vanilla warrants are one of the most abundant types of warrant issued on the JSE.

Thirdly all American style warrants were removed from the expiration study. This made intuitive sense as these American warrants allow the holders to exercise them at any time during their life. This ability to be exercised at anytime makes it difficult to measure their influence on the underlying at maturity as some of these warrants may have been exercised during their life if conditions were favourable. This would lead to a diluted effect at maturity. In order to avoid the ambiguity caused by possible early exercise, these American style warrants were left out. For the examination of the introduction effect, the American style warrants were not filtered out.

After the filtering process, the study arrived at a total of 49 sample warrant dates for the expiration effect assessment. 11 of these warrant expiration days belonged to in the money warrants. 38 belonged to out the money warrants. It is important to mention that all of the options in the sample for the expiration study are European puts. In total warrants for 23 companies are studied for the expiration effect. A list of these companies is provided in the appendix 1.

After the filtering process, the study arrived at a total sample of 84 warrant introduction days that were used to examine for a warrant introduction price effect. 11 of these warrant listing days belong to in the money warrants. 73 belong to out the money warrants. The larger sample size compared to the expiration sample is largely due to the acceptance of American call

warrants. There are 56 American calls, 1 European call and 27 European puts in the introduction sample. 28 companies' shares were studied for an introduction effect. A list of all these companies is also provided in appendix 1.

3.2 Background on the Event Study Methodology

MacKinlay (1997) describes the event study methodology as "an approach used in finance and economics to measure the impact of an event on the value of a firm, a stock, the economy or industry". The event study method is therefore a method used to examine the share return behaviour for a sample of firms that encounter a common type of event (e.g. the issuing of warrants or expiration of warrants). The event can take place at a particular calendar date or at different points in time, as is the case with this study. Event studies have been used in various studies related to share price movements because it is generally accepted that share prices are affected by new information that enters the market.

A quick survey of past event studies that have been done shows that the structure of the event study has not changed much over the last 30 - 40 years (Kothari & Warner, 2006). The method is still primarily based on the table method that was derived by Fama, Fisher, Jensen, and Roll (1969) in the classical stock split event study. However there have been two major changes that have taken place. The first change relates to the use of more frequent return periods. Today, it is not uncommon to see event studies conducted using intraday data. This development has assisted in improving the robustness of the results obtained by the method.

Secondly, there has been a modification to the statistical techniques used to measure the abnormal returns and make inferences. This change is accompanied by changes in asset pricing theory with the most significant being the Fama-French 3-factor model for the estimation of normal returns. The years of event study usage have allowed this method to progress while still maintaining its core function as a traditional measure of share price movements caused by corporate events.

The expiration and introduction of warrants is not new information as the information is common knowledge from the time that the bank announces that it will be issuing warrants. It is therefore important to have an event window whereby the actions of the market are studied prior to the introduction and expiration days.

Within the context of this study, the expiration and introduction of covered warrants can therefore be considered as events that are related to the underlying shares. The event study methodology is therefore appropriate and valid for this study. Furthermore, the event study methodology has been applied to assess the impact of expiration days and introduction days by Chen and Wu (2001), Chen and Wu (2010), Chan and Jelik (2007) and Pope and Yadav (1992) as well as Chung, et al., (2014). These authors all consider the introduction and expiration of warrants as material events for the underlying assets . It can therefore be seen that based on prominent past literature that the method is a valid for the nature of this study.

The sample size obtained for the general introduction and expiration studies make the event study reliable. However, there are some concerns about the sample sizes for the sub samples of in the money and out the money warrants. This weakness is considered in the analysis of results.

3.3 Full Structure of the Event Study

The following section will explain the full structure of the event study and also explain how the characterization of the elements have been applied to the study.

3.3.1 Event Window

The time of the event (introduction and expiration day) is represented by t = 0. All days prior to the event are prefixed with a (-) and all days post the event are prefixed with (+) or left with no prefix in some cases.

All the days surrounding the event are called the event window. This study has chosen an event window of 5 days, spilt equally. Therefore 5 days prior and 5 days post the event. The event window length has been subjective in all previous literature. The only criteria is that the window must be long enough to absorb all the information content but should be short enough to exclude any unnecessary information.

Chen and Wu (2001) choose 15 days as their event window, whereas Pope and Yadav (1992) select 5 days as the event window. Chan & Jelik (2007) choose 10 days before and after the expiration and introduction as their window. The choice of the estimation window for this study is 5 days because the JSE has many warrants that are issued close to each other. Consequently to avoid dropping too many event days out of the sample, a tighter event window is chosen.

Furthermore, the focus is to assess the short term influences of the events hence, a long event window was not necessary for the assessment.

An event window is important for a study of this nature because it allows for the assessment of a price trend leading to the event. As mentioned previously, introduction and expiration days will not serve as new information to the market. However, the market will anticipate the event because it is detailed in the specifics of the warrant contract. We can expect that most of the market movement will take place prior to the event day as market players prepare for the event and after the event day as market players unwind the their pre-event strategies. An examination of the post event days therefore allows for an examination of a reversal of behaviour after the event.

3.3.2 Return Characterisation

For each share i, the return on the share for the time period t relative to the event is depicted by R_{it}. The R_{it} can be decomposed into a normal/expected return as well as an unexpected return. It can therefore be said that $R_{it} = E_{it} + e_{it}$ where E_{it} is the "normal" (expected or predicted return applying a certain model of expected returns), and e_{it} is the component of returns which is abnormal or unexpected. We can also say that e_{it} is the difference between the return conditional on the event and the expected return unconditional on the event. The aim is to assess the statistical significance of e_{it} around the event. As such one of the most important elements of the event study is deciding on an estimation model that will assist in finding that normal return.

3.3.3 Estimation Period and Estimation Model

The estimation period is the period before the event window that is used in the market model to estimate the normal returns. For this study an estimation period of 60 days is chosen. Empirical evidence shows a small difference with regards to using a longer estimation period. Chan & Jelik (2007) assess the use of 160 days vs 60 days and find that there is no benefit to using a longer period. The study is mostly concerned with the share price movements over a short period of time and therefore a shorter estimation period makes particular sense. As mentioned above, there are no warrant introductions for a respective stock within the estimation period for the introduction study. There are also no warrant expirations for a respective stock within the estimation period for each share in the expiration study. This is so that the expirations

or introductions do not affect each other and hence disturb the estimation model's prediction of normal returns.

The market model is a model which is derived using a regression of the ordinary least squares (OLS). Brenner (1977) assesses other models that could be applied in the event study and asserts that the market model works as well as the other models. The market model states the following about the expected return of the underlying: R_i = alpha + Beta(R_m). As mentioned above if the returns during the event window differ from the expected returns, we can attribute that to the warrant event.

There are a variety of market models available but the two most prominent are the capital asset pricing model (CAPM) and the arbitrage pricing theory (APT). The CAPM which was developed by Sharpe (1964) and John Lintner (1965) is an equilibrium model whereby the normal/expected return of a given asset is determined by its covariance with the market portfolio (otherwise known as systemic risk). The APT, which was developed by Stephen Ross (1976), is a theory where the normal return of a given asset is an amalgamation of more than one risk factor (i.e. not just market risk). The APT linearly models all these risk factors. Both models have their strengths and weaknesses but the CAPM is notorious for having a range of assumptions[5] which are particularly not suitable for a developing market, in particular, market perfection. This would introduce the likelihood that the results of the study may be incorrect due to the specific CAPM restrictions.

The study therefore used a 3 factor APT model[6]. In conducting the study, the 3 factor model also indicated a superior R-square for all sampled shares which further provided a reason for its application to this study. The use of the APT is also in line with one of the major modifications that have taken place with regards to asset pricing theory and so its use is directly in line with some of the major modifications of the event study methodology . In summary the main gain from using the APT is to reduce the biases of the CAPM (MacKinlay, 1997)

3.3.4 Cross-sectional Aggregation and Statistical Techniques

[5] 1. Markets are competitively perfect. 2. Markets are frictionless without transaction costs 3. Investors are myopic 4. Investments are limited to publicly traded assets with unlimited borrowing and lending at the risk-free rate. 5. All investors are rational mean-variance 6. Perfect Information 7. Everyone has homogenous beliefs concerning the distribution of security returns.

[6] The 3 factors used were the financial index, mining index and all share index.

Aggregate Abnormal Return

Once the normal return model was regressed for each share, the model was used to assess what the normal return should be during each time period in the event window and on the event day. The difference between the actual return and the normal return is known as the abnormal return. All of the abnormal returns found for each share were then cross-sectionally aggregated for each time period.

For a sample of N shares, the cross-sectional mean average abnormal return for period t:

$$AARt = \frac{1}{N}\sum_{i=1}^{N} eit \qquad (1.1)$$

Cumulative Abnormal Return

In addition to testing the average abnormal return, it is also common to test for the change in the investors wealth. The cumulative average residual (CAR) method assesses the abnormal performance of the investor by summing each days abnormal performance for the length of interest. The cross sectional addition of cumulative abnormal return is defined as follows:

$$CAAR\,(\mathrm{T1},\mathrm{T2}) = \sum_{t=T1}^{T2} AARit \qquad (1.2)$$

For the standard event study, the null hypothesis to be tested is whether the mean abnormal return at time t is equal to zero. The value of the test statistic is calculated as follows:

$$t = \frac{AERt}{s/\sqrt{N}} \qquad (1.3)$$

Where s is the sample standard deviation

The ordinary event study methodology using the t-test may be biased because there is a possibility that the events may be cross-sectionally dependent and not normally distributed. The Wilcoxon Ranked Sign test is thus also calculated on top of the regular t-test where the results of the t-test appear to be marginal. This nonparametric test tests for significance using the median assuming that the distribution is unknown or non-normal.

The t-statistic for the cumulative abnormal return is calculated as follows:

$$t = \frac{\mathrm{CAR}(\mathrm{T1},\mathrm{T2})}{[\sigma 2(\mathrm{T1},\mathrm{T2})]^{\frac{1}{2}}} \qquad (1.4)$$

$$\text{where } [\sigma^2(\mathrm{T1},\mathrm{T2})] = L\,6^2(\mathrm{ARt}) \qquad (1.5)$$

L relates to the length of time one wishes to assess

The above t-test statistics in eq. (1.3) and (1.4) are well-specified provided that the variance of the one-period mean abnormal return has been correctly estimated and are independent. However event-time clustering tends to break the independence assumption for the abnormal returns in the cross-section . As such this can tend to bias the test statistic upwards if this clustering is not accounted for due to the lower standard deviation (caused by the unaccounted clustering). Noting this, the study chooses to use the event period variance because the alternative of using historical or post event time-series variability may actually understate the true variability of the event-period abnormal performance. The upward increase in return variability during the event period is intuitively expected as the events may cause uncertainty in the market.

Trading Volume

It is also noted in the literature that abnormal returns are linked with abnormal trading volumes (eg Chen & Wu (2001) and Chan & Wei (2001)). Therefore in order to rationalise the results of the price effect study, the abnormal trading volumes were also assessed. In line with Chan and Wei (2001), the trading turnover rate for each share on day t is applied as the proxy for trading volumes. The turnover ratio for each underlying stock i on day t is defined as:

$$\mathrm{TOit} = \frac{\text{Number of shares traded it}}{\text{Number of shares outstanding it}} \qquad (1.6)$$

The average daily turnover rate during the estimation period is used as the normal trading volume. In line with the price study, the estimation period is 60 days before the event window for each share and is defined as:

$$\text{AVG (TOi)} = \frac{1}{60} \sum_{-65}^{-6} \text{TOit} \qquad (1.7)$$

Therefore the cross sectional aggregation is defined by the following equation:

$$\text{TOt} = \frac{1}{N} \sum_{i=1}^{N} \frac{\text{TOit}}{\text{AVG}(\overline{\text{TOi}})} \qquad (1.8)$$

i = 1….N- number of underlying shares

The abnormal trading volume at time t is defined as follows:

$$\text{AVt} = \text{TOt} - 1 \qquad (1.9)$$

The test statistic is defined as

$$\text{t} = \frac{\text{AVt}}{\text{s}} \qquad (1.10)$$

Where (s) is the volume sample standard deviation

By calculating the statistical significance of the abnormal trading volume, it helps to provide some further analysis as to how the market reacts to around the event days.

Sampling distributions of test statistics

As can be seen, the primary statistical test used is the t-test. However in order to ensure robust results, the Wilcoxon Signed Rank test is also applied in some cases to supplement the results found by the t-test. This is particularly necessary when the results show marginal significance or marginal insignificance using the t-test.

In terms of the t-test, the actual return over the event window is compared to the assumed return under that null hypothesis which is that it is equal to zero. The non-parametric Wilcoxon test is used to test the median. The test is used to compare the median of the results obtained in the event window with the assumed distribution under the null hypothesis that the median is equal to zero. The critical values for both tests are based on the 5% two tail region. That is, any results that fall in this region are considered to be statistically significant.

3.4 Weaknesses of the Event Study/Limitations

The event study methodology is a valid method for this study. However, the method has some inherent limitations. The following is list of the major limitations and how this study has tried to reduce these limitations.

The first of the weaknesses is the joint test problem. This problem arises because the result of statistical significance requires that the specification of the normal returns to be accurate (Kothari et al, 2006). This why the choice of the market model is very important and why the study opted away from using the CAPM model and instead used the 3 factor APT model with a higher R-square.

Secondly, because the returns for each share are regressed against the market, there is a possibility that shares are cross correlated against each other. The basic event study method does not account for this cross correlation. As such the study also performs a non parametric test in order to confirm the results of the t-test this mostly appropriate when the results of the t-test appear to be marginal. In order to account for the event induced variance, the study always calculated the sample standard deviation using the deviation over the event window as opposed to the estimation period

Thirdly the method assumes that there are no confounding effects around the event days. The possibility of confounding events is always prevalent such as poor economic growth and political issues. In order to avoid some of these issues, the study used a short event window

Fourthly, capturing the correct date of the events can always be subject to inaccuracies as such the study used event data that was provided directly from the JSE's historical database.

Conclusion

The chapter has provided a detailed description of the sampling procedure and the final sample selection. Furthermore, the chapter explained the event study methodology that was applied for this study and characterised the variables that were used for the study. Rationalisation was provided as to why the event study was chosen. Apart from the fact that the method is a reliable way to measure the impact of events, the method is also employed by previous literature. The

major limitations are noted and attempts are made to circumvent all weaknesses. The following Chapter will provide detail as to the results that were obtained.

4 RESEARCH FINDINGS, ANALYSIS AND DISCUSSION

4.1 Introduction

This chapter will discuss the empirical results observed by the study. What follows is a detailed report and interpretation of the results. The structure of the chapter will be as follows: The chapter begins by providing a brief context and recapping on the elements of the sample. In presenting the results, the report shall begin by first examining the results of each of the general samples. After the assessment of the general samples, an examination of the in the money and out the money sub samples is provided. Each in the money and out the money sample is split into calls and puts. The standard normal t-test is used as the primary test for Average Abnormal Returns (AAR), Cumulative Average Abnormal Returns (CAAR) and Abnormal Volume Traded (AVT). The 5% significance level is deemed as statistically significant. Where it appears that a t-test statistic marginally misses the critical value or marginally meets the critical value, a further non-parametric assessment is prepared using the Wilcoxon Signed Rank test. The chapter concludes with a summary that discusses the pertinent results and how these results relate to the most notable literature.

4.2 Brief Context

For the expiration effect sample, 38 of the warrants expired out the money and 11 expired in the money. All the warrants for the expiration study are European Puts.

For the introduction effect study, 73 of the warrants were listed out the money and 11 were listed in the money. The total introduction sample consisted of 52 warrants that were American calls, 1 was an European call, and 26 were European puts. A distinct warrant type that is lacking in the sample is the American put. In fact, from the data gathered it was noted that there are no American puts that are issued on the JSE currently. A plausible reason for this is the cash strain that an early exercise of American puts may place on the issuing banks[7].

All warrants in our samples are vanilla warrants, therefore there are no special properties inherent in the warrants that would give reason to account for unique selling and buying

[7] If the bank, predicts the performance of the underlying asset very incorrectly, they will be obligated to buy a lot of the underlying shares from the investors. The timing of such an unfavourable performance in the share can be very sudden as seen by the 60% decline in African Bank Ltd on 6 2014 Aug . As such, there are some unique liquidity risks embedded in writing American puts.

pressure due to any exotic properties. Therefore, it is assumed that price effects would take place over a short term period before the listing or expiration day. Furthermore, as mentioned in the introduction chapter, although the JSE is a developing market with less liquidity than most of the developed markets, warrants are written on the highest liquidity ranking shares as such any price effect is assumed less likely to be caused by a lack of liquidity.

In order to explain the results of the price study with greater accuracy, the study also performs statistical tests on the changes in trading volume. The aim is not to study volumes in detail but rather to use the volume results to help explain the results of the price effect. The focus of this study was purely on the price effects. Additionally, the in the money and out the money warrant groups are split into call warrants and put warrants as opposed to simply asserting that the results of calls are the same of those of puts. This approach assists in rationalising the results better than most of the past studies. An intricate sub-sampling procedure was also performed by (Chan & Jelik, 2007). Unfortunately their 6 sample set did not assess puts and calls separately as the study was based only on call warrants.

4.3 Results for the Introduction Effect - General Sample

In terms the of the first primary research question whether the listing day of warrants has an impact on the price of the underlying asset, Table 4.1 table 4.2 below indicate the results of the general sample's AAR and AVT respectively

Table 4.1: AAR General Sample Introduction

DAY	AAR	CAAR	TEST STAT AAR
-5	-0.32%	-0.32%	-1.01
-4	-0.42%	-0.74%	-0.91
-3	-0.22%	-0.96%	-0.81
-2	0.03%	-0.93%	0.10
-1	0.47%	-0.46%	1.69
0	0.34%	-0.12%	1.44
1	0.09%	-0.03%	0.32
2	0.20%	0.17%	0.80
3	-0.28%	-0.10%	-1.39
4	-0.17%	-0.27%	-0.81
5	0.07%	-0.20%	0.25

Table 4.2 AVT General Sample Introduction

DAY	AVT	TEST STAT AVT
-5	8.71%	0.86
-4	4.31%	0.35
-3	31.72%	1.71
-2	4.81%	0.85
-1	2.38%	0.32
0	5.09%	0.49
1	-8.31%	-1.09
2	-10.47%	-1.50
3	-10.08%	-1.89
4	-6.49%	-0.95
5	14.02%	1.53

* Denotes significance at the 5% level. ** Denotes significance at the 2% level.

As can be seen, there are no days before the introduction of the warrants that exert any significant negative or positive movements in the stock prices. The volume traded also does not show any significant results at all. Although there is an indication of a buying pattern before the listing date, it is not overwhelming. The line graph below helps to visualise better the non-

effect. The graph shows more clearly that as the event day draws nearer, the cumulative returns of the investor tend to hover around zero. It can therefore be inferred that there is no significant price effect caused by the general sample of warrants around introduction days. The reason for this may be because the general sample consists of both calls and puts that are themselves both in and out the money.

The results of the general sample seem to agree with the initial findings of the first Nathan Report in the options literature and Hagelin & Alkeback (1998) in the warrants literature. It is possible that having varying push and pull factors may generally result in a net zero effect.

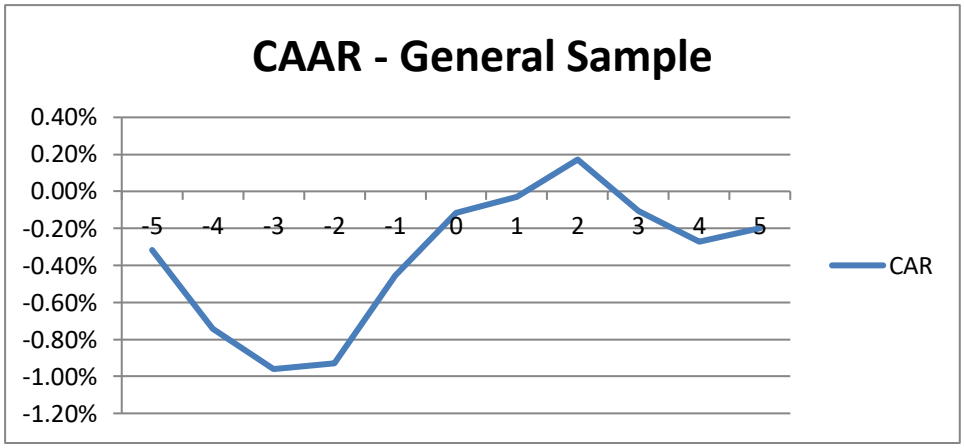


Figure 1: Line Graph Showing Pattern of Movement for CAAR

4.4 Results for the Introduction Effect - In the Money Sample

It is possible that the general sample may be clouded with varying impacts that collectively lead to a non-effect. But not all individual stocks will have both calls and put issued on them. It is therefore not valuable to interpret the results of the general sample without also assessing the components of the general sample separately. This is perhaps the most valuable contribution that this study adds to the global literature. As such, the study looked at the effect of in and out the money calls as well as in and out the money puts in isolation. The results for the in the money sample are presented as follows:

Table 4.3 AAR In the Money Listing

In the Money Calls					In the Money Puts			
DAY	AAR	CAAR	TEST STAT AAR		DAY	AAR	CAAR	TEST STAT AAR
-5	-0.2%	-0.19%	-0.21		-5	-1.81%	-1.81%	-1.23
-4	-2.1%	-2.25%	-1.22		-4	-0.93%	-2.74%	-0.73
-3	-0.4%	-2.61%	-1.57		-3	0.42%	-2.32%	0.37
-2	0.2%	-2.37%	0.45		-2	0.47%	-1.86%	0.73
-1	1.7%	-0.66%	**4.18		-1	-1.17%	-3.03%	-1.27
0	1.2%	0.49%	1.22		0	-1.95%	-4.98%	-2.01
1	-0.7%	-0.17%	-0.64		1	1.26%	-3.72%	1.14
2	1.2%	1.02%	*2.68		2	-2.23%	-5.96%	-6.71
3	-0.5%	0.52%	-1.38		3	1.01%	-4.95%	0.49
4	0.6%	1.10%	1.02		4	-1.01%	-5.96%	-0.95
5	0.0%	1.14%	0.06		5	-0.37%	-6.33%	-0.29
CAAR (0,5)		1.8%	**3.42		CAAR (0,5)		-3.3%	*-3.1

* Denotes significance at the 5% level. ** Denotes significance at the 2% level.

In the money calls seem to influence the underlying assets positively very close before the listing day with a statistically significant gain of 1.7% on the day before listing. The in the money puts do not exert any significant price impact before the day of listing.

The results for the in the money calls confirm the findings of Chen and Wu (2001) that a positive price effect exists immediately before and on the expiration day for in-the-money call warrants. But what is interesting to note in this South African study is that the upward trend tends to remain prevalent, with day +2 also showing a significantly large increase of 1.2%. Furthermore, from the listing day up until day +5, the CAAR increases significantly by 1.8%.

This continuous price trend does not conform with the notion of price reversal and agrees more with the possibility of a permanent price effect as found by Conrad (1989) in the her study of the US options market.

For the puts, although the downward price movements before listing are not significant, there is also indication that the share prices continue to decline even after the introduction day. In fact the CAAR from listing day to day +5 shows a statistically significant decline of 3.3%. This somewhat also weakly supports the findings of a permanent price decline.

An interesting observation is also that the puts have an opposite effect on the underlying assets compared to the calls. This opposite effect is well visualised by the line graph below which shows that AAR for calls tends to be up when that of puts is down and vice versa. This confirms the intuitive insight that call warrants and put warrants should have an opposite effect on the underlying assets. The observation also supports the argument that the banks may be delta hedging around the introduction day. This means that they need to acquire the shares of in the money calls and sell the shares of in the money puts in order to cover their respective short positions. This also gives some explanation as to why the general sample depicts no price effect.

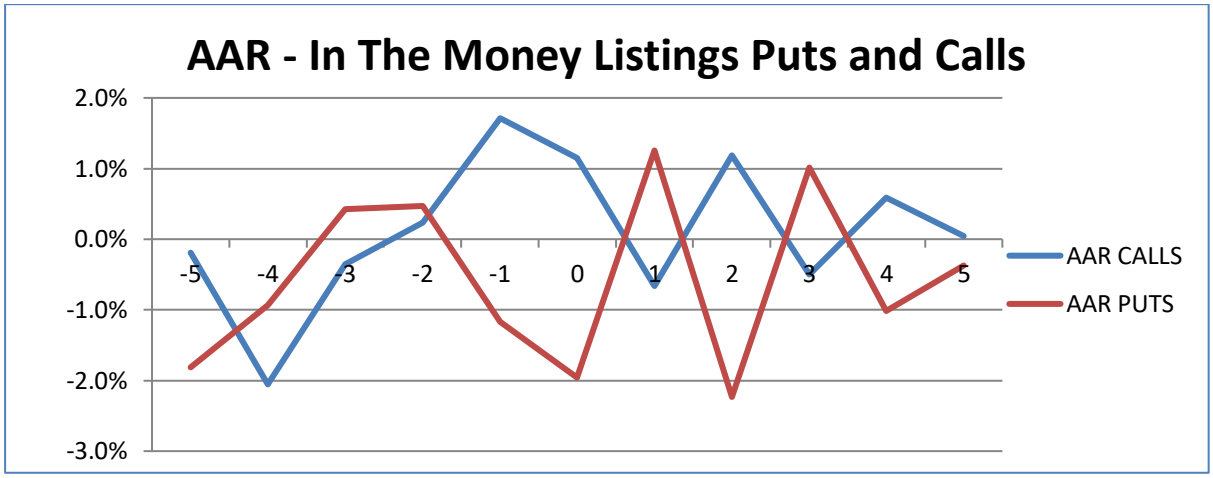


Figure 2: Line Graph Showing Opposite Effects of Puts and Calls

The abnormal trading volumes (table 4.4) are fairly consistent in relation to the results found in the price effect with mostly positive increases in trading volume observed by the calls. However none of the increases are significant except for a decline in trading shown on day 3. The results for the puts are similar with only day -3 showing significantly less trading in the underlying asset.

Table 4.4 AVT In the Money Listings

In the Money Calls		In the Money Puts

DAY	AVT	S.D	TEST STAT AVT		DAY	AVT	S.D	TEST STAT AVT
-5	1.5%	0.838665	0.04		-5	34.05%	0.516639	1.14
-4	8.5%	1.191677	0.17		-4	-22.48%	0.677074	-0.58
-3	13.0%	0.618807	0.52		-3	-52.01%	0.132893	*-6.78
-2	-2.0%	0.28606	-0.17		-2	18.19%	0.257093	1.23
-1	18.4%	0.653168	0.69		-1	-20.33%	0.574887	-0.61
0	6.8%	1.457576	0.11		0	20.75%	0.754095	0.48
1	9.6%	0.777241	0.30		1	23.78%	0.835179	0.49
2	-3.9%	0.946985	-0.10		2	-0.91%	0.322958	-0.05
3	-44.0%	0.301296	**-3.58		3	24.62%	1.388083	0.31
4	-33.5%	0.454884	-1.80		4	13.80%	0.695819	0.34
5	7.6%	0.686426	0.27		5	9.90%	0.325828	0.53

* Denotes significance at the 5% level. ** Denotes significance at the 2% level.

The above insignificant volume results seem to challenge the findings of most warrants and options literature that warrant introductions are associated with significant price movements that are supported by significant increases in the trading volumes. Although it does not necessarily discount that delta hedging may still be at play. Perhaps due to the regulation on the JSE with regards to the limit on the amount of warrantable stocks, the effect on volume may be slightly diluted in the South African Market.

4.5 Introduction Effect: Out The Money Sample

Table 4.5 AAR Out the Money Listings

Out The Money Calls					Out The Money Puts			
DAY	AAR	CAAR	TEST STAT		DAY	AAR	CAAR	TEST STAT
-5	-0.00331	-0.00331	-1.01		-5	-0.0051	-0.0051	-1.13
-4	-0.00052	-0.00383	-0.09		-4	-0.00193	-0.00703	-0.57
-3	-0.00436	-0.00818	-1.09		-3	0.002839	-0.00419	0.82
-2	0.003058	-0.00512	0.84		-2	-0.00243	-0.00662	-0.50
-1	0.001542	-0.00358	0.68		-1	0.004956	-0.00167	0.88
0	0.005189	0.001607	1.86		0	-0.0029	-0.00457	-1.24
1	0.002718	0.004325	0.75		1	0.000664	-0.00391	0.21
2	0.001666	0.005991	0.54		2	-0.00105	-0.00496	-0.28
3	-0.00088	0.005115	-0.31		3	-0.00622	-0.01118	-1.67
4	-0.00121	0.00391	-0.56		4	-0.0069	-0.01808	-1.68
5	0.002395	0.006305	0.64		5	6.13E-05	-0.01802	0.01

* Denotes significance at the 5% level. ** Denotes significance at the 2% level.

The results of the out the money puts shows that they have a similar but slightly opposite effect on the underlying asset as the in the money counterparts. The results show that before the listing day the stock price is never significantly affected by the listing of out the money puts. The volume confirms the indication of no selling or buying pressure around the event day. But the share price does show some tendency of rising a little more as opposed to declining around the

listing day. After the listing day, however, it appears that the stock price becomes depressed with day +3 and +4 showing declines of 0.62% and .69% respectively. This finding of stock declines after experiencing gains supports the principle of price reversal. The cumulative abnormal return from day 0 indicates a decline of -1.635% which is marginally significant at the 10% region confirmed with the Wilcoxon test. Although this interpretation provided some insights, due to the lack of statistical significance, it must be inferred that there is no price effect exerted by out the money puts on their underlying assets.

The out the money calls seem to also have an effect that corresponds with the in the money calls. From around - 2 day there is some upward price pressure that runs up until +2 day. But the rise from day -2 to day -1 is not statistically significant as found by the in the money calls. As with the in the money calls, this ride in the share price is first introduced with some stock price declines, however these declines were also not significant. After the listing date there is no evidence of a return reversal. In fact day + 1 and day +3 show statistically insignificant increases of 0.27% and 0.24% respectively. This finding weakly supports the findings of Bansal, Pruitt, and Wei (1989), Conrad (1989), and Detemple and Jorion (1990) who examined the effect of option introduction on share returns and found that they are connected with a positive and permanent price effect. The support is weak because, due to the lack of statistical significance it must be inferred that there is no effect exerted by out the money calls. This is lack of significance is matched with no changes in the trading volume as shown by the table 5.6 below

Table 4.6 AVT Out the Money Listing

Out The Money Calls					Out The Money Puts			
DAY	AVT	SD	TEST STAT AVT		DAY	AVT	SD	TEST STAT AVT
-5	6.38%	0.521743	0.561		-5	35.37%	0.68753	1.782
-4	3.04%	0.57477	0.243		-4	7.54%	0.704289	0.371
-3	84.87%	2.665846	1.459		-3	4.91%	0.474069	0.359
-2	9.74%	0.336368	1.327		-2	13.79%	0.702861	0.680
-1	1.28%	0.387949	0.151		-1	-1.32%	0.364307	-0.125
0	11.51%	0.46169	1.142		0	0.21%	0.389734	0.019
1	-12.10%	0.368964	-1.503		1	4.64%	0.407218	0.394

2	-4.95%	0.337484	-0.672		2	1.93%	0.253085	0.264
3	-5.17%	0.24694	-0.959		3	-6.09%	0.371038	-0.569
4	-2.07%	0.34527	-0.275		4	-3.90%	0.353131	-0.383
5	17.05%	0.66368	1.177		5	8.79%	0.284998	1.069

* Denotes significance at the 5% level. ** Denotes significance at the 2% level.

In summary the effect of out the money calls is similar to the result of in the money calls except that the out the money calls lack the significance of the in the money sample. This does show that issuing banks have a tendency to cover their positions and the that the level of covering is somewhat dependent on the "moneyness" of the options.

The effect of out the money puts appears to be slightly different to that of in the money puts. The in the money puts show deep stock price declines after the introduction. Whereas out the money puts shows a gentle rise in stock prices that this followed by a decline after the listing day with neither of the effects showing any level of significance. The Wilcoxon signed rank test show confirms the results. We can therefore infer that at the 5% significance level that there is no price effect exerted by out the money puts on the underlying asset around the listing day of the put warrants.

Although the results of the general sample were difficult to interpret it may symbolise that the pioneering Nathan report had some grounds in its finding that derivatives have no effect on the underlying asset, particularly if that asset has both call and put options written on it, which may assist to cancel the effect of the other. The study somewhat confirms this intuition as it was noted that puts and calls tend to exert opposite price pressures on the underlying assets.

4.6 Results for Expiration Effect - General Sample

In terms of the second primary research question, whether there are price movements caused by the expiration of warrants, the following tables 4.7 and 4.8 report the average abnormal returns and the abnormal volume traded respectively for the event day and the event window of 5 days prior and 5 days post the event.

Table 4.7 AAR General Sample

DAY	AAR	CAAR	TEST STAT AAR
-5	0.00%	0.00%	-0.010
-4	0.38%	0.38%	0.853

-3	-0.39%	-0.02%	-0.978
-2	-0.66%	-0.68%	-1.568
-1	-0.26%	-0.94%	-0.955
0	0.18%	-0.76%	0.629
1	-0.33%	-1.09%	-0.871
2	-0.30%	-1.39%	-0.975
3	-0.50%	-1.88%	*-2.287
4	-0.39%	-2.27%	-1.590
5	-0.19%	-2.46%	-0.939
CAAR (-3,1)		-1.31%	-1.4988
CAAR (1,5)		-1.71%	*-2.2751

Table 4.8 AVT General Expiration

DAY	AVT	TEST STAT AVT
-5	-16.74%	-1.354514604
-4	-7.06%	-0.547627757
-3	-22.75%	** -2.75230441
-2	-1.61%	-0.133909274
-1	-18.13%	-2.09982699
0	-0.27%	-0.024432423
1	-2.95%	-0.370478896
2	-4.86%	-0.540731873
3	3.73%	0.298290849
4	1.91%	0.209627203
5	11.92%	0.952863474

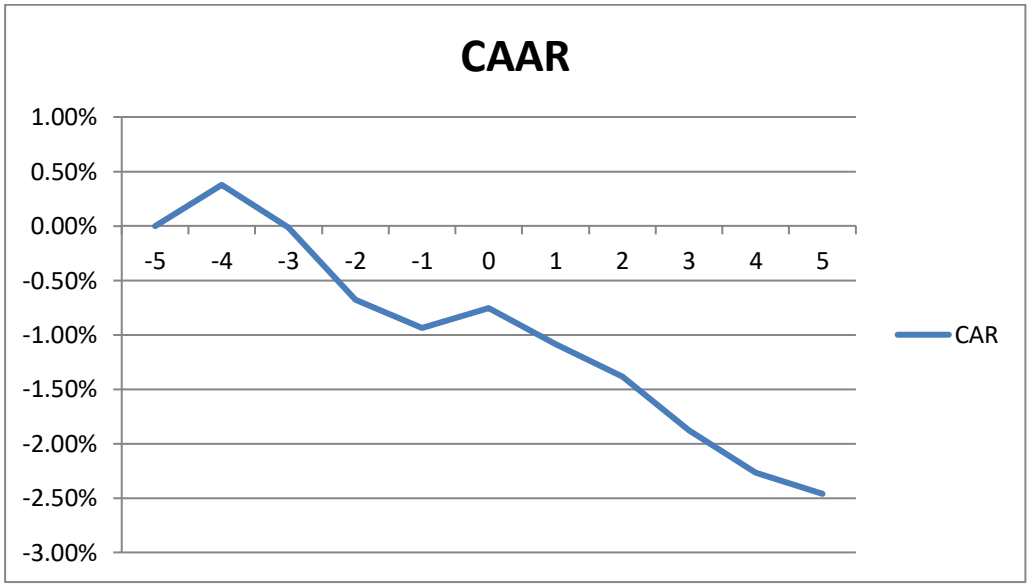
* Denotes significance at the 5% level. ** Denotes significance at the 2% level.

As shown in table 4.7, share price returns decline immediately before the expiration day. From day -3 onwards to day -1 the share prices of the general sample of shares tends to show a downward movement. These declines are however not statistically significant. In addition the CAAR from day -3 to day 1 confirms no statistical significance. On the event day there is an upward movement in the share prices but once gain this upward tick is not significant which is in line with the non significance of the prior down days.

The lack of statistical significance before the expiration day therefore agrees with the original findings by the Nathan Report, Klemkosky (1978), Klemkosky and Maness (1980), Officer and Trennepohl (1981) in the options literature that there should be no price effect exerted by the derivative options on their underlying assets. However, after the expiration day a different finding emerges. It appears that the CAAR experiences a significant drop after the expiration day. In fact from day 1 up until day 5, the CAAR goes down by 1.71% which is statistically significant at the 5% level (confirmed by the Wilcoxon test) This shows that after the expiration day, underlying shares tend to experience a continuous drop with day 3 specifically experiencing a significant 0.5% drop.

In order to see the pattern of movement a bit more clearly, we plot the results on a line diagram.

Figure 3 Line Graph Showing Pattern of CAAR For General Sample



The line graph shows a distinct downward movement in the share prices after the event day that never recovers. However, the decline in the share price does not appear to be volume driven as table 4.8 of the volume study does not show any abnormal trading movements, apart from a significant drop in the in trading experienced during day -3. It is therefore clear that the drop in the underlying share prices after the expiration day may not actually be caused by immense selling pressure. A clearer explanation for this phenomenon may be found by assessing the expiration effect of in money and out the money puts separately.

In order to better interpret the results, the general sample is split into an in the money group and an out the money group. All warrants in the general sample were European puts so there was no opportunity to assess the expiration effect from the point of view of calls. It makes intuitive sense that in the money and out the money warrants should also be studied separately as the "moneyness" of the warrants may determine the level of covering that is required and may send a different price signals.

4.7 Expiration Effect: In the Money Puts

There were only 11 in the money observed in the study. The poor sample size is kept in mind with regards to the interpretation of results

Table 4.9 AAR in the Money Expiration

DAY	AAR	CAAR	TEST STAT AAR
-5	0.12%	0.12%	0.471764125
-4	0.33%	0.45%	0.516944600
-3	1.47%	1.92%	2.313450207
-2	-0.26%	1.65%	-0.290868377
-1	-0.81%	0.84%	-0.771905615
0	0.44%	1.28%	1.081170552
1	-1.14%	0.14%	-2.079096654
2	-0.73%	-0.59%	-1.225961656
3	0.05%	-0.53%	0.080543523
4	-1.25%	-1.79%	-1.682633734
5	-1.27%	-3.05%	*-2.447578572
CAAR(1,-2)		-1.87%	#-2.2325

Table 4.10 AVT in the Money Expiration

DAY	AVT	TEST STAT AVT
-5	16.36%	0.474624
-4	-23.20%	-2.42405
-3	-22.42%	-1.7856
-2	22.91%	1.083434
-1	-43.58%	**-5.22173

0	-29.80%	**-7.00487
1	-11.06%	-1.15044
2	-27.23%	**-2.86321
3	5.88%	0.400401
4	-2.05%	-0.1593
5	10.14%	1.292737

* Denotes significance at the 5% level. ** Denotes significance at the 2% level

[#] Denotes 5% significance when applying Wilcoxon Signed Rank Test

The in the money puts do not appear to impute any statistically significant effect on the price of the stocks on or before the expiration day. Similar to the general sample there is a decline in share prices that is prevalent only after the expiration day. The CAAR from day 1 to day 2 drops by 1.87%. This sharp drop is only significant at the 10% level using the normal t-test but when applying the Wilcoxon Signed Rank test the result shows statistical significance at the 5% level. We can therefore postulate that there is a generally downward movement in the underlying assets of in the money warrants but only after maturity day.

The negative price trend after the day of expiration could be due to the market using other means to take a short position. The idea is that the market has to move away from using the puts warrants to take short positions because they have matured. This is a view supported by (Chan & Jelic, 2007). As such, investors have to move to shorting the underlying asset directly. However, the decreased trading volumes undermine this argument that short selling is prominent after the warrants have expired because there is no indication of increased selling volumes. In fact, day -1, 0 and 2 show that there is statistically less trading volume. This contradicts the argument that there may be additional selling being executed by the issuers. It does however give further credence that there are no delta hedging trades taking place before expiration and there are no trading reversals afterwards.

The reason for what may be causing the downward pressure can only be linked to a lower demand for the underlying assets. This study proposes the following reason: Perhaps, the market could have viewed the fact that the warrant expired in the money as a negative price signal on the future value of the underlying assets and halted its demand for the underlying asset.

4.8 Out The Money Puts

Table 4.11: AAR in the Money Expiration

DAY	AAR	CAAR	TEST STAT
-5	-0.06%	-0.06%	-0.14152
-4	0.34%	0.27%	0.649323
-3	-0.65%	-0.38%	-1.45662
-2	-0.83%	-1.21%	-1.71689
-1	-0.22%	-1.43%	-0.86569
0	0.17%	-1.26%	0.533104
1	-0.04%	-1.29%	-0.08437
2	-0.15%	-1.44%	-0.46996
3	-0.44%	-1.89%	-2.219
4	-0.09%	-1.98%	-0.40599
5	-0.13%	-2.11%	-0.36424
CAAR(-5,-1)		-1.43%	-1.336
CAAR(1,-5)		-8.6%	-1.0393

Table 4.12 AVT in the Money Expiration

DAY	AVT	TEST STAT
-5	-26.10%	-3.10311
-4	-1.65%	-0.10727
-3	-18.74%	-1.78803
-2	-5.32%	-0.40183
-1	-6.56%	-0.54372
0	12.08%	0.801256
1	0.76%	0.082593
2	4.51%	0.411294
3	1.51%	0.101422
4	1.94%	0.182844
5	10.38%	0.685084

* Denotes significance at the 5% level. ** Denotes significance at the 2% level

The results of the out the money put warrants show that the share prices remain generally depressed around the maturity date but the price depression is not statistically significant.

This supports the finding by Chen and Liao (2010) that out the money warrants should not have any effect on the underlying asset as the issuer will have no need to cover its position. The results that emerge from this sample are also consistent with the findings of Chamberlain et al. (1989); Chen & Williams (1994) and Schlag (1996) in the options literature, that there is a little evidence of a price effect. There is also indication of no changes in the trading volumes around the expiration days with only day -5 showing statistically less trading volumes. These undefined sporadic volume patterns are also in line with the findings of Chen and Wu (2001) and give further credence to the lack of a defined price pattern. The reduced trading volume on day -5 could be an indication of the lower interest in the underlying by the general market.

These findings of price effect insignificance may imply that warrant expirations of out the money puts do not convey any new information which could affect the underlying assets. Therefore they do not impact the assets because this news has already been priced by the market. This agrees with the insight by Bollen and Whaley (1999). This insight will hold particularly true for warrants that have been deep out the money for a while where there is a small chance of an in the money swing hence respective parties would have unwound their positions a while back

4.9 Relating the Major Findings to the Theory

It has been argued that delta hedging is the most plausible reason for a possible price effect around listing and maturity days of warrants (Chen & Wu, 2001). When writing warrants, the issuer initially takes a short position in the warrants, which means that he will be exposed to losses should the warrant retire in the money. This risk can be mitigated through delta hedging strategies. The delta D, measures the change in the value of the warrant as the price of the underlying changes. Therefore in order for the issuer to be delta hedged, the issuer must purchase (sell) D number of stocks for each call (put) warrant issued. Delta is dependent on the prevailing stock price and the passage of time. Therefore, the issuer will be required to adjust his position constantly. It is intuitive to expect that the best time to buy or sell the underlying stocks is when the warrants are just about to be issued.

The same can be said when a warrant is about to expire. The issuing bank is anticipated to long or short its position in the underlying share based on the "moneyness" of the warrant. Therefore, if the warrant is about to expire in the money, the bank needs to bulk up on its position in the underlying asset (for call warrants) or the bank needs to engage in counteracting shorts (for put warrants). In theory, one expects that these positions should be reversed after the expiration day as banks reverse their delta strategies.

We see the above theories play out fairly well in the results. For example, the study shows that there is no significant effect imposed by any of the out the money warrants before listing days and the same applies when looking at the expiration day of these out the money warrants. The reason for the lack of any significance seems to be due to their out the money status which means that the issuers do not have to do any covering using the underlying assets. Any covering that is done, is done at a small scale due to the low delta. The results are therefore in line with the theory that there is no price effect imposed by out the money puts and out the calls around the listing dates or at the maturity dates. However, in line with the theory, we see significant price effects prevalent somewhere for in the money warrants due to their higher delta and higher hedge demands. The regulation of a market therefore plays an important role. In China for example, delta hedging is not a plausible reason to expect a price effect because the market does not allow short trading[8]. In this market, all banks are required to deposit the underlying shares in a clearing house before the warrants are listed on the market (Chen & Xing Liao, 2010).

In addition - on the JSE, and in most warrant markets, the expectation of an introduction effect for in the money options is largely rooted in the regulation of warrant listings. According to the section 19 of the JSE listing requirements, the issuing bank must hold a certain portion of shares or show that it has a certain net asset value before it can be granted the ability to list a warrant on the JSE. As such, if the bank chooses to hold a position in shares, the expectation is that there will be a short term increase or decrease in the price of the underlying asset. This is seen to play out once again with the results for the in the money warrants.

[8] There has been movement in the Chinese market to transform this regulation. At the writing of this report, the Chinese market has started to expand its short selling pilot scheme.

On the JSE, the one regulation that may have a limiting factor on the price impact of warrants is the regulation that limits the amount of warrantable shares. This seemed to have some bearing when interpreting the results of the in the money warrants because there was never an overwhelming change in the trading volume. The lighter than expected volume movements may be due to the aforementioned JSE regulation.

Another motive that may cause prices to change around the introduction and maturity days, may not be for hedging purposes, but could actually be due to price manipulation. The higher (the lower), the price of the underlying asset, the higher the value of a call warrant (put warrant). In order to be able to sell these warrants at a higher prices, the banks may manipulate the price of the underlying asset by inducing buying and selling pressure. The ignorant retail investor may not be aware of this. Price manipulation is a valid argument but would require more in depth analysis.

4.10 Conclusion

In conclusion, it can be inferred that there is generally no listing price effect and that there is generally a downward price pressure associated with warrants after their expiration date.

It is clear that there is no effect exerted by all out the money calls or puts around listing days or expiration days.

In the money puts tend to drag share prices downwards but only after the listing and expiration days.

In the money calls exert a statistically significant upward pressure on shares before and after the listing days. A summary of the empirical results is also found below to show a complete overview.

Table 4.13: Summary of the Empirical Results

Sample	Price Effect
Listing effect generally	Generally no effect
In the money calls - listing effect	Positive price permanent effect
Out the money calls - listing effect	No effect
In the money puts - listing effect	Negative after listing
Out the money puts -listing effect	No effect

Expiration effect generally	Negative after listing
In the money puts - expiration	Negative after listing
Out the money puts - expiration	No effect

What follows is the conclusion chapter that indicates the major findings and the implications of these results, followed by ideas for future research.

5 RESEARCH CONCLUSION

5.1 Major Findings and Implications

The aim of this study was to assess the price effect exerted by JSE warrants on the listing days and on the maturity days of the warrants. A sample of warrant introduction and expiration dates from 01 Jan 2008 - 31 December 2012 were assessed. The study was approached from a general standpoint and also sub-sampled calls and puts separately. The results confirm the insight that the price effect depends on the type of warrant as well as its "moneyness"

The general sample for the introduction effect is a more diverse sample with puts and calls so it is interesting to note that it indicated no effect. This is in line with the original findings of the Nathan Report and the warrant studies conducted in Malaysia (Yip & Hooy, 2012 and Yip & Lai, 2009) as well as Alkeback & Hagelin (2004) in Sweden. It may appear that in order for warrants to impose no effect, there must be a complete market for warrants. In other words, both puts and calls issued on the same underlying assets. The general sample for the expiration effect does show a price effect but this sample is only composed of puts which is therefore still in line with the above argument. This may be particularly useful for the regulatory community if they wish to minimise the effects of warrants.

The "moneyness" and type of the warrant appears to have an influence on the price impact . All out the money warrants showed no price effect while all in the money warrants showed some indication of a price effect. Secondly, puts and calls typically showed opposite effects. It is quite striking to see how the past literature has not approached the research problem by applying this separated approach as it appears intuitive that the "moneyness" and warrant type should have an influence on the price impact. The intuition is confirmed by the results of the study. This also supports the idea that delta hedging may be prominent.

Furthermore, the movement of prices is not always associated with abnormal trading volumes. This is a finding that is in contrast with most of the past literature and could be attributed to the limit that the JSE imposes on the number of warrantable stocks. This supposedly indicates that the protective mechanism imposed by this regulation is working quite well from a volumes perspective.

Although price effects are noted for the in the money warrants, their economics is somewhat dubious. The highest, statistically significant, one day price movement is noted as 1.7%, which

would be easily wiped out by transaction costs. This has particular implications for the trader wishing to exploit the findings of a price effect and somewhat undermines its practical significance.

5.2 Limitations

The results for the in the money samples can be subjected to scrutiny because of the poor sample size. Unfortunately each of the in the money samples only had 11 warrants hence this took away from the robustness of the results. Furthermore, the filtering process also meant that the study was unable to examine an expiration effect for calls. While it may have been conducive to have more events, the rigorous filtering process was also important in order to avoid any ambiguous noise.

The study may also be losing out on some important information by choosing to look at the listing date as opposed to the announcement date. It could be argued that the banks will take their covering positions around the announcement day as opposed to the listing date. A comparison of the two dates would have provided some valuable insights.

The research design was also somewhat limited in that it did not necessarily adjust for the possibility for confounding events. These are events related to changes in the economic climate or the regulatory environment. An improvement to this study would have been to isolate these particular events.

5.3 Conclusion

This study has therefore contributed to the knowledge of the study of warrants because it is the first to be conducted on the JSE. It is also among the only studies that digs deep and approaches the examination by isolating the warrants according to their "moneyness" and type.

In order to expand the findings of this paper and the general study of derivatives on the JSE, two future research ideas are suggested. Firstly, it would be appropriate to compare the price effect of the announcement day with the listing day and observe where most of the bank covering actually takes place. This study assumed that most of the covering would take place around the listing day, which may not necessarily be the case. Another suggestion would be to empirically examine the price effect of options and compare it to warrants on the JSE.

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7 APPENDICES

Table 7.1 Appendix 1

Shares Codes for Companies Used in Introduction Study			Shares Codes for Companies Used In Expiration Study	
SYC	KIO		VOD	GFI
SOL	IMP		TKG	FSR
SLM	HAR		SOL	CFR
SHP	GFI		SHP	BIL
SBK	FSR		SAP	ASA
SAP	EXX		SAB	ANG
SAB	CFR		OML	AMS
REM	BTI		NPN	AGL
PPC	BIL		NED	ACL
PAP	ASA		MTN	ABL
OML	ANG		KIO	HAR
NPN	AMS		INL	
NED	AGL			
MTN	ACL			