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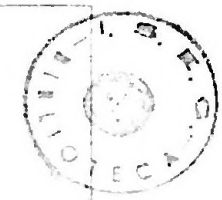

Mestrado em Gestão

Effects Associated with Changes on Index Composition: Evidence from the Portuguese Stock Market

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Glossary of Terms

AAR - Average abnormal return

ACAR – Average cumulated abnormal return

AD - Announcement day

AR - Abnormal return

AV – Average Volatility

CAR - Cumulated abnormal return

DAX (Deutsche Börse AG) - Deutsche Stock Exchange Index

DJIA - Dow Jones Industrial Average index

ED - Effective change day

FTSE All-Share Index - London Stock Exchange index

FTSE100 - London Stock Exchange index

ISE 30 and ISE 100 - Istanbul Stock Exchange indexes

KFX - Copenhagen Stock Exchange index

MDAX - Deutsche Stock Exchange Mid-Cap index

MIB 30 (Milano Indice Borsa 30) - Milan Stock Exchange index

S&P MidCap 400 - Standard & Poor's Mid-Cap index

Midex - Milan Mid-Cap index

MSCI - Morgan Stanley Country Indexes.

Nikkei - Japan Stock Exchange index

NZSE 10 and NZSE 20 - New Zealand Stock Exchange indexes

PSI 20 - Portuguese Stock Index 20

S&P 500 - Standard & Poor's 500 index

SAR - Standardized abnormal return

TSE 300 - Toronto Stock Exchange 300 index

VR - Volume ratio

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Mestrado em Gestão

Supervisor: Prof. Doutor João Duque

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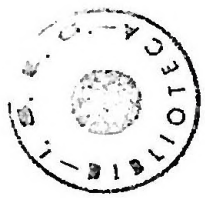

ABSTRACT

According to previous studies in other markets, changes in a stock market index composition have shown abnormal returns are available at the date when index changes become effective. Stocks (added or deleted) tend to generate abnormal returns. However, the event also affects the trading volume.

This study examines the stock reaction that occurs when shares are added to or deleted from the Portuguese stock index PSI20.

The study focuses on three different effects: abnormal returns, trading volume and volatility. The volatility effects are not statistically significant. Trading volume provides few statistically significant results, nevertheless they corroborate the price effects findings. The study provides evidence that deletions are associated with negative effects while additions are associated with positive effects. For additions a 3.33% abnormal return was found, while for deletions a -5.03% abnormal return was observed.

The market seems not to anticipate additions. However, for deletions there are clear signs of anticipation. For additions a temporary price pressure effect was found, while deletions show a permanent effect.

The results indicate the existence of abnormal returns, which represent a market efficiency violation.

Keywords: Stock index revisions, index composition, price and volume effects, event study, abnormal returns

JEL Classification Code: G11, G12, G14

Efeitos Associados à Alteração da Composição de um Índice de Acções: Aplicação ao Mercado de Capitais Português

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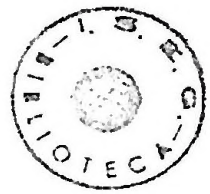


RESUMO

As alterações da composição dos índices representativos do mercado accionista, apresentam em diversos estudos, rendibilidades anormais, no período em que se verifica a efectiva alteração da composição do índice. Complementarmente, verifica-se que o volume de transacções dos títulos apresenta alterações face ao padrão normal.

O presente estudo consubstancia o enquadramento ao fenómeno referenciado, procedendo a sua aplicação ao mercado de capitais português, com base no índice PSI-20. Os efeitos estudados compreendem a rendibilidade anormal, o volume de transacções e a volatilidade. Relativamente à volatilidade, esta não apresenta qualquer significância estatística. O volume de transacções revela alguns efeitos estatisticamente significativos, corroborando a evidência da rendibilidade anormal. O estudo fornece evidência de que os títulos excluídos do índice, estão associados a uma rendibilidade negativa, ao passo que, os títulos adicionados ao índice são detentores de rendibilidade positiva. Relativamente aos títulos adicionados, a rendibilidade determinada foi de 3.33 por cento e nos títulos excluídos a rendibilidade apurada foi de -5.03 por cento.

No caso dos títulos adicionados, não existe evidência de antecipação do evento pelo mercado. No entanto, no caso dos títulos excluídos do índice existe uma clara antecipação.

Nos títulos adicionados os efeitos reportados são temporários, no entanto, nos títulos excluídos do índice o efeito é permanente.

Os resultados evidenciam a existência de rendibilidade anormal, o que consubstancia uma violação da eficiência do Mercado.

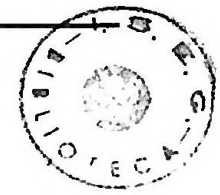
Palavras chave: Revisão do índice accionista, composição do índice, efeito preço e volume, estudo de eventos, rendibilidade anormal

Código de classificação JEL: G11, G12, G14

Contents

Tables Index

Figures Index



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In my mother's

memory

Introduction

Introduction

This study examines the effects that occur when stocks are added to or deleted from a stock market index.

The study will focus on the index replacements effects over certain variables, namely price, volume and volatility. The study addresses the question whether there are effects associated with index replacements in the Portuguese stock market.

The main goal will be to collect evidence of the effects observed on stocks that are excluded from or included in the main Portuguese stock index, in order to determine the magnitude of the impact and the timing during which these effects can be observed. We hope that the conclusions will help to determine how new information about announcements of additions to or removals from the index have been incorporated in each stock. This will be crucial to evaluate the Portuguese stock market version of the Efficient Market Hypothesis.

Most of the papers on this subject report the existence of stock markets inefficiencies. However, they present a variety of explanations for the observed evidence. These different explanations are due to the different effects reported, particularly concerning the impact and the duration of the effects (transitory or permanent).

The study intends to increase knowledge of the Portuguese stock market, specially regarding investors' behaviour, in order to compare the Portuguese market with other stock markets. There is a vast set of empirical literature on this subject, but mostly focused on the United States market. This study could be seen as a step in this direction. Therefore, it seems pertinent to develop a study that focuses on the Portuguese index replacement effects. The chosen index was the PSI-20 index, an index composed of the 20 most frequently traded blue-chip stocks.

In this study we use the event study methodology in order to establish a connection between the variables under study (price, volume, bid/ask spread and volatility) during the event window. The event window is the length of time over which one may observe the stock reaction to the event. Usually it starts immediately before an announcement of a stock that is to be added to or removed from the index, and ends shortly thereafter (moment when the stock assimilates the news).

The methodology relies on two main assumptions: the strong version of the Efficient Market Hypothesis, which states that stock prices reflect all relevant and available information quickly responding to the arrival of new and relevant information; and that the price of an efficiently traded stock equals the present value of the future free cash flows. Additionally, it is assumed that the impact on stock prices will reveal changes in the future free cash flows if four conditions are observed: the event is well defined, the event is known, there are no reasons to believe that the market anticipated the event and it is possible to isolate the event effects from other occurrences in the market.

The procedure for performing an event study has a series of specifically well-defined steps. First, one estimates the variable under study (for instance the stock price return) during the event window. To perform this estimation, one uses a model that takes into account market and/or industry. Next, the predicted value is subtracted from the actual value to compute what is called the abnormal return. The cumulative abnormal return is than calculated as the sum of a set of abnormal returns over a number of time periods. Therefore, the difference between the actual and predicted returns gathered over all these periods is called the cumulative abnormal return (CAR). To determine whether the difference between the actual and the predicted return is due to chance, the CAR is tested for statistical significance.

The main findings can be summarized as follows. First, the study provides evidence that deletions are associated with negative effects while additions are associated with positive effects. Second, investors do not wait until the effective date change to rebalance their portfolios. Third, the market seems not to anticipate additions, while deletions show clear anticipation signs. Fourth, additions behaviour can be explained by the price pressure hypothesis, while for deletions the most accurate explanation is the information hypothesis. Fifth, the findings suggest that the Portuguese stock market is not efficient, however one can conclude the existence of an improvement in efficiency, based on the analysis of sub-periods.

The study proceeds as follows. The first chapter describes the literature review and the explanations given by researchers for the effects observed during a revision of the index composition. The second chapter describes the index, the dataset and the methodology used. In Chapter 3 the results are presented. Chapter 4 discusses those results and finally, the conclusion is presented.

Chapter 1

Literature Review

Since Shleifer (1986) and Harris and Gurel (1986) who examined the effects associated with changes in index composition, this subject has been widely studied, mainly in the United States stock market.

In this chapter we review the main literature on the subject, presenting the plausible reasons for the phenomenon in the first section, and in the second section, the empirical findings. We will use a chronological approach to present the index replacement effects-related literature.

1.1 - Explanation hypotheses

Several hypotheses have been proposed in the literature in order to explain why traded stocks should present some changes in their patterns if they are simply added to or deleted from the list of equities that are included in stock indexes used as benchmarks. These changes are not exclusively related to stock price behaviour, being possibly extended to trading volumes or even other characteristics such as spreads, stock price return distributions, etc.

Although a very significant number of authors present a vast number of explanations, they can be summarized in five major explanation hypotheses.

The **price pressure hypothesis** (due to downward sloping short run demand curves) states that changes in index composition have consequences on demand and trading activity. However these effects should rationally be temporary and might be related to the action of index funds when trying to minimize the tracking error of managed portfolios. In this case, in the long run, this effect is expected to vanish.

The **imperfect substitutes hypothesis** (due to downward sloping long run demand curves) states that when the indexers buy stocks, the number of available shares to be traded (free float) tends to reduce. Therefore the market price of the stocks should increase if the long-term demand curve is downward sloping and if it is not affected by the price insensitivity to the demand behaviour of the indexers. Under the imperfect substitutes explanation hypothesis the effects reported should be permanent because the new price (after the announcement) shows a new equilibrium distribution for the stock

price. This means that equilibrium prices change when demand curves shift to overcome the excess demand.

The **liquidity or information cost hypothesis** states that the effects shown are due to the change in the general costs related to trading as a result of a persistent increase in the stock trading volume when stocks are added to indexes. The hypothesis is based on the assumption that investors demand a premium for holding stocks with higher trading costs or with less available information. As trading volume should increase when stocks are added to reference indexes, a reduction in volatility and in bid/ask spread should be observable. Therefore, this hypothesis predicts a decrease in the stocks trading costs and an increase in stock prices for stocks just added to the index. Amihud and Mendelson (1986) were the first to formalize the liquidity hypothesis. They derived the asset returns function as a concave and increasing function of the bid-ask spread.

According to the **information hypothesis** (or attention hypothesis or certification hypothesis or shadow cost hypothesis) it is assumed that all investors know the basic structure of security returns. The deletion from or the addition of a stock to the stock market index provides new information to the stock market regarding its future prospects. Under these assumptions an addition is considered good news, while a deletion is a bad new. An example of this situation occurs when a stock is added to an index. When added to an index the stock increases its value just as a result of belonging to the stock market index (an equivalency can be drawn made with a soccer team that reaches the premier league). The newly added stock (or company) will have closer scrutiny by analysts and will be the subject of greater attention from institutions and the media. This should lead to a lower risk associated with the information availability and accuracy. Therefore, when stocks are added to the index more investors are aware of its existence and, as a consequence, the required rate of return should fall due to the decrease in non-systematic risk. According to this hypothesis the effects reported are expected to be permanent.
This hypothesis finds its roots in Merton (1987), who developed the theory of equilibrium pricing with incomplete information.

According to the **selection criteria hypothesis** the effects are due to the selection criteria used to determine the index composition. The effects detected in an index

composition change are due to the underlying fundamentals of the stocks themselves. Therefore, when stocks are added to the index this is a good sign because they should be the result of stronger fundamentals, with a stronger historical performance. Prices should then react accordingly, showing an increase in market capitalization.

At this point the major explanation hypotheses of changes in index composition were examined. Results are summarized in the following table.

Table 1-Explanation hypotheses for index composition changes effects

Explanation hypothesis / Researcher(s)	Price pressure	Imperfect substitutes	Liquidity	Information	Selection criteria
Shleifer (1986)		√			
Goetzmann and Garry (1986) (a)					
Harris and Gurel (1986)	√				
Woolridge and Gosh (1986)	√		√		
Lamoureux and Wansley (1987)	√				
Jain (1987)				√	
Pruitt and Wei (1989)	√				
Dhillon and Johnson (1991)		√		√	
Edmister *et al.* (1994 and 1996)					√
Beneish and Gardner (1995)			√		
Collins, Wansley and Robinson (1995)			√		
Beneish and Whaley (1996)	√				
Lynch and Mendenhall (1997)	√	√			
Chung and Kryzanowski (1998)	√				
Deininger, Kaserer e Roos (2000)		√			
Barontini and Rigamonti (2000)			√	√	
Brealey (2000) (b)					
Liu (2000)		√			
Hanaeda and Sarita (2001)		√			
Elayan, Li and Pinfold (2001)	√				
Bildik and Gülay (2001)				√	
Cooper and Woglom (2002)	√				
Bechmann (2002)			√		
Chakrabarti *et al.* (2002)	√			√	
Chen *et al.* (2002)				√	
Hanaeda and Sarita (2003)		√			

(a) They examined the AT&T spin-off in 1983 and they did not presented any explanation hypothesis

(b) Brealey collected evidence against the selection criteria, "... abnormal returns are observed for both indexes suggests that the effect is not simply due to the growth of index funds or performance benchmarking." and he concluded that those price effects are likely to be very small.

1.2 - Empirical Findings

Fama, Fisher, Jensen and Roll[1] developed the event study method in 1969. Since then several researchers have adopted the event study methodology to perform empirical research in finance[2].

Surprisingly, the event study methodology developed earlier is not dissimilar to that which is applied today. Contrary to what would be expected there have only been a limited number of refinements in the event study methodology[3].

The major refinements are the non-synchronous technique of Scholes and Williams (1977), the speed of adjustment measure proposed by Hillmer and Yu (1979), the power and robustness presented by Brown and Warner (1985) and the fragility of the market model in an event study as documented by Coutts, Mills and Roberts (1994 and 1995). The latest refinement was the conditional event study by Acharya (1993), later formalized by Prabhala (1997).

Until October 1989 (when a change occurred in the S&P 500 revision procedures) the announcement day coincided with the effective day of the change. Shleifer (1986) found a positive relation between the announcement of a change in the S&P500 composition and a price effect. He examined the period between 1966 and 1983. According to his results a positive abnormal return of 2.79 per cent was detected for stocks that were added to the index, in the sub-period 1976-1983. In addition he found that firms with lower-rated debt did not have a strong addition day response when compared to those with higher-rated debt. Although Shleifer (1986) did not suggest a liquidity hypothesis to explain his findings, he stated that, probably, the action of analysts and investors form the most likely explanation for the evidence collected, due to the fact that a stock added to the index started to undergo closer scrutiny. This may lead to a greater institutional interest, increasing trading volume and decreasing the stock bid-ask spread.

[1] Fama, E.; Fisher, L.; Jensen, M. and Roll, R. (1969).

[2] For a general review of the event study methodology see Cable and Holand (1999), MacKinlay (1997) and Strong (1992).

[3] For a detailed discussion of the original method modifications see Binder (1998).

Goetzmann and Garry (1986) examined the exclusions from the S&P500 occurred on the November 30, 1983. They were caused by the AT&T spin-off. With this spin-off seven new listed companies were created, which were immediately included in the index. As a consequence, six other companies were removed from the index. The study showed a negative abnormal return of 2 per cent.

Harris and Gurel (1986) found a significant abnormal positive price reaction on the announcement day of 3.13 per cent for the stocks added to the index when studying the effects of the addition of new stocks to the S&P500, between 1978 and 1983. They also found a negative abnormal price reaction of 1.4 per cent for the stocks deleted from the index. They also found that stock prices fully revert to their pre-announcement levels within three weeks. Furthermore, the authors argue that the price effects are due to the large trading volume detected. These findings can be taken as evidence of a temporary price pressure. However, the volume effect is permanent for stocks added to the index.

Shleifer (1986) and Harris and Gurel (1986) were the first to recognize that a permanent price response associated with stock added to or deleted from an index is consistent with the fact that stocks seem to possess downward-sloping demand curves. Neither author found any evidence to validate the information hypothesis.

Woolridge and Gosh (1986) examined the additions to S&P500 on the announcement day between 1977 and 1983 (which at that time was equivalent to the effective change day) and found a positive abnormal price positive reaction of 2.77 per cent. Additionally, they detected an increase in the trading volume. The authors argued that the effects detected were due to the price pressure hypothesis or liquidity hypothesis.

Lamoureux and Wansley (1987) examined the effects on an S&P500 change. They found a positive abnormal return from stocks added of 2.3 per cent. However, the effect reported in the added stocks was temporary. This study corroborates the price pressure hypothesis.

Evidence against the price pressure hypothesis was presented by Jain (1987). He examined the stocks added to and deleted from S&P500 supplementary indexes, which are not tracked by index funds. The effect stated by the author was a permanent price effect. Jain found that the systematic risk of stock changes drastically after the change in the index composition. However, the effect reported seems to be independent of the size of the firms. He suggested that additions to or deletions from the index convey

information to the market. His findings were not consistent with either the price pressure hypothesis or imperfect substitutes hypothesis and he attributed the observed effects to the information hypothesis.

Pruitt and Wei (1989) studied the link between the institutional investors' behaviour and the changes in the index composition, for both additions and deletions. They analyzed the portfolio reallocation of institutional investors when an index composition change takes place and showed that they are positively correlated. The authors also observed the price effect and concluded that index funds are responsible for 2 per cent of the increase in the trading volume. Their results also prove the existence of a very large institutional elasticity in demand for stocks. These findings were consistent with the price pressure hypothesis, although they did consider the imperfect substitutes hypothesis inconsistent with their findings.

In October 1989 Standard & Poor's Corporation announced a change in the procedures of the revision of the S&P500 Index. Before that time, changes in the S&P500 Index were announced after the close of trading and the change became effective on the next trading day. From October 1989 on, the procedure was modified so that the index replacement was announced approximately one week before the effective change. According to Beneish and Gardner (1995) the new policy on the index revision had the intention of limiting the price pressure under the stock in an index composition change. However, the authors argued that the new policy resulted in an increase of the price reaction previous to the effective change with a reversed effect after the stock is effectively added to the index.

Dhillon and Johnson (1991) documented a positive permanent stock price and volume effect following the announcement of an addition to the S&P500. The authors examined the options and bonds return of firms being added to S&P500, between 1984 and 1988. They reported an increase in call options premiums and bond prices and a decrease in put options premiums as a result of the index replacement announcement. In addition, the trading volume increased permanently after the inclusion in the index composition. These findings are taken as evidence since the effect is due to an increase in the stock liquidity and to a decrease in the information costs and on the bid-ask spread. According to the authors the evidence collected was not consistent with price pressure hypothesis but could be explained through the information hypothesis. The imperfect substitutes

hypothesis could fit the evidence registered only if stocks, bonds and options for the same firm were close substitutes.

Edmister, Graham and Pirie (1994 and 1996) studied the S&P500 additions before October 1989. The authors corroborated Dhillon and Johnson's (1991) findings, concerning the perceivable liquidity effect when observing changes in the index composition. Regarding the 1996 study, they found evidence of a permanent increase in trading volume of 18 per cent after index inclusion and a simultaneous decrease in the bid-ask spread of 12 per cent. They concluded that the trading activity of excluded stocks is correlated with changes in trading volume. Regarding the selection criteria for stocks to be included in the S&P500 Index, Edmister et al (1994 and 1996) concluded that stocks added to the index in the previous two years (before the addition) showed higher prices volatility when compared to the market. This effect was called the selection criteria effect[4].

Beneish and Gardner (1995) examined changes in the DJIA (Dow Jones Industrial Average). They found no price or trading volume effect from additions into the index. They suggested that the result was due to a lack of index funds rebalancing, since index trading is limited for the sample period and, additionally, most of the index funds mimic the S&P500, not the DJIA. However, the results showed a significant price effect as well as a decrease in the trading volume when deletions were observed. The evidence suggested that, in the case of stock addition, both the price pressure and imperfect substitutes hypotheses were unlikely explanations. Regarding the deletions, the explanation presented by the authors suggests that the key issue is the firm itself. Therefore, the added stocks are usually actively-traded and prominent firms, while deleted stocks are correspondingly smaller and less-traded firms, which raise limited expectations. They found that the evidence was consistent with information cost and liquidity explanations. These explanations sustain that investors demand a premium for higher trading costs and for holding stocks that have relatively less available information.

Collins, Wansley and Robinson (1995) examined the Standard & Poor's MidCap 400 Index constitution on 5th June1991. The evidence supported an increase in abnormal

[4] This effect was studied in detailed by Copeland and Mayers (1982); Fama and French (1992) and Kryzanowski and Zhang (1992).

returns and trading volume. The MidCap stocks significantly outperformed the market during the 52 weeks following the announcement. According to the authors the effects could be explained with the information cost hypothesis. The MidCap stocks were expected to receive increased attention (investor recognition) with the index creation.

Beneish and Whaley (1996) documented abnormal returns during the period between 1986 and 1994 for changes in the index composition (3.67 per cent from 1986 to 1989 and 5.9 per cent from 1989 to 1994). Using the reported abnormal return calculated between the announcement day and the effective day of the change of the S&P500 Index, they found that the trading volume pattern was according to the price effect. It presented an increase of 30 per cent during a sixty days period after the announcement day and when compared with a period of normal trading. The temporary effect reported by Beneish and Whaley (1996) was due to the activity of the investment funds. They presented the effect as the S&P500 game. This effect is shown when arbitrageurs buy stocks added to the index (on the announcement day) in order to sell them to the index funds, when the change in index composition becomes effective. These funds cannot buy the stocks earlier since a tracking error would be generated -Beneish and Whaley (1997).

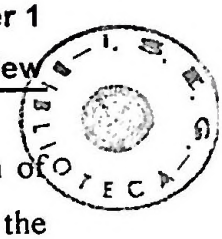
Lynch and Mendenhall (1997) observed the pattern of prices and volume during the period between 1990 and 1995. They tested the strategy of buying stocks that would be added to the index on the announcement day. Then they sold the stock when the change in the index became effective. The authors found that the price effect shows a greater magnitude on the announcement day. They observed a positive abnormal return for stocks added to the S&P500 of 3.16 per cent and a negative abnormal return for stocks deleted from the index of 6.26 per cent. However, a significant part of the effect seems to be temporary. The findings showed that the effects could be observed solely from the announcement day until the effective change day. Therefore, after the index replacement, the authors observed a partial reversion of the effect reported for stocks added to the index. The results on the volume effect showed a permanent effect. The trading volume did not return to the average pre-event trading volume. They demonstrated that the trading volume remains more than 30 per cent above the average volume even 60 days after the announcement. According to the authors the results show

the existence of a temporary price pressure and a downward sloping long run demand curves, a clear indicator of a market efficiency violation.

Chung and Kryzanowski (1998) examined the price and volume effects of the TSE300 (Canada) during the period between 1990 and 1994. The authors stated that the effects detected were temporary. They also concluded that the TSE300 (which is revised annually, presenting a longer advance notice period) produced different results when compared with the indexes revised on an ongoing basis like DJIA and S&P500. According to the authors this was caused by the fact that the number of changes was higher and therefore the need for rebalancing would be more urgent in order to minimize the tracking error. The authors found smaller abnormal returns when compared with the United States evidence. These findings were consistent with the price pressure hypothesis.

Deininger, Kaserer and Roos (2000) studied the stock price reaction to an index replacement in Germany (DAX and MDAX). The authors found a positive abnormal return on the announcement day of 1.72 per cent for stocks that were added to the MDAX index with an increase of 8.76 per cent from this date up to the effective replacement date. Additionally, for stocks deleted from the index they reported a negative abnormal return of 1.36 per cent. Concerning trading volume, the trend is similar but with less magnitude. Both effects were statistically significant. The authors did not find any reversion of effects during the fortnight following the replacement date. The effects reported by the authors do not fit into the price pressure hypothesis. They argue that the index replacement does not reflect an impact on stock price volatility, and price reactions on the announcement day do not correlate with long run volume ratios. Therefore, the evidence collected seems to point towards the imperfect substitutes hypothesis.

Barontini and Rigamonti (2000) examined revisions of the MIB30 and MIDEX (Milan), studying reactions of MIB30 stocks prior to and post the creation of mid-cap index (MIDEX). Prior to the MIDEX creation the evidence collected for additions to MIB30 sustained a positive abnormal return of 7 per cent. Additionally, an effect reversion was detected after a three weeks period on average. The trading volume showed abnormal levels in the days following the announcement and on the effective change day it reached 6.80 times the normal trading volume. Also prior to the creation of the index



MIDEX, the evidence collected for deletions sustained a negative abnormal return of 4.19 per cent. However, in this case, the effect did not present any reversion. After the MIDEX creation, stocks added to MIB30 showed a persistent negative abnormal return, while deleted stocks showed the existence of a temporary price pressure. On the other hand, stocks added to MIDEX exhibited a positive abnormal return of 11 per cent, while deleted stocks experienced a negative 6.6 per cent abnormal return. However, in this case, both effects appeared to be permanent. The authors argued that the explanation for the evidence must exclude the information hypothesis. They were strongly convinced that most consistent explanations could be found in the price pressure and liquidity hypotheses.

Brealey (2000) examined the price and volume effects of the FTSE All-Share Index and FTSE100 (London) during the period between 1994 and 1999. He observed a positive, but not statistically significant, abnormal return over the event window for additions. Deletions were associated with a negative cumulative abnormal return of 4.5 per cent (for FTSE All-Share Index) and 2 per cent (for FTSE100). Brealey (2000) presents a remarkable conclusion, pointing out the fact that abnormal returns are observed on both indexes which suggests that the effect is not simply due to the growth of index funds or performance benchmarking.

Liu (2000) examined the Nikkei 500 during the period between 1991 and 1999. The study provided a price and volume effect. He found a positive abnormal return of 1.54 per cent for additions, while deleted stocks experienced a negative 2.57 per cent abnormal return. The effects do not show any reversal trend. However, when compared with previous studies, focused on the S&P500 index he concluded that the effects were considerably smaller. He also found that trading volume increased significantly for both additions and deletions in the short run. However, for deleted stocks the long run trading volume continues to decrease. He concluded that trading volume effects do not always correspond to price effects. The author argued that the explanation for the evidence must exclude both the price pressure hypothesis and the information hypothesis, and that the most likely explanation is the imperfect substitutes hypothesis.

Elayan, Li and Pinfold (2001) examined the price effect of changes in the composition of NZSE10 and NZSE20 (New Zealand) during the period between 1995 and 2000. The study shows significant index effect. Index additions lead to a positive abnormal return

of 2.13 per cent while deletions lead to a negative abnormal return of 2.51 per cent, for a 2 day period ending on the effective change day. Regarding the explanations for the evidence collected, the authors argue that the information hypothesis does not play an important role. However, they were strongly convinced that the price pressure hypothesis seemed to provide the most accurate explanation for the detected effects.

Bildik and Gülay (2001) examined the price and volume effects of the ISE-100 and ISE-30 (Istanbul), during the period between 1995 and 2000. The evidence collected confirmed that the market reacts to changes in the index composition, particularly for deleted stocks.

Cooper and Woglom (2002) analyzed the trading effects of the S&P500 during the period between 1978 and 1998. They found a positive stock price effect, which was, at least in part, permanent. The price reversal in the most recent period is substantial. The results also show a permanent increase in the stock price volatility, which is related to a stock volatility increase. However, they also concluded that the effects appear to have increased dramatically in the most recent period.

Bechmann (2002) examined the price and volume effects of the KFX (Copenhagen) during the period between 1989 and 2000. This index has a specific characteristic due to the index selection criteria for the replacements. It generally implies that the changes will be, on average, anticipated by one month. The study provided evidence for a positive stock price and volume effect on stocks added to the index and a negative stock price and volume effect on stocks deleted from the index. The results on stock returns and trading activity indicate the existence of a price pressure around the index replacement date. However, the author argues that the permanent nature of the price effect and the evidence of the trading volume suggest that the most likely explanations corroborate the imperfect substitutes, the information cost and the liquidity hypotheses.

Chakrabarti et al. (2002) provided the first international study. They examined the MSCI Country Indexes from 1998 to 2001. They monitored 19 countries (Australia, Canada, Finland, France, Germany, Hong Kong, India, Indonesia, Italy, Japan, Malaysia, Norway, Philippines, Singapore, South Korea, Sweden, Taiwan, United Kingdom and the United States) measured by the changes in the indexes. The authors detected that return and volume exhibited similar effects to those detected in others studies. Index replacements showed an impact on returns as well as on trading volumes.

The evidence was consistent with the price pressure hypothesis. However, the effects do not show signs of reversal, rather being permanent, suggesting a considerable information effect (information hypothesis).

Chen, Noronha and Singal (2002) studied the price effects around S&P Index changes during the period between 1962 and 1999. Index additions led to a positive abnormal return of 2.40 per cent while deletions led to a negative abnormal return of 1.75 per cent. They found that the price effect of index changes is consistent with Merton's (1987) investor awareness and market segmentation hypothesis. They argued that the asymmetric price effects of additions to and deletions from an index have not been explained by empirical studies and are consistent with market segmentation hypothesis.

Hanaeda and Sarita (2003) examined the price and volume effects related to thirty Nikkei 225 exclusions, which occurred on 30th April 2000. They found that the newly added firms experienced a positive abnormal return of 19 per cent, in the five-day period after the announcement. Deleted stocks experienced a negative abnormal return of 36 per cent. In contrast, all remaining stocks showed a negative abnormal return of 14 per cent. They also found an increase in the trading volume for both added and deleted stocks. They found support for the imperfect substitutes hypothesis.

Table 2 tries to summarize the major study findings both for additions and deletions, on the first trading day after the announcement day.

Table 2 - Index replacements effects on the announcement day next trading day

Researcher(s)	Index	Period	Additions	Deletions
Shleifer (1986)	S&P500	1966-1975	(0.2%)	n.a.
	S&P500	1976-1983	2.79%	n.a.
Goetzmann and Garry (1986)	S&P500	1983	n.a.	(2.00%)
Harris and Gurel (1986)	S&P500	1978-1983	3.13%	(1.40%)
Woolridge and Gosh (1986)	S&P500	1977-1983	2.77%	n.a.
Lamoureux and Wansley (1987)	S&P500	1966-1975	0.50%	n.a.
	S&P500	1976-1985	2.30%	n.a.
Jain (1987)	S&P500	1977-1983	3.10%	(1.17%)
Pruitt and Wei (1989)	S&P500	1973-1986	-	-
Dhillon and Johnson (1991)	S&P500	1984-1988	3.30%	n.a.
Edmister *et al.* (1994 and 1996)	S&P500	1983-1989	3.30%	n.a.
Beneish and Gardner (1995)	DJIA	1929-1988	0,57%	(2,31%)
Collins, Wansley and Robinson (1995)	S&P MidCap400	1991	(0,149%)	n.a.
Beneish and Whaley (1996)	S&P500	1986-1989	3.67%	n.a.
	S&P500	1989-1994	5.90%	n.a.

Lynch and Mendenhall (1997)	S&P500	1990-1995	3.16%	(6.26%)
Chung and Kryzanowski (1998)	TSE300	1990-1994	1.70% annual 2.5%non annual	(1.30%) annual 2.9%non annual
Deininger, Kaserer e Roos (2000)	DAX MDAX	1988-1997	2.38% 1.72%	(0.80%) (1.36%)
Barontini and Rigamonti (2000)	MIB30 MIDEX	1995-1999	0.84% 0.76%	(0.84%) 0.03%)
Brealey (2000)	FTSE 100 FTSE All Shares	1994-1999	(0.40%) 0.50%	0.10% (0.30%)
Liu (2000)	Nikkei500	1991-1999	1.54%	(2.57%)
Elayan, Li and Pinfold (2001)	NZSE 40 NXSE 10	1991-2000	0.96% 1.37%	(2.20%) (3.14%)
Bildik and Gulay (2001)	ISE	1995-2000	0.16%	(0,38%)
Coopers and Woglom (2002)	S&P500	1978-1998	3.50%	n.a.
Bechmann (2002)	KFN Index	1989-2000	0.26%	(0.22%)
Chakrabarti *et al.* (2002)	MSCI	1998-2001	1.11%	(1.49%)
Chen *et al.* (2002)	S&P500	1962-1976	(0.04%)	(0.39%)
	S&P500	1976-1989	3.11%	(0.85%)
	S&P500	1989-1999	4.93%	(5.55%)
Hanaeda and Sarita (2003)	Nikkei225	2000	5.41%	(18.79%)

n.a. – not available

Chapter 2

Index, data and methodology

2.1 - Index

The PSI-20 was introduced in 1995. However, it has been computed since 31st December 1992, starting with a base value of 3000 points at this time. The index represents the 20 largest and most liquid share issues selected from the universe of companies listed on the main Portuguese market (the Market of Official Quotations). The index is used as a benchmark for the equity market and as an underlying index for futures and options.

2.1.1 - Index revision criteria

The technical committee defines the index revisions. The meetings of the technical committee may be ordinary (periodical) or extraordinary. The technical committee meets periodically twice a year, in December and June. The extraordinary meetings take place whenever necessary. The decisions taken by the technical committee become effective in the first trading session of the month following the relevant meeting. For the periodic reviews that take place in January and July, the ranking is computed on the basis of 30th November and 31st May data, respectively. The index is subject to interim reviews in January and July. Combining the need for a stable yet flexible sample, the review of the PSI-20 composition will be based on the following rules:

(i) an index constituent will be replaced whenever:

a) it is placed below 22nd in the new ranking;

b) it ranks 21st or 22nd and is to be replaced by a non-constituent placed 18th or higher in the new ranking.

(ii) A non-constituent will be included in the index whenever:

a) it is placed 18th or higher in the new ranking;

b) it ranks 19th or 20th in the new ranking replacing an index constituent that ranks 22nd or lower.

The waiting list identifies those securities with the highest probability of being included in the index whenever an index constituent needs to be replaced. The waiting list is calculated and published on the first trading day of each month, with the exception of December and June, in which the waiting list is published at the same time as the index

portfolio for the following semester, following the Technical Committee's periodic meeting.

2.1.2 - Index stock selection methodology

The same selection methodology has been used to select listed stocks since inception until 1st October 2001. On that date, the Portuguese Stock Exchange[5] decided to modify the selection methodology.

According to the original selection methodology, the stocks were selected based on liquidity and market value. The stocks were ranked by R ratio. For the liquidity ratio the reference period is of half a year. For the market value (R ratio) update information is used.

$$R = IL \text{ x Market Value} \tag{2.1}$$

$$IL_i = \left(\frac{n_i}{N}\right)^{0.3} \times \left(FR_i\right)^{0.2} \times \left(\frac{q_i}{Q}\right)^{0.5} \tag{2.2}$$

Where,

IL_i - Liquidity ratio from stock i

n_i - Average trading events per day

N - Average trading events per day (official market - TRADIS)

FR_i - Trading frequency (ratio between the number of sessions where the stock was traded and the total number of sessions available)

q_i - Daily average number of shares traded on stock i

Q - Daily average number of shares traded in the market

[5] Former BVLP was renamed Euronext Lisbon in December 2001

2.1.3 - Index computation

The index calculation follows the traditional *Laspeyres* methodology for weighted price indexes, according to which the weight of any individual issue reflects the proportion of its capitalization in the overall capitalization.

The calculation formula follows:

$$I_t = I_{t-1} \frac{B_t}{B_{t-1}} \tag{2.3}$$

where,

t stands for the moment of the index calculation;

I_t represents the index value at time t;

I_{t-1} represents the last index value;

B_t represents the index market value at time t, i.e.,

$$\sum_{i=1}^{N0} pi,t \text{ X } qi,t \tag{2.4}$$

Where,

$N0$ number of issues included in the index;

$p_{i,t}$ price of issue i at time t;

$q_{i,t}$ number of shares of issue i used to calculate the index at time t.

The number of shares of each issue applied in the calculation of the selection indexes will be that defined by the Technical Committee at each moment, based on the number of shares listed and on the following technical adjustments:

- Inclusion, Exclusion and Replacement of Issues;
- Change in the Number of Shares;
- Rights Issue;
- Bonus Issue;

Additionally, the number of shares has to be adjusted by applying the Free Float (FCFF) and CAP limit (FCAP) adjustment factors.

2.1.3.1 - Free float adjustment factor

The new selection method adopts a capitalization adjustment based on the free float. In order to compute the free float adjustment factor three conditions are observed:

(i) The definition of the restricted share capital (in percentage), based on the holdings of at least 5%, as reported to Euronext Lisbon or published under the terms of the Securities Act, the Banking and Financial Institutions General Regime and the remaining applicable legal and regulatory standards.

(ii) Free Float is calculated according to the following equation:

$$FF = 100\% - PQ \tag{2.5}$$

Where,

FF = Free Float

PQ = Sum of the restricted holdings of listed shares adjusted in terms of the ratio between the number of shares issued and the number of shares listed.

(iii) Definition of the Free Float adjustment factors (FCFF), are established according to the following table:

Table 3-Free Float Adjustment Factor

Free Float (FF)	*Free Float Adjustment Factor (FCFF)*
Less than or equal to 10%	0.10
Higher than 10% and less than or equal to 20%	0.25
Higher than 20% and less than or equal to 30%	0.40
Higher than 30% and less than or equal to 40%	0.60
Higher than 40% and less than or equal to 50%	0.80
Higher than 50%	1.00

The FCFF are reviewed on the periodic basis (December and June), becoming effective, respectively, in January and July, and are calculated on the information available on 30th November and 31st May, respectively.

2.1.3.2 - CAP limit adjustment factor

Additionally, in order to ensure that the portfolio of the PSI-20 index is adequately diversified, a limit on the weight of each issue included in the index is applied after the free float adjustment.

(i) Definition of the individual weights of the index constituents based on the number of shares defined in 5.3, adjusted for the Free Float, and the average weighted prices of the month previous to the date the new index composition is published.

(ii) If any issue's weight is greater than 20% of the total index capitalization adjusted for Free Float, the respective number of shares is reduced in order not to exceed 20% of the capitalization

(iii) Steps (i) and (ii) are repeated until no issue exceeds the 20% limit.

(iv) Calculation of the share quantity adjustment factor due to the CAP limit, based on the formula:

$$FCAP = \frac{QAPC}{QANC} \tag{2.6}$$

Where,

FCAP - CAP Limit adjustment factor, rounded to the third decimal place

QAPC - adjusted number of shares, i.e. after applying the CAP limit

QANC - unadjusted number of shares, i.e. before applying the CAP limit

The FCFF are reviewed on the periodic basis (December and June), becoming effective, respectively, in January and July. Between these dates, the weight of the issues in the index will fluctuate freely, possibly exceeding the 20% limit.

2.2 - Sample and data description

Daily prices and trading volumes for the stocks included in PSI-20 were collected from the Dathis[6]. All prices were adjusted for dividends, stocks splits, rights issues, etc. Euronext Lisbon supplied announcement days (AD), while effective change dates (ED) were determined by the author (PSI-20 analysis).

We started with an initial sample of 70 stocks from which the PSI-20 index was computed over the period comprising from January 1996 (Euronext Lisbon could not provided the 1995 announcement dates) to October 2001[7]. The initial sample was reduced to a final sample of 39 events[8]. The screening tests applied consisted of:

- New issues of stocks already in the index were not included;
- Stocks with an insufficient price history were not accepted in the sample. That is, all the stocks with less that 30 historical price observations before the announcement day were excluded;
- Stocks that were de-listed following the deletion from the index were excluded. Therefore, all deleted stocks with less than 30 price observations after the effective change date were excluded;
- All changes that were related with company name changing, and that suffered spin-off operations or mergers and acquisitions, were excluded.

The number of additions and deletions in the final sample and the average number of days between the announcement day and the effective change day for our final sample are presented in table 4.

In the observation period 17 stocks have been added (and 22 have been deleted) from the PSI-20 index.

[6] Euronext Lisbon database

[7] The sample ended in October 2001 due to the PSI-20 new selection methodology

[8] For a sample description see Table A-1 in the appendix

Table 4-Descriptive statistics on the final sample of PSI-20 Index

Events				Trading days between announcement and effective change			
Year	Addition	Deletion	Total	Addition	Deletion	Annual average	Global average
1996	3	3	6	18,0	18,0	18,0	15,1
1997	2	5	7	20,0	19,8	19,9	
1998	4	5	9	17,3	18,0	17,7	
1999	4	4	8	16,8	16,8	16,8	
2000	2	3	5	3,0	10,7	7,6	
2001	2	2	4	11,0	11,0	11,0	
Total	17	22	39				

The annual average number of trading days between the announcement day and the effective change day shows a range between 3 and 20 days with a mean of 15,1 days.

2.3 - Methodology

In this study we used the event study methodology. In order to perform this methodology an event window must defined. This is done in reference to the announcement day (henceforth referred to as AD) as well as an effective change day (henceforth referred to as ED). It must be pointed out that the window length varies from firm to firm, because the length between AD and ED varies from case to case.

The periods under study include the full period (from 1996 to 2001) and five different sub-periods (1996 to 1998; 1999 to 2001; 1996 to 1997; 1998 to 1999 and 2000 to 2001) which were determined by dividing the full period into three parts in order to perform a sub-period variability analysis (this methodology was applied by Bildik and Gulay [2002]).

In order to collect additional data to explain the effects detected, the sample was divided according to the following intervals[9]:

- Pre-announcement period (from AD-15 to AD-1) during which we will test if there is any market anticipation to the index change.

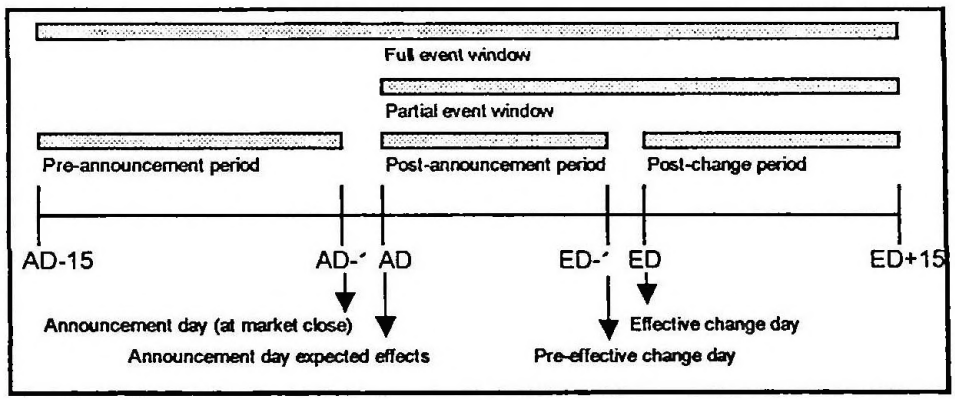
[9] Previous studies use event windows as short as 10 days and as long as 120 days around the event day. We determine that a 31 day window could serve the purposes of this study, according to Liu (2001).

- The announcement day (AD) when it is expected to be able to observe the stock price reaction to the announcement. The announcement to the market is assumed to be made on day AD-1 at the close of the market. Therefore the effects from the announcement are only expected on AD.
- The post-announcement period is defined as the time window between AD to ED-1. This analysis gives the opportunity of following the market reaction from the announcement day until the day before the effective change date.
- On effective change date (ED) the change is assumed to occur at the market opening.
- In the post-change period (from ED to ED+15) one can analyze the persistence of the effects detected.

Additionally, in order to determine whether the effects detected are temporary or permanent the full event window (from AD-15 to ED+15) and the partial event window (from AD to ED+15) are computed.

The time windows under study are summarized below:

Figure 1 – Event windows under study



2.3.1 - Abnormal return (Price effects)

The abnormal return (AR) in stock *i* at day *t* is measured by a market adjusted returns model[10] as follows[11]:

[10] Others papers also report market adjusted returns models, see Bildik and Gulay (2001), Barontini and Rigamenti (2000), Lynch and Mendenhall (1997) and Benesh and Whaley (1996).

$$AR_{it} = R_{it} - R_{mt} \tag{2.7}$$

Where,

R_{it} is the return in stock i on day t and it is computed as the natural logarithm of stock price i on day t on day t-1.[12]

R_{mt} is the return in the market portfolio on day t and it is computed as the natural logarithm of the index on day t on day t-1. The PSI-20 TR[13] is used as a proxy for the market portfolio.

The stock abnormal return over the event window is calculated by summing the daily abnormal return over that window and is called CAR.

$$CAR_i(t_1;t_2) = \sum_{t=t_1}^{t_2} AR_i \tag{2.8}$$

The average abnormal return (AAR) over the window is the stock CAR's divided by the number of days in the window. Additionally, a measure of the abnormal return over the event window can be obtained by taking sample averages of firms' CAR's (ACAR is the CAR averaged through the number of stocks in the sample).

At this point the ACAR must be tested and in order to do so we will use the methodology suggested by Boehmer, Musumeci and Poulsen (1991)[14]. This test will check whether the null hypothesis of zero abnormal return is rejected. In order to perform the statistical test under the null hypothesis, abnormal returns have to be jointly normal and stationary distributed. Therefore the following assumption must hold:

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[11] More sophisticated models of the return generating process can be used to calculate abnormal returns. However, market models provided similar conclusions when compared to market adjusted returns. As was reported by Edmister et al. (1994) market model coefficients are biased by a selection effect. That is due to the fact that a stock with a significant price increase relative to the market is more likely to be included in an index. Using a post-replacement estimation period Edmister et al. (1994) show that abnormal return seems to be persistent. Therefore, by using market adjusted returns the bias estimation problem can be avoided. Additionally, Jain (1987) observed that the market model parameters are non-stationary across the replacement.

[12] All the quotes were previously adjusted, therefore the formula shown does not consider any adjustment.

[13] The PSI-20 TR is a performance index, based on the PSI-20 index methodology, with a single difference: it adjusts for gross dividend payments, reflecting the reinvestment of the dividends into the index constituents.

[14] This is an event-study methodology under conditions of event-induced variance.

$$AR_{it} \cap N(0,\sigma_i) \tag{2.9}$$

However, the first step in order to perform the test is to compute the abnormal returns on stock *i* on the event day t standardized by the estimation period standard deviation (which goes from AD-40 to AD-15).

The purpose of standardization is to ensure that each abnormal return will have the same variance. Since the average is null, by dividing each firm's abnormal return by its standard deviation the AR is standardized.

$$SAR_{it} = \frac{AR_{it}}{\sigma_i} \tag{2.10}$$

The variance σ_i can be presented as:

$$\sigma_i = \sqrt{\frac{1}{(T-1)} \sum_{t=1}^{T} \left(AR_{it} - \overline{AR_{it}}\right)} \tag{2.11}$$

Placing equation 2.11 in equation 2.10 and adding a commonly used term in order to adjust the forecast error (adjust the standard error by the prediction error in order to account for the different time horizon), gives a new equation which can be presented as:

$$SAR_{it} = \frac{AR_{it}}{(\sigma_i)\sqrt{1 + \frac{1}{T_i} + \frac{(R_{mt} - \bar{R}_m)^2}{\sum_{e=1}^{T}(R_{me} - \bar{R}_m)^2}}} \tag{2.12}$$

Where,

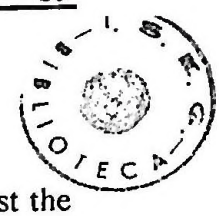
AR_{it} - abnormal return on stock *i* in the event period

SAR_{it} - standardized abnormal return on stock *i* in the event period

σ_i - standard deviation of stock *i* in the estimation period (AR)

T_i - number of trading days in the estimation period

R_{mt} - market return on day *t* in the event period



R_{me} - market return on day e of the estimation period

$\overline{R_m}$ - average market return in the estimation period

In the second step, ordinary cross-sectional technique is applied to measure and test the significance of the existence of abnormality. The following t-test is applied to test the hypothesis in which the average standardized abnormal returns (SAR) across firms are equal to zero.

$$\frac{\frac{1}{N}\sum_{i=1}^{N} SAR_{it}}{\sqrt{\frac{\sigma^2_{SAR}}{N}}} \cap t_{n-1} \tag{2.13}$$

Where,

N - number of companies in the sample

σ^2_{SAR} - SAR's variance

2.3.2 - Abnormal trading volume (Trading volume effects)

Trading volume could be defined as the daily turnover of a stock. In order to test the abnormal trading volume the Harris and Gurel (1986) volume ratio (henceforth referred to as VR) is used, by linking the firm trading volume to the market trading volume (the PSI-20 is used as a market volume proxy).

$$VR_{it} = \frac{\frac{V_{it}}{V_{mt}}}{\frac{V_i}{V_m}} \tag{2.14}$$

Where,

V_i - average trading volume of stocks during the period from AD-40 to AD-15

V_m - average trading volume of market during the period from AD-40 to AD-15

V_{it} - trading volume of stock i on day t in the event period

V_{mt} - trading volume of market on day t in the event period

In order to isolate the abnormal trading volume in the event period of a change in the index, the VR is computed by averaging the event daily volatility by the estimation period (AD-40 to AD-15).

After the VR is computed it is averaged across the number of stocks in the sample. Assuming that an index replacement has no effect on the trading volume, the liquidity effect can be measured through the analysis of the trading volume per period. If during the event window the daily trading volume is not different from normal, VR equals one. The volume ratio (VR) will also be statistically tested (t-test).

2.3.3 - Abnormal volatility (Volatility effects)

The impact of an index replacement on stock price volatility is also studied. For this purpose the methodology applied by Deininger et al. (2000) will be replicated in the present study.

For every stock in the sample the annual volatility is computed according to the next formula, using 30 days before and after the effective replacement date and announcement date.

$$\sigma_i^T = \sqrt{250 \frac{1}{T-1} \sum_{t=1}^{T} \left(R_{it} - E[R_{it}]\right)^2} \tag{2.15}$$

Due to the fact that the stock return probably will not be stationary, the sample average of the difference between stock and market volatility will be computed.

$$AV = \frac{1}{N} \sum_{i=1}^{1} \left(\sigma_i^T - \sigma_m^T\right) \tag{2.16}$$

A statistical test[15] must be performed in order to evaluate if the effect event has impact on volatility and if the returns are normally and stationary distributed.

For robustness reasons a non-parametric test will also be applied, in this case the sign-rank test of Wilcoxon will be used.

[15] Paired sample test

Chapter 3

Empirical results

3.1 - Empirical Results

3.1.1 - Abnormal returns (Price effects)

The price effects following a stock addition to the PSI-20 Index are summarised in Figure 2 and Table 5.

Figure 2 – Full period added stocks ACAR

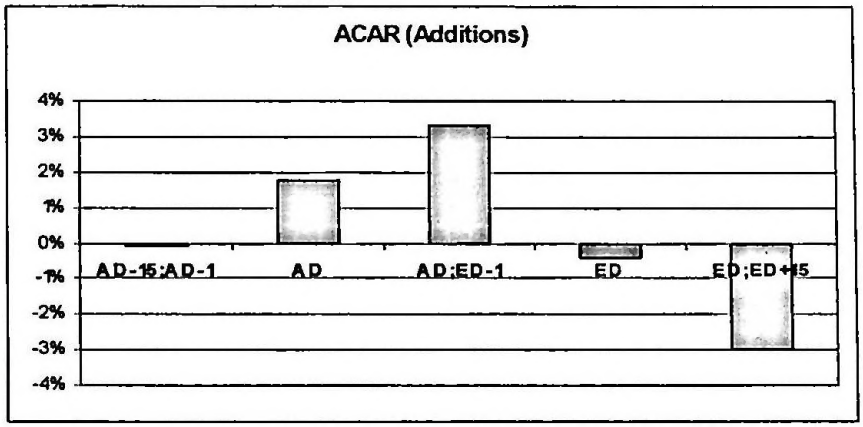


Table 5 - Added stocks ACAR

Event Window	Full period	1996-1997	1998-1999	2000-2001
Sample	17	5	8	4
[AD-15;AD-1]	-0,06%	0,94%	0,66%	-2,76%
t-stat. (a)	0,825	0,707	0,950	-0,148
[AD]	1,78%	0,32%	2,40%	2,39%
t-stat. (a)	2,626**	0,615	1,860	1,056
[AD;ED-1]	3,33%	2,02%	5,63%	0,37%
t-stat. (a)	3,952*	1,591	3,075**	0,014
[ED]	-0,40%	-0,58%	-0,74%	0,49%
t-stat. (a)	-1,915***	-2,198***	-1,673	0,160
[ED;ED+15]	-3,02%	-6,37%	-2,16%	-0,53%
t-stat. (a)	-1,231	-2,150***	-0,279	-0,188
[AD;ED+15]	0,31%	-4,35%	3,47%	-0,17%
t-stat. (a)	0,605	-1,851	1,259	-0,109
[AD-15;ED-1]	3.27%	2,97%	6,29%	-2,39%
t-stat. (a)	2,901**	1,704	2,668**	-0,104
[AD-15;ED+15]	0,26%	-3,40%	4,13%	-2,92%
t-stat. (a)	1,121	-0,740	1,576	-0,200

(a) Statistically significant (marked with grey colour): * for 1%; ** for 5% and *** for 10%

First a full period analysis will be performed. Therefore, in the 15 trading days preceding the announcement day the return is negative but very close to zero, which is a clear evidence of no market anticipation. The abnormal return is statistically significant between the event windows AD to ED. However, ED shows a trend inversion. In ED

we are in the presence of negative abnormal returns. This trend is also shown in the event window ED;ED+15. However in this case it is not statistically significant. This means that the positive abnormal returns are offset in the 15 days following the ED. Therefore the price effect reported is temporary.

In sub-periods 1996-1997 and 1998-1999 patterns are very similar. As one can see, in sub-period 1996-1997 in spite of positive abnormal returns records in the event windows before ED, none of them are statistically significant. Nevertheless, in ED and in ED;ED+15 a negative abnormal return is shown, which is statistically significant.

In the sub-period 1998-1999 the only event window which is statistically significant is the event window AD;ED-1. These findings corroborate the previous full period analysis.

The pattern changed during the last years (sub-period 2000-2001) in which the sample size is reduced to four events. The index additions seem to have had a greater impact during the earlier years. However, one must be cautious regarding this possible conclusion due to the reduced sample. Nevertheless, none of the tests, for sub-period 2000-2001, point to any statistically significant results, in spite of abnormal returns reported. Therefore, in spite of the sample size and the results obtained, one might conclud that the market in the early years was inefficient, but with time is becoming more efficient and developed.

Most of the reviewed papers pointed to an increased index replacement effect due to the growth of stock market index funds. This effect should be observed in ED and thereafter. However, this effect could not be observed in the Portuguese stock market. This finding will be carefully analyzed in the next section.

Figure 3 – Full period deleted stocks ACAR

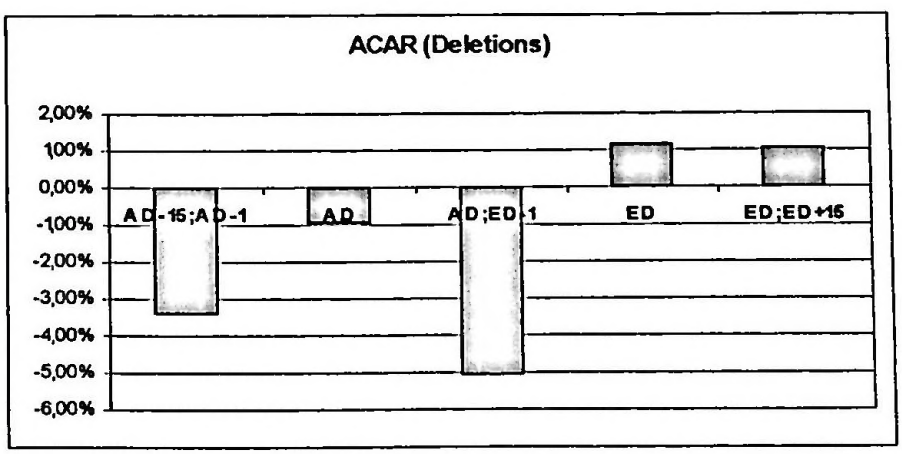


Table 6 - Deleted stocks ACAR

Event Window	Full period	1996-1997	1998-1999	2000-2001
Sample	21	8	9	4
[AD-15;AD-1]	-3,40%	-2,15%	-4,19%	-4,14%
t-stat. (a)	-1,445	-0,624	-0,815	-1,002
[AD]	-0,94%	0,99%	-3,05%	-0,07%
t-stat. (a)	-0,942	0,833	-1,420	0,311
[AD;ED-1]	-5,03%	-2,03%	-9,55%	-0,86%
t-stat. (a)	-2,577**	-0,470	-3,467*	0,042
[ED]	1,15%	0,77%	2,27%	-0,61%
t-stat. (a)	1,172	0,366	1,243	-0,315
[ED;ED+15]	1,05%	-1,04%	1,34%	4,54%
t-stat. (a)	-0,228	-0,166	-0,819	0,930
[AD;ED+15]	-3,98%	-3,06%	-8,21%	3,68%
t-stat. (a)	-1,399	-0,281	-2,601**	0,717
[AD-15;ED-1]	-8,43%	-4,17%	-13,74%	-5,00%
t-stat. (a)	-3,115*	-0,646	-3,362*	-1,418
[AD-15;ED+15]	-7,38%	-5,21%	-12,40%	-0,46%
t-stat. (a)	-2,423**	-0,430	-4,447*	0,086

(a) Statistically significant (marked with grey colour): * for 1%; ** for 5% and *** for 10%

A similar behaviour pattern is observed in stock deletions. The price effect following a stock deletion from PSI-20 Index is summarized in Figure 3 and in Table 6. It would be expected that deletions show negative abnormal return. The event window AD-15;AD-1 shows a significant abnormal negative return. However, one cannot conclude that market anticipation occurred because the results are not statistically significant. The full period event window AD;ED-1 shows a statistically significant result in which a negative abnormal return of 5.03 per cent is shown. In this particular case the sub-period 1998-1999 corroborates these findings. In spite of the negative abnormal returns reported none of the other event windows show statistically significant results (the event windows AD-15;ED-1 and AD-15;ED+15 are useful to determine whether the effects detected are temporary or permanent).

To summarize, both additions and deletions show abnormal return effects. For additions the effect is reversed in ED and thereafter. However, for deletions the reversal effect is partial and non significant, as one can see from the event window AD-15;ED+15. These findings are consistent with records reported in other studies.
Further insight can be gained with the trading volume analysis.

3.1.2 - Abnormal volume (Trading volume effects)

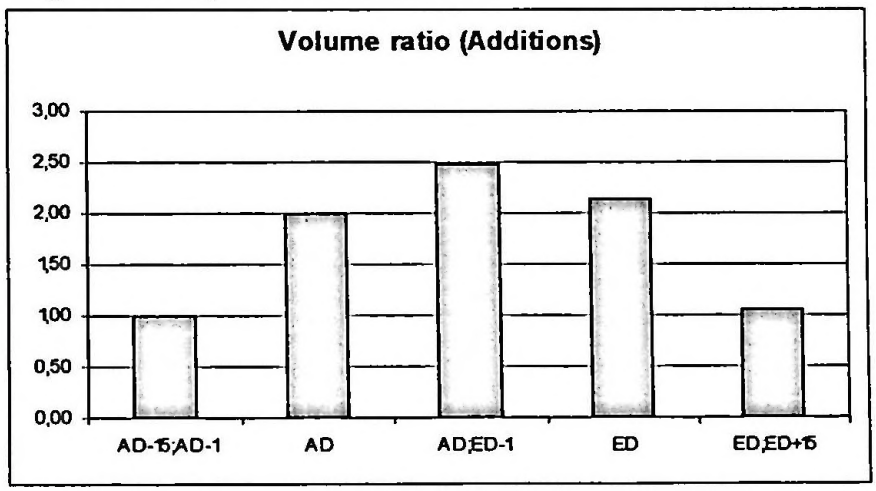
It is known from literature that volume changes have a perceivable effect on the transaction market cost and could induce a change in the volatility and in stock bid-ask spread.

According to the methodology described in section 2.3.2, the volume ratio VR will state the trading volume level, according to the following:

- VR = 1 the trading volume is not different from normal;
- VR < 1 the trading volume in the event window is lower than normal;
- VR > 1 the trading volume in the event window is higher than normal.

As for the stock price effects, trading volume was examined closely for the same event windows. Figure 4 plots the VR evolution over the event window while Table 7 summarizes the volume ratios for stocks added to the index with the t-test result.

Figure 4 – Full period added stocks VR



The VR behaviour through the event window provides a strong evidence of abnormal trading activity. The VR is almost symmetric reaching the highest value in event window AD;ED-1. During the AD-15;AD-1 event window, VR is close to normal trading volume. However, between announcement day (AD) and effective change day (ED) the VR indicates that investors start to adjust their portfolios in accordance with the index addition.

Table 7 - Added stocks trading volume

Event Window	Full period	1996-1997	1998-1999	2000-2001
[AD-15;AD-1]	0,991	0,941	1,117	0,974
t-stat. (a)	0,228	-0,453	0,481	-0,074
[AD]	2,000	0,802	2,483	2,774
t-stat. (a)	1,381	-0,853	1,153	0,835
[AD;ED-1]	2,475	2,059	2,726	2,909
t-stat. (a)	2,667**	1,102	1,734	1,529
[ED]	2,147	0,321	3,096	3,287
t-stat. (a)	1,454	-2,995**	1,242	1,308
[ED;ED+15]	1,065	1,122	1,059	1,223
t-stat. (a)	0,624	0,219	0,347	0,615
[AD;ED+15]	1,378	1,322	1,504	1,515
t-stat. (a)	1,876***	0,693	1,291	1,050
[AD-15;ED-1]	1,318	1,407	1,396	1,346
t-stat. (a)	1,714	1,003	0,981	0,987
[AD-15;ED+15]	1,206	1,236	1,286	1,277
t-stat. (a)	1,515	0,656	0,928	1,175

(a) Statistically significant (marked with grey colour): * for 1%; ** for 5% and *** for 10%

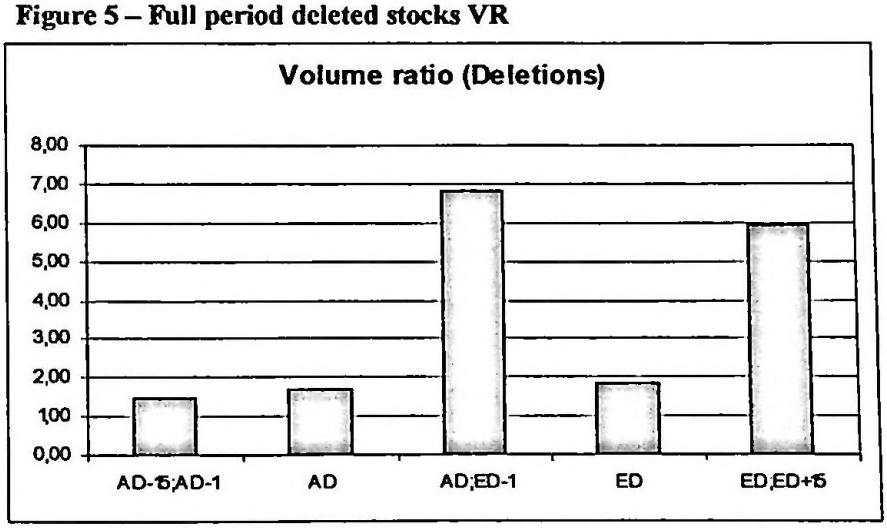
Findings show that most of the VRs are higher than one, leading to the conclusion that an abnormal trading volume was detected. However, most of the VRs are not statistically significant.

In the full period, VR is statistically significant for AD to ED-1 and for AD to ED+15.

The sub-period analysis is inconsistent with the full period analysis. However, it varies across sub-periods. The analysis for the sub-periods is statistically significant only once.

On the other hand Figure 5 and Table 8 show findings for deleted stock.

Figure 5 – Full period deleted stocks VR



In the event window AD;ED-1 and ED;ED+15 the VR values are extremely high, even when compared with additions. One possible explanation according to Bechmann (2002) is that "it may be more important for investors to make the necessary adjustment of their portfolios for deletions than for additions before the change in the index becomes into effect"[16]. However, this explanation does not explain the effect detected in the VR after the effective change date. Another possible explanation could be that the trading volume in the event window AD;ED-1 could lead to a stock price decrease, reaching levels that investors consider undervalued.

The VR for deleted stocks also represents values above normal in the full period event analysis, showing apparent abnormal behaviour is. However, statistical analysis shows that these figures are statistically more relevant when compared to added stocks. Therefore, there are three statistically significant event windows in the full event period analysis ED, AD to ED+15 and AD-15 to ED+15.

Table 8 – Deleted stocks trading volume

Event Window	Full period	1996-1997	1998-1999	2000-2001
[AD-15;AD-1]	1,477	1,214	1,146	2,750
t-stat. (a)	1,580	0,515	0,822	1,414
[AD]	1,669	0,860	2,188	2,120
t-stat. (a)	1,009	-0,322	0,806	1,261
[AD;ED-1]	6,846	4,462	2,086	22,323
t-stat. (a)	1,537	1,491	1,593	1,097
[ED]	1,855	1,030	2,281	2,545
t-stat. (a)	1,782***	0,055	1,584	1,099
[ED;ED+15]	5,959	12,466	1,818	2,264
t-stat. (a)	1,190	1,047	1,677	1,183
[AD;ED+15]	7,525	11,504	1,944	12,123
t-stat. (a)	1,766***	1,226	1,810	1,153
[AD-15;ED-1]	4,249	3,115	1,534	12,628
t-stat. (a)	1,668	1,382	1,589	1,216
[AD-15;ED+15]	5,551	8,151	1,651	9,126
t-stat. (a)	1,880***	1,284	1,806	1,296

(a) Statistically significant (marked with grey colour): * for 1%; ** for 5% and *** for 10%

In spite of the performed analysis, there is no strong significant statistical evidence to confirm the impact of index composition changes in the stock market trading volume. However, there is a positive abnormal trading volume and the fact that the statistical test is not significant does not mean that trading volume reaction is not persistent.

[16] These findings are also in accordance with Bildik and Gulay (2001)

3.1.3 - Abnormal volatility (volatility effects)

Several studies[17] show that an increase (decrease) of the trading volume per transaction could lead to a decrease (increase) of the bid-ask spread and volatility. In order to conclude whether the price effects are due to the liquidity, volatility must be analyzed. The volatility analysis might be seen as a proxy of the bid-ask spread changes.
In the methodology described in section 2.3.3, volatility analysis will be divided in two different perspectives, a 60 day range centred on the effective change date (ED) and on the announcement day (AD). In the test AV represents the differential volatility between the period before the event (ED or AD) and the period after.

3.1.3.1 - ED

Regarding the additions, Table 8 shows that in the full period a reduction in the stock price volatility occurs after the index effective change day (ED). This means that the stock price volatility in the 30 days period pre-ED is higher than the volatility of the 30 days period post-ED. However, the sub-period analysis shows that the reported effect is not stationary. The sub-period from 1998 to 1999 shows the opposite effect. The volatility effect is only statistically significant in one scenario (period between 1996 and 1997).

Table 9 – Additions volatility effects (ED)

Windows	Sample	$AV_{[ED-30,ED-1]}$	$AV_{[ED,ED+29]}$	$AV_{[ED-30,ED-1]-[ED,ED+30]}$	t-stat. (a)
1996-2001	17	0,108	0,104	0,005	0,066
1996-1997	5	0,096	0,134	-0,038	2,200***
1998-1999	8	0,110	0,071	0,039	-0,747
2000-2001	4	0,137	0,174	-0,037	1,597

(a) Statistically significant (marked with grey colour): * for 1%; ** for 5% and *** for 10%

In the case of deletions, in almost all scenarios a stock price volatility reduction occurs after the index effective change date (ED), as shown in Table 10. However, these results are not statistically significant.

[17] See among others Amihud and Mendelson (1986) who developed a ground-breaking model that shows an increasing and concave relation between expected return and relative spread (bid-ask spread in relation to stock price).

Table 10 – Deletions volatility effects (ED)

Window	Sample	AV [ED-30,ED-1]	AV [ED,ED+29]	AV[ED-30,ED-1]-[ED,ED+30]	t-stat. (a)
1996-2001	21	0,181	0,150	0,032	-0,994
1996-1997	8	0,217	0,128	0,089	1,484
1998-1999	9	0,203	0,174	0,028	0,951
2000-2001	4	0,062	0,137	-0,075	-0,881

(a) Statistically significant (marked with grey colour): * for 1%; ** for 5% and *** for 10%

3.1.3.2 - AD

However, one might think that if volatility was observed around the announcement day the conclusions could be different. Those results are shown in the following tables. Nevertheless, they are not statistically significant.

Table 11 – Additions volatility effects (AD)

Window	Sample	AV [ED-30,ED-1]	AV [ED,ED+29]	AV[ED-30,ED-1]-[ED,ED+30]	t-stat. (a)
1996-2001	17	0,086	0,117	-0,031	-1,155
1996-1997	5	0,104	0,160	-0,056	-1,061
1998-1999	8	0,091	0,050	0,041	0,932
2000-2001	4	0,056	0,245	-0,189	-3,024

(a) Statistically significant (marked with grey colour): * for 1%; ** for 5% and *** for 10%

Table 12 - Deletions volatility effects (AD)

Window	Sample	AV [ED-30,ED-1]	AV [ED,ED+29]	AV[ED-30,ED-1]-[ED,ED+30]	t-stat. (a)
1996-2001	21	0,158	0,186	-0,028	-0,474
1996-1997	8	0,270	0,165	0,104	0,919
1998-1999	9	0,106	0,226	-0,120	-1,585
2000-2001	4	0,053	0,138	-0,085	-1,112

(a) Statistically significant (marked with grey colour): * for 1%; ** for 5% and *** for 10%

As a remark one might say that the volatility analysis presented in this section leads to the conclusion that an index replacement is not on average associated with a perceivable change in market liquidity.

Chapter 4

Discussion

4.1 - Empirical results discussion

This section tries to formulate some reasonable explanations in accordance with the observed evidence. The following table tries to summarize the relevant empirical results, namely returns and trading volume.

Table 13 – Full period summarized findings

	Additions		Deletions	
Event Window	Abnormal returns	Abnormal volume	Abnormal returns	Abnormal volume
AD-15;AD-1	-	⇓	-	⇑
AD	+	⇑	-	⇑
AD;ED-1	+	⇑	-	⇑
ED	-	⇑	+	⇑
ED;ED+15	-	⇑	+	⇑
AD;ED+15	+	⇑	-	⇑

Statistically significant marked with grey colour

In order to determine which of the explanation hypotheses best fits the recorded behaviour of the Portuguese stock market exchange, the event windows must be analyzed.

The pre-announcement period (AD-15;AD-1) shows the inexistence of a market anticipation of the event. Despite that, for deletions an abnormal negative return was detected. However, it is not statistically significant. The volume ratio and volatility analysis are not conclusive. Therefore, one must conclude that there is no market anticipation.

If there was no market anticipation the announcement day (AD) effects should be incredibly strong and in fact they are. For additions, the volume analysis corroborates the price effects, showing a statistically significant positive abnormal return. For deletions the analysis is not statistically significant, in spite of the negative abnormal return reported.

The event window AD;ED-1 effects show clearly the existence of price pressure. Therefore we are in the presence of price effects and trading volume effects for both additions and deletions.

The event window ED is statistically significant for deletions trading volume, in which it is 1.85 times normal. However, this event window is also statistically significant for additions showing a negative abnormal return, which shows an effect inversion.

The effects reported in the event window ED;ED+15 show that these effects are transitory for additions. Abnormal returns seem to revert to normal. This means that price reversal evidence was found for additions. For deletions, in spite of the positive abnormal return found, the effect does not show any sign of reversion. The negative abnormal return shown by event windows AD-15;ED-1 and AD-15;ED+15 is statistically significant.

The trading volume and the volatility analysis provided weak evidence of the effects. Bechmann (2002) found similar conclusions and points toward a possible explanation in which "if investors buy and hold the stocks added to the index one should not expect a general increase in the trading volume. However, if there are more active investors, an increase should be expected". On the other hand this could also be explained through the small Portuguese stock market in which the major institutional investors could hold the stock before the event. Brealey (2002) concluded that index funds follow mainly index stocks. However, funds show a clear trend to hold a higher proportion of non-index stocks.

Price and trading volume are affected by the event. The event window ED;ED+15 shows a clear price reversal for additions. However, for deletions the price effects seem to be permanent. This issue is crucial to determine whether the price effect can be explained by the price pressure hypothesis. The following table tries to summarize the abnormal return total effects.

Table 14 - Full period ACAR

	Additions	Deletions
AD-15;ED+15	0.26%	-7.38%
Maximum	3.33%	-1.15%
Minimum	-3.02%	-8.43%

Statistically significant marked with grey colour

Table 14 shows the abnormal return impact over the full event window (AD-15;ED+15). For additions it shows a negligible rise in price and a price reversion effect

can be observed. For deletions the abnormal return reaches -8.43 per cent. Deletions seem to have major impact on prices. Additionally, there is no indication of an effect reversion. However, to determine clearly if the price effect is permanent or temporary, it would be necessary to increase the event window in order to establish the stock price behaviour. Therefore, the event window ED;ED+30 is computed. The following table shows the evidence collected.

Table 15 - Deleted stocks event window ED;ED+30

Event Window	Full period	1996-1997	1998-1999	2000-2001
ED;ED+30	-0,21%	-7,59%	2,87%	7,60%
t-stat. (a)	0,200	-2,142***	0,847	2,133

(a) Statistically significant (marked with grey colour): * for 1%; ** for 5% and *** for 10%

Therefore, in spite of a non-statistically significant positive abnormal return the evidence collected shows no sign of a full reversion during the weeks following the event (if one compute the AD-15;ED+30 full period return it reaches -8.64 per cent). Nonetheless, additions show temporary price pressure while for deletions the effect seems to be permanent.

In order to determine the most likely explanation for the evidence collected, the effects analysis was split between additions and deletions.

4.1.1 - Additions explanation hypothesis

For additions the effects reported strongly seem to support the price pressure hypothesis. The temporary stock price effect is inconsistent with investors' awareness and market segmentation hypothesis (the Portuguese market is a small one and there is no evidence of shadow costs), selection criteria hypothesis (the PSI-20 Index has a waiting list), information hypothesis (the effects are permanent), liquidity hypothesis (trading volume records are not statistically significant) and imperfect substitutes hypothesis (the effects are permanent). However, the evidence collected fits into the price pressure hypothesis

According to the effects explanations hypothesis, temporary price increase is due to speculators, funds, index funds, mutual funds and institutional investors activity, moving stock prices away from their equilibrium values. This price reversion does not

simply represent a slow adjustment to any value-relevant information announcement. According to the price pressure explanation it would be expected that index funds and institutional investors rebalance their portfolios. It follows that the largest temporary effect occurs on the day before the effective change. Consequently, the price pressure hypothesis implies a price reversion that starts on the effective change day (ED). Since investors do not wait to rebalance their portfolios until the effective date change. The Portuguese stock market possesses some particularities, namely as far as regulations are concerned, which forbids index funds to possess a position higher than 20 per cent in a particular stock. However, some of the PSI-20 stocks weigh more than 20 per cent. Therefore there is no index fund operating over the PSI-20 Index. Then there is no index fund rebalancing. Nevertheless, the evidence collected shows that the market reacts to the index composition changes. However, one could be led to conclude that the price pressure explanation hypothesis is an unlikely explanation. The results seem to strongly support the price pressure hypothesis, however the effects reported should not result from index funds action, which cannot replicate the PSI-20 portfolio due to regulations (as explained before).

Most researchers who found an abnormal return with evidence of temporary price pressure explain the effects with index funds activity. Other researchers tried to explain the evidence collected with different theories. Among others, Brealey (2002) stated that "a change in index composition does lead to portfolio shift (though this need not be a result of the activity of index funds)". Additionally, Pruit and Wei (1989) found that additions to the S&P500 Index experienced an institutional ownership and those abnormal returns are positively related to the institutional ownership change. Brealey (2002) presented another possible explanation in which fund managers compare their performance with the market index. In the Portuguese stock market the PSI-20 Index is used exclusively as a performance benchmark. Therefore, one of their main goals is to achieve a higher performance than the index. For the index managers the index stocks are less risk when compared to non-index stocks. Other explanations could be related to firms' dimension for stock added to or deleted from the index, since large companies' stocks influence heavily the index and generally added or deleted stocks are smaller. Therefore, small companies' returns tend to be higher than those of large companies.

The fact is that there is a temporary price effect for additions. The most likely explanations for the findings would probably be a mix of the mentioned explanations, institutional investors activity (among others investors) and performance benchmarking.

4.1.2 - Deletions explanation hypothesis

For deletions the permanent price effect is inconsistent with price pressure hypothesis, investors' awareness and market segmentation hypotheses (the Portuguese market is a small one and there is no evidence of shadow costs), selection criteria hypothesis (the PSI-20 Index has a waiting list), liquidity hypothesis (trading volume records are not statistically significant). However, the evidence collected fits into the information hypothesis (the effects are permanent) and into the imperfect substitutes hypothesis (the effects are permanent).

According to the information hypothesis explanation, a stock deletion can lead to a higher risk associated with the information available. Therefore a deletion is considered bad news. In addition, Goetzmann and Massa (1999) documented that abnormal return could be caused by the index stocks required return adjustment, leading to an equity cost increase for deletions. However, that added stocks equity cost change can only explain a small part of the abnormal return reported and it should have a permanent effect. This would be consistent with the evidence collected.

According to the imperfect substitutes hypothesis return and volume effects should be correlated on the announcement day, because for investors the stocks that will be added to the index do not have close substitutes outside the index. Then when the announcement is made downward sloping demand curves shift inward as soon as the index replacement is announced. Deininger *et al.* (2000) proposed a methodology in order to determine if this hypothesis can explain the findings. The correlation between abnormal return and trading volume was computed.

Table 16 – Correlation between abnormal return and trading volume

	Deletions
	$ACAR_{AD}$
VR_{AD}	0,202274
t-test (a)	0,900304

(a) Statistically significant (marked with grey colour)

The correlation[18] coefficient between announcement day ACAR and VR will determine the feasibility of the imperfect substitutes hypothesis to explain the study findings. However, the results show that a non-statistically significant correlation was detected. Therefore, according to the authors the effect cannot be explained by the imperfect substitutes hypothesis. However, the findings gathered in this study show that neither abnormal returns nor trading volume are statistically significant on the announcement day (AD). Then the correlation between both should not be relevant because there are no statistically significant effects to correlate.

However, it is possible to find additional explanations, such as the performance benchmarking[19] (which can also be applied for deletions).

Therefore, one might conclude that in fact there is a permanent price effect for additions. The most likely explanation for the findings would probably be a mix between information hypothesis and performance benchmarking, although the last one at a lower level.

[18] The t-test used is a standard correlation coefficient statistic for small samples $\frac{r\sqrt{n-2}}{\sqrt{1-r^2}} \cap t_{(n-2)}$, where r is the ρ estimator

[19] Explained in the previous section (4.1.2. – Additions explanation hypothesis)

Conclusion

Conclusion

A vast set of similar studies about index replacements reported stock market inefficiencies (namely abnormal returns and abnormal trading volume). However due to different market regulations, stock market structure and index revisions rules, it is pertinent to evaluate the Portuguese stock market index revision effects. This study examined the effects of index changes for the PSI-20 index over the period 1996-2001. The study provides evidence that deletions are associated with negative effects while additions are associated with positive effects. The study focuses on three different effects, abnormal returns, trading volume and volatility. The volatility effects are not statistically significant. Trading volume provides few statistically significant results. Nevertheless they corroborate the price effects findings. The abnormal returns for post-announcement event windows are statistically significant and provide evidence that both additions and deletions are associated with abnormal return effect in specific event windows. Namely the event window AD;ED-1 shows a substantial rebalancing activity. For additions a 3.33% abnormal return was found, while for deletions a -5.03% abnormal return was observed. Additionally, the market seems not to anticipate additions. However, for deletions there are clear signs of anticipation. Therefore, one can conclude that investors do not wait until the effective date change to rebalance their portfolios.

For additions a temporary price pressure effect was found, which can be explained through the price pressure hypothesis.

Deletions show a permanent effect. The evidence might be explained by the information hypothesis.

According to the studied period (from 1996 to 2001), the findings suggest that the Portuguese stock market is not efficient. It is possible for an investor to obtain abnormal positive returns. This means that according to the pattern observed an investor could beat the market. If this is true than the investor should predict the changes in the index composition before other investors in order to obtain a positive return, particularly between the announcement day and the effective change day. Abnormal returns are large enough to provide a profit, even after deducting the brokerage fees. However, one

must remember that screening tests were applied. Therefore, profit opportunities are modest but worth seeking.

The results indicate the existence of abnormal returns, which represent a market efficiency violation. The semi-strong form of market efficiency is inconsistent with abnormal returns.

Therefore, the findings support that the Portuguese stock market is not efficient, however the sub-period results suggest the existence of an improvement in efficiency.

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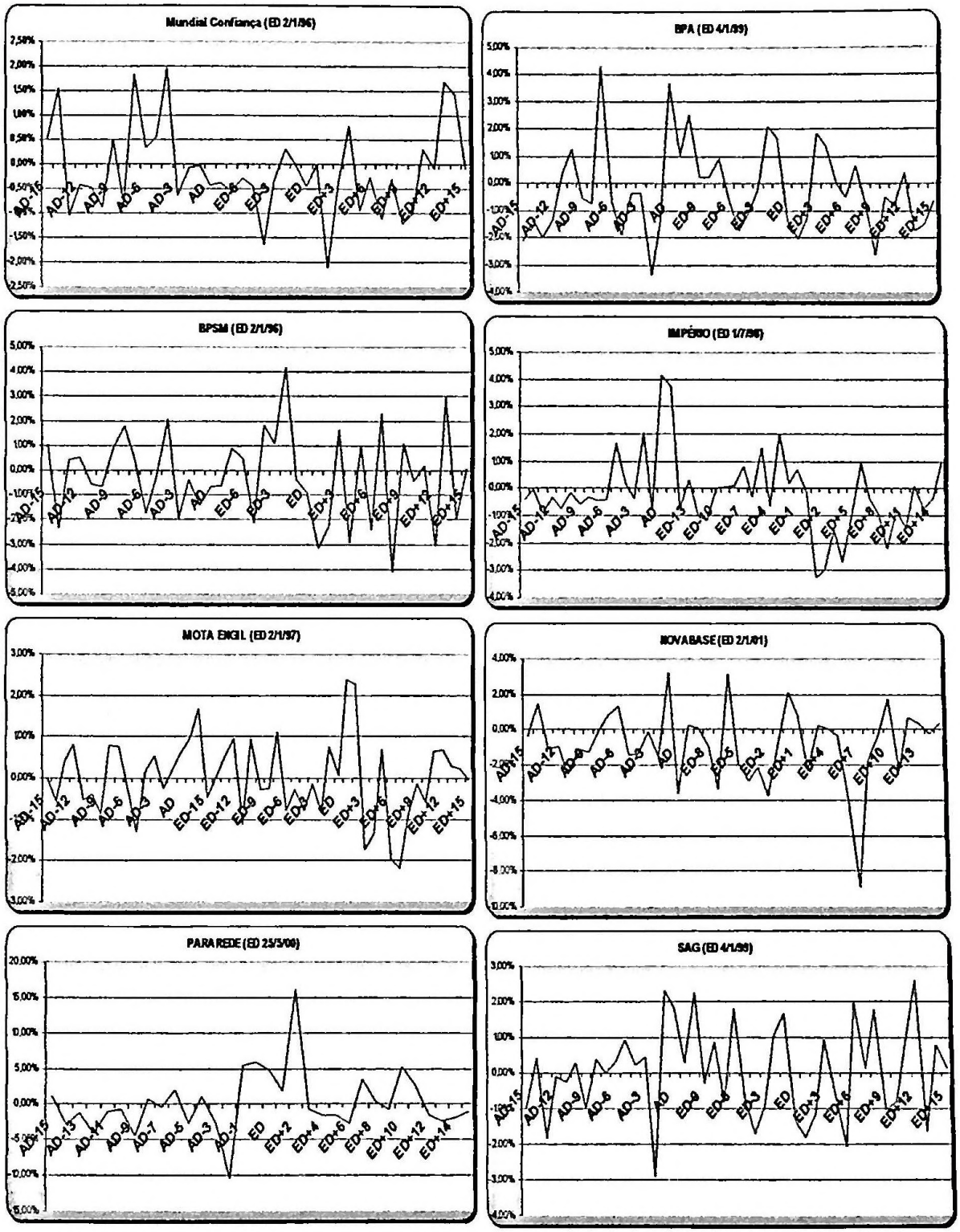
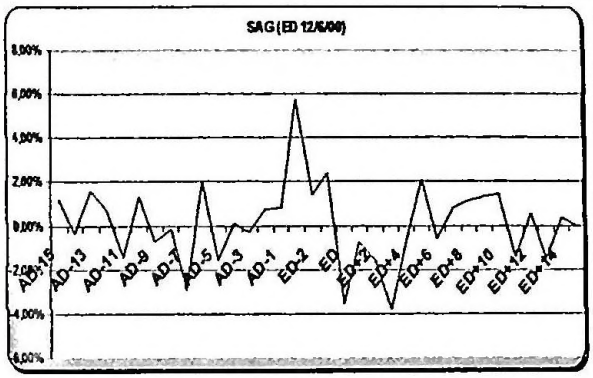
Appendix

Table 17 – Sample description

Firm Stocks	Event	Announcement day (AD)	Effective change day (ED)
B.CHEMICAL (PORTUGAL) - Nom.	Deleted	15-Dec-95	02-Jan-96
BANIF - Nom.	Deleted	15-Dec-95	02-Jan-96
BPSM - Nom.	Added	15-Dec-95	02-Jan-96
CPP - Nom./Port.Regist.	Deleted	15-Dec-95	02-Jan-96
MUNDIAL CONFIANCA - Nom.	Added	15-Dec-95	02-Jan-96
SEMAPA	Added	15-Dec-95	02-Jan-96
CORTICEIRA AMORIM, SGPS	Deleted	03-Dec-96	02-Jan-97
ENGIL, SGPS	Added	03-Dec-96	02-Jan-97
SONAE INDUSTRIA, SGPS	Deleted	03-Dec-96	02-Jan-97
BANCO FOMENTO E EXTERIOR-Nom.	Deleted	18-Apr-97	28-Apr-97
LISNAVE	Deleted	18-Apr-97	28-Apr-97
TELECEL	Added	18-Apr-97	28-Apr-97
TRANQUILIDADE-Tipo B-Nom.	Deleted	12-Jun-97	01-Jul-97
ENGIL, SGPS	Deleted	12-Dec-97	02-Jan-98
SONAE INDUSTRIA, SGPS	Added	12-Dec-97	02-Jan-98
SOPORCEL	Deleted	12-Dec-97	02-Jan-98
TRANQUILIDADE-Tipo B-Nom.	Added	12-Dec-97	02-Jan-98
UNICER - Nom.	Deleted	12-Dec-97	02-Jan-98
IMPERIO - Nom.	Added	05-Jun-98	01-Jul-98
TRANQUILIDADE-Tipo B-Nom.	Deleted	05-Jun-98	01-Jul-98
BTA - Nom.	Deleted	25-Jun-98	25-Jun-98
SONAE IMOBILIÁRIA.	Added	25-Jun-98	25-Jun-98
BPA - Nom.	Added	11-Dec-98	04-Jan-99
SAG GEST, SGPS	Added	11-Dec-98	04-Jan-99
SEMAPA	Deleted	11-Dec-98	04-Jan-99
SONAE INDUSTRIA, SGPS	Deleted	11-Dec-98	04-Jan-99
SAG GEST, SGPS	Deleted	14-Jun-99	01-Jul-99
SOPORCEL	Added	14-Jun-99	01-Jul-99
INPARSA	Deleted	28-Jul-99	30-Jul-99
SEMAPA	Added	28-Jul-99	30-Jul-99
IMPERIO - Nom.	Deleted	13-Dec-99	03-Jan-00
PARAREDE, SGPS	Added	24-May-00	25-May-00
BPSM - Nom.	Deleted	07-Jun-00	12-Jun-00
SAG GEST, SGPS	Added	07-Jun-00	12-Jun-00
SEMAPA	Deleted	27-Jun-00	03-Jul-00
NOVABASE, SGPS	Added	13-Dec-00	02-Jan-01
SONAE IMOBILIÁRIA.	Deleted	13-Dec-00	02-Jan-01
SEMAPA	Added	14-May-01	16-May-01
SOPORCEL	Deleted	14-May-01	16-May-01

Figure 6 – Added stocks abnormal returns charts

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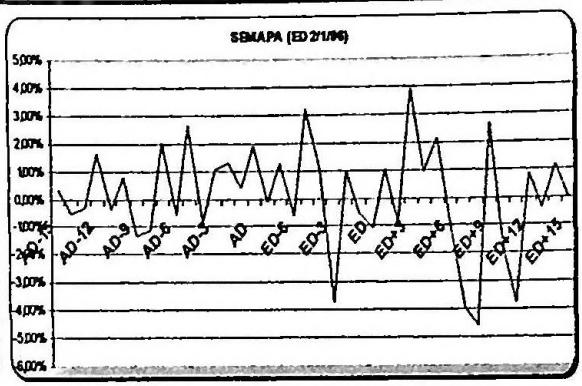
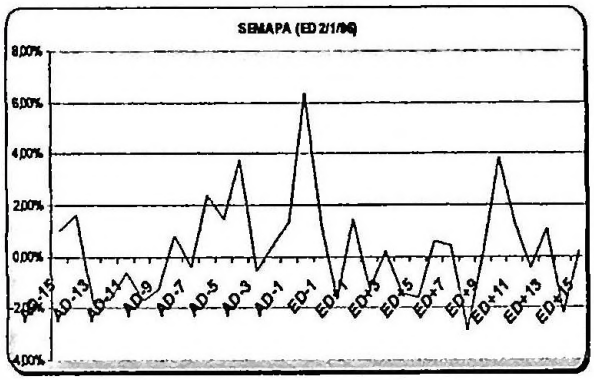

SEMAPA (ED 2/1/96)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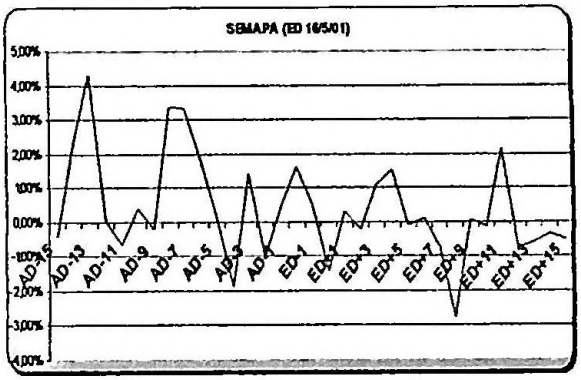
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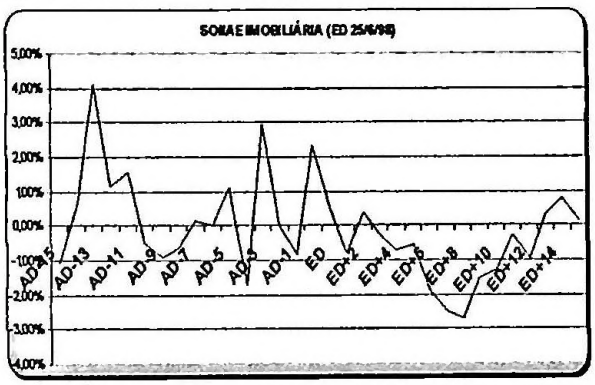
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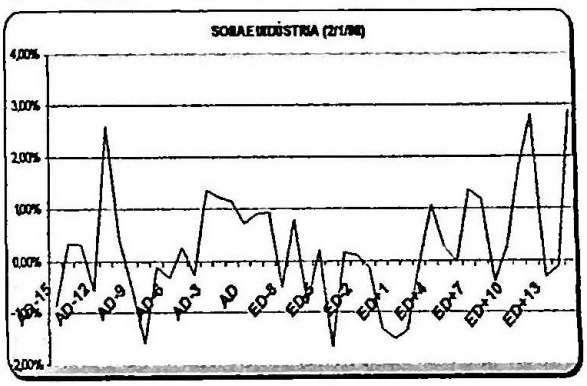
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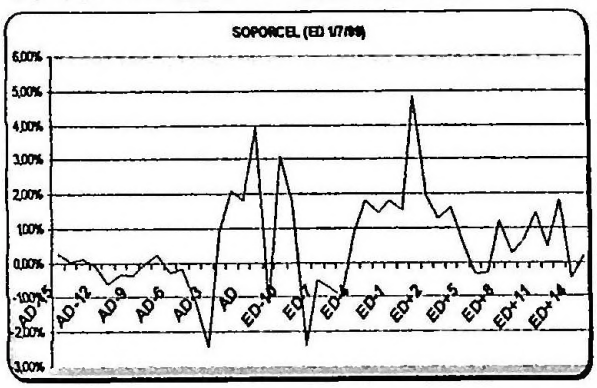
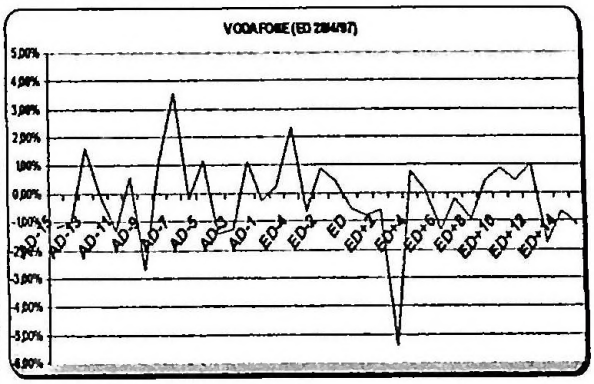

SOPORCEL (ED 1/7/99)


VODAFONE (ED 28/4/97)

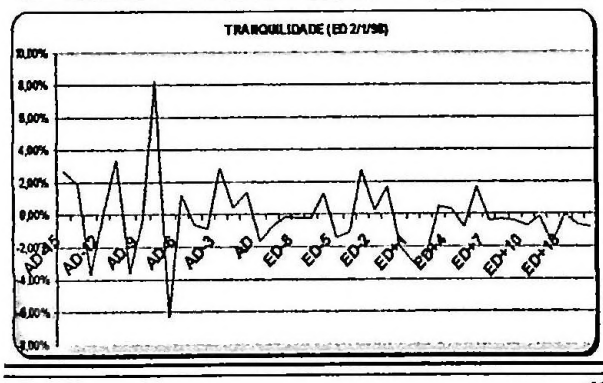
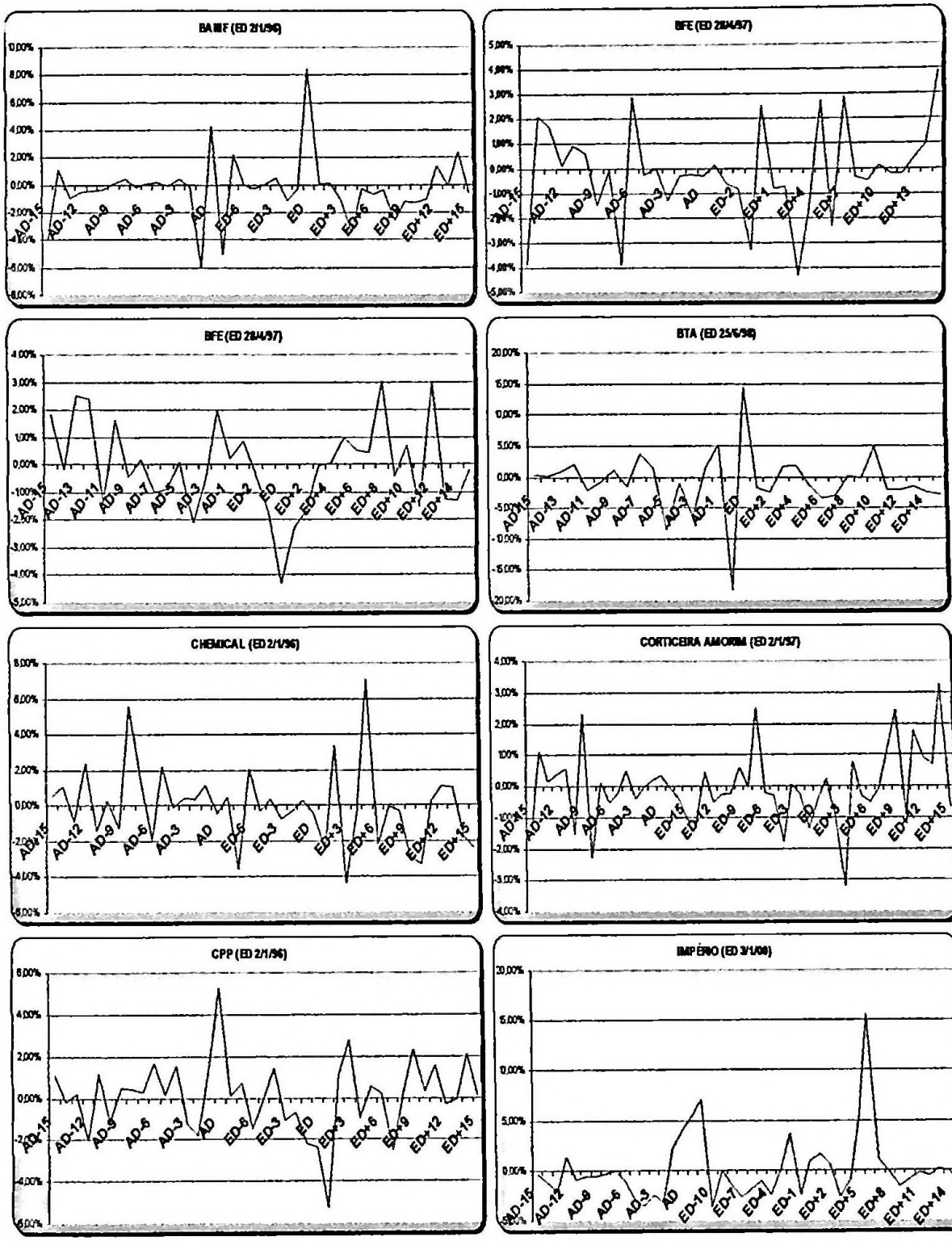
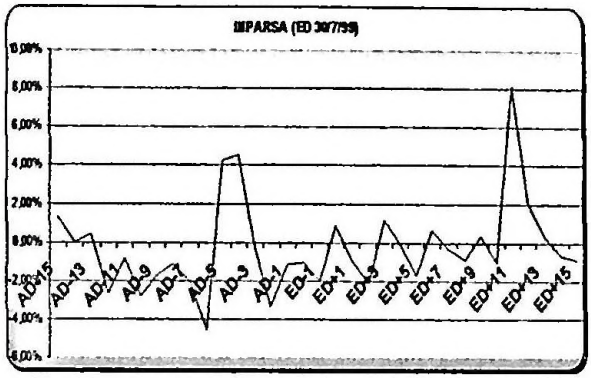

TRANQUILIDADE (ED 2/1/96)

Figure 7 - Deleted stocks abnormal returns charts

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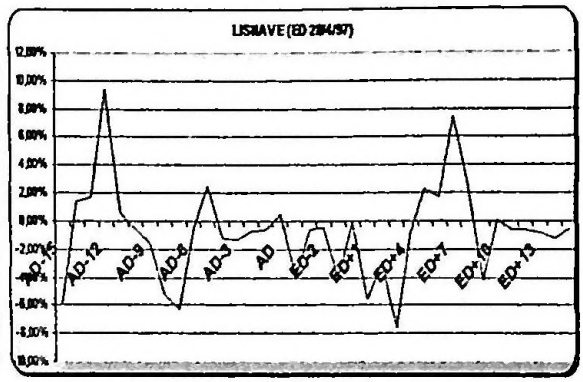
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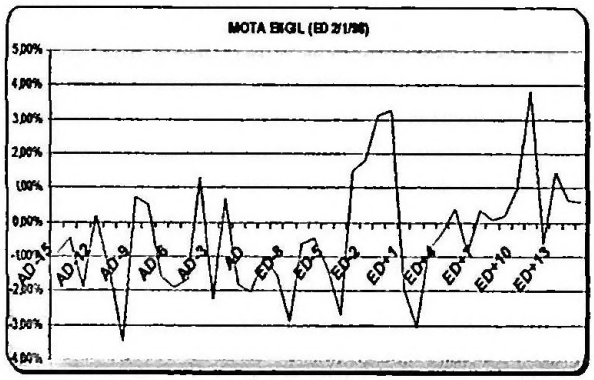
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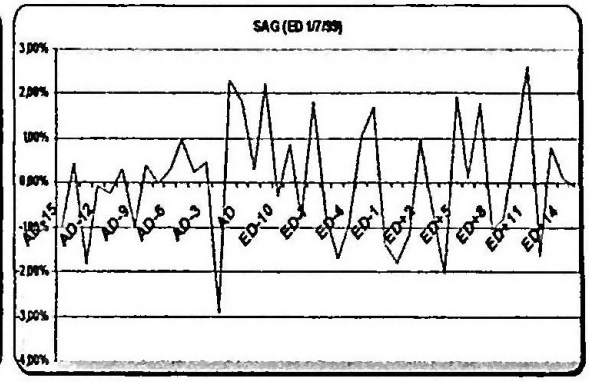
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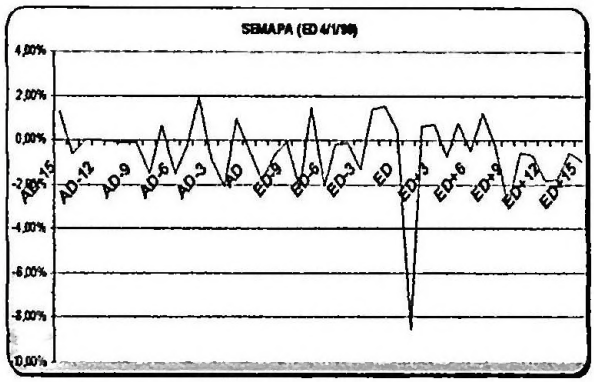
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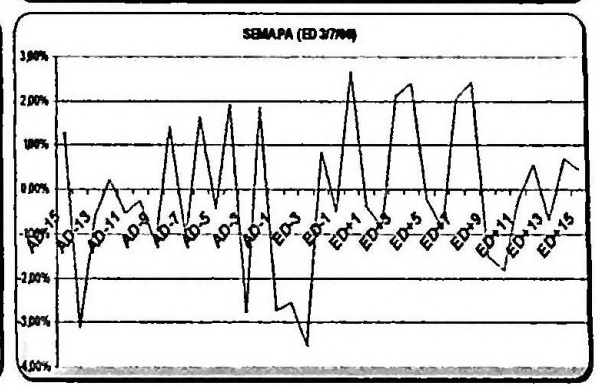
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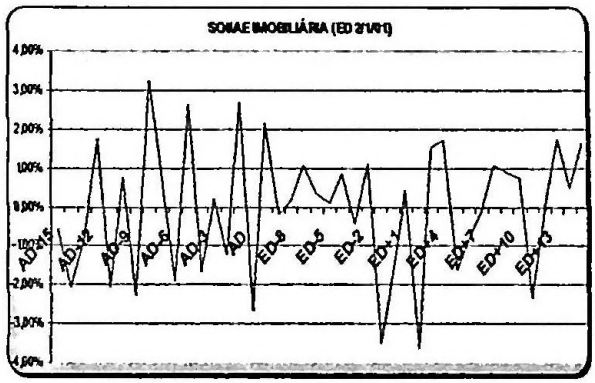
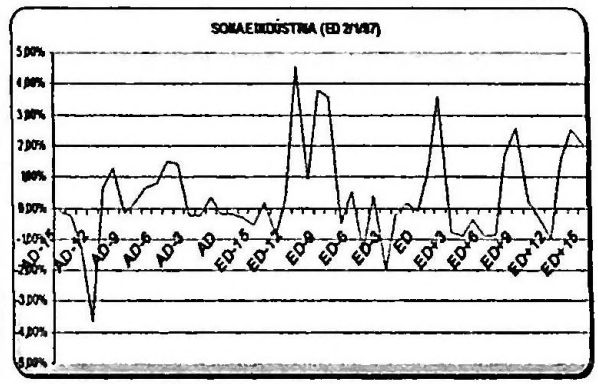
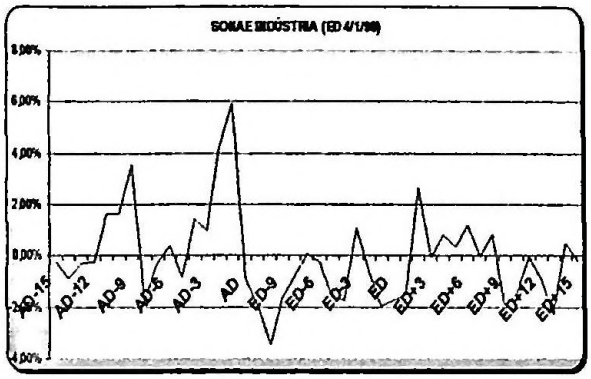
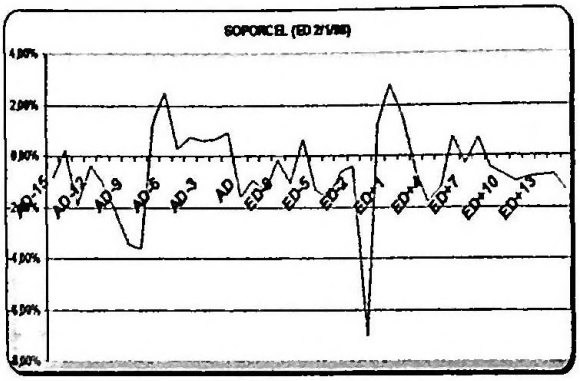

SONAE IMOBILIÁRIA (ED 2/1/01)


SONAE INDÚSTRIA (ED 2/1/97)


SOMAE INDÚSTRIA (ED 4/1/98)
AD-15
AD-12
AD-9
AD-6
AD-3
AD
ED+3
ED+6
ED+9
ED+12
ED+15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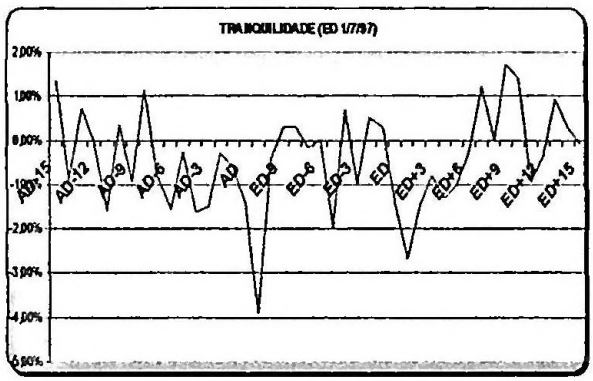
AD-6
AD-3
AD
ED+1
ED+4
ED+7
ED+10
ED+13


TRANSQUILIDADE (ED 1/7/97)
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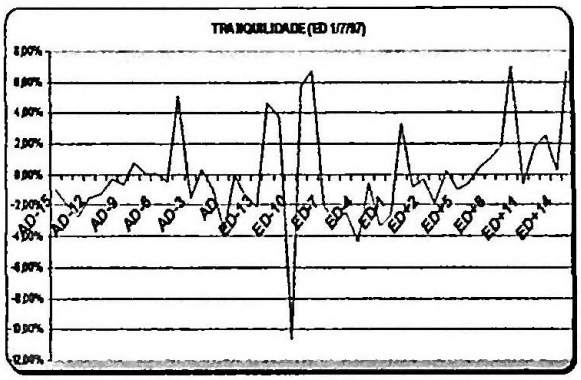
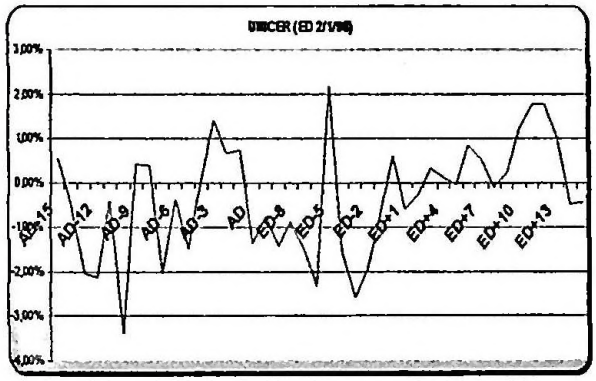
AD-12
AD-9
AD-6
AD-3
AD
ED+3
ED+6
ED+9
ED+12
ED+15


TRANSQUILIDADE (ED 1/7/97)
AD-12
AD-9
AD-6
AD-3
AD
ED+1
ED+4
ED+7
ED+10
ED+13


UNICER (ED 2/1/98)
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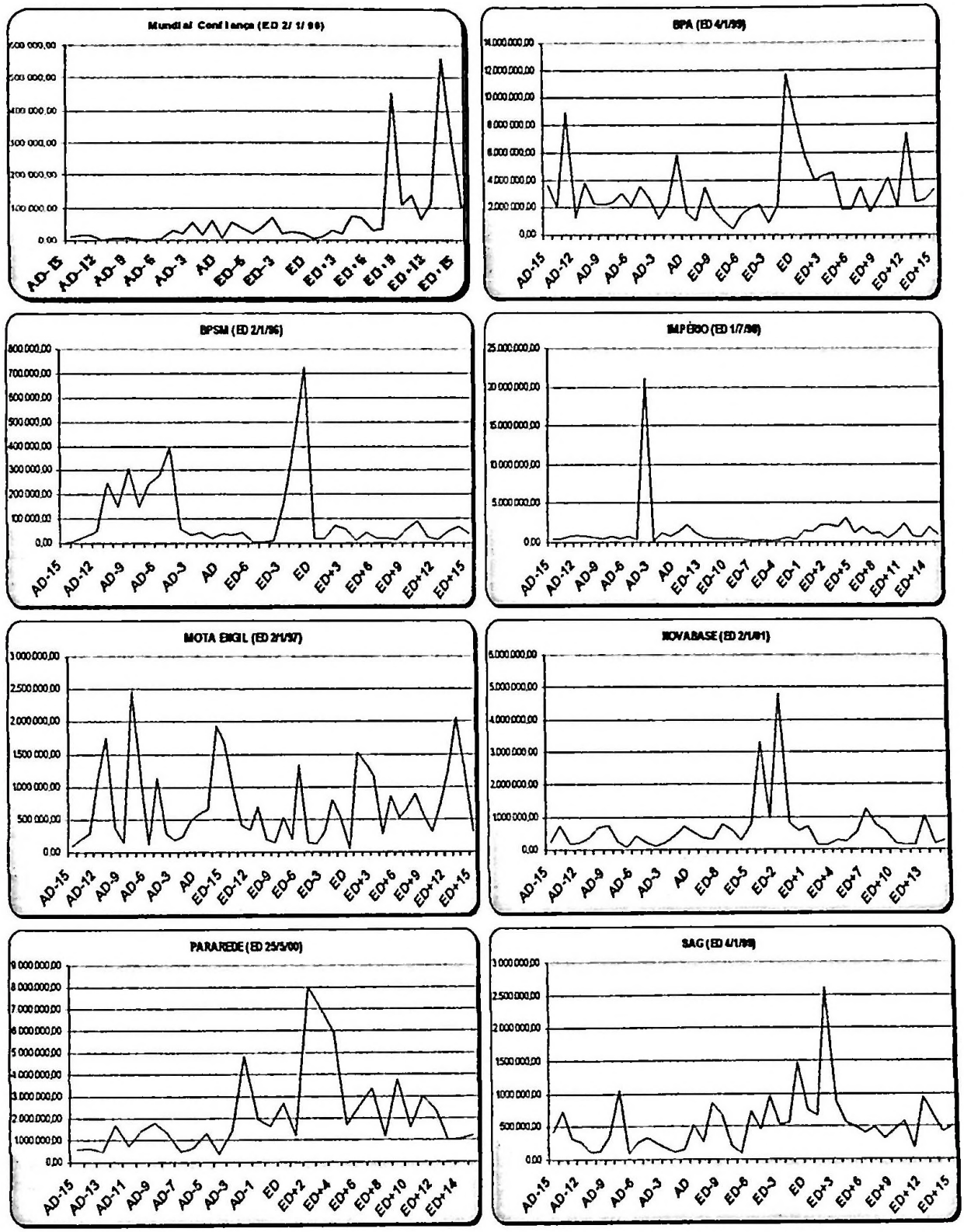
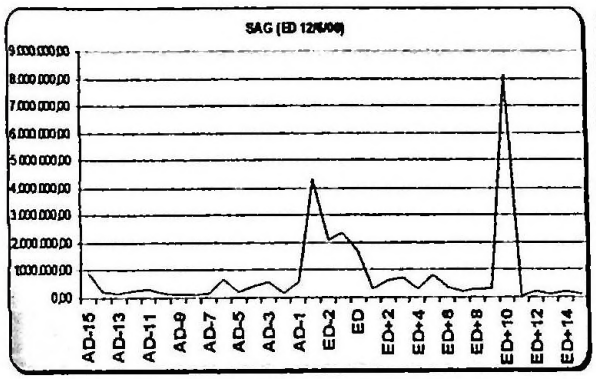
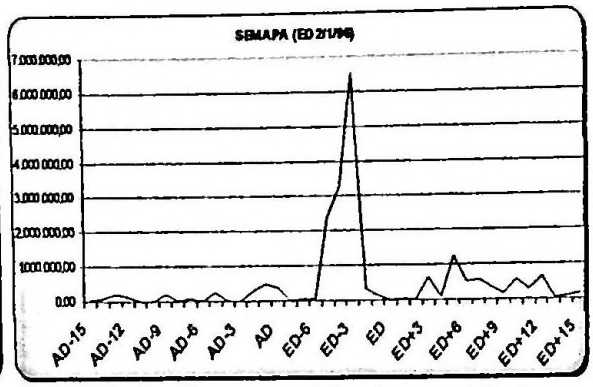
AD-12
AD-9
AD-6
AD-3
AD
ED+1
ED+4
ED+7
ED+10
ED+13

Figure 8 - Added stocks trading volume charts




SAG (ED 12/6/98)
AD-15
AD-13
AD-11
AD-9
AD-7
AD-5
AD-3
AD-1
ED-2
ED
ED+2
ED+4
ED+6
ED+8
ED+10
ED+12
ED+14


SEMAPA (ED 2/1/98)
AD-15
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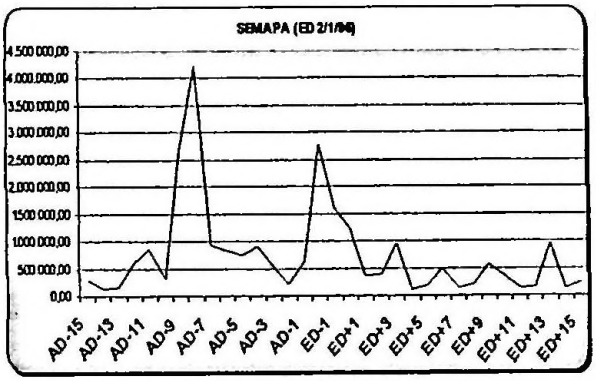
AD-3
AD
ED-6
ED-3
ED
ED+3
ED+6
ED+9
ED+12
ED+15


SEMAPA (ED 2/1/98)
AD-15
AD-13
AD-11
AD-9
AD-7
AD-5
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AD-1
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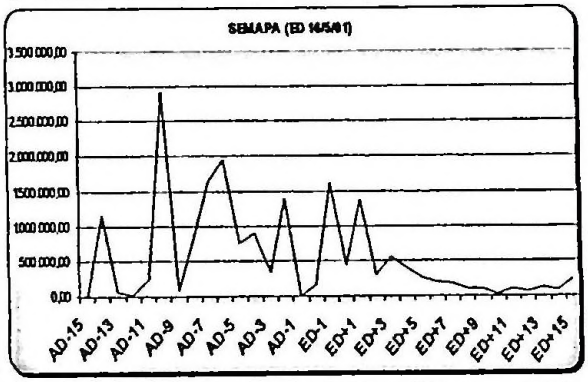
ED+5
ED+7
ED+9
ED+11
ED+13
ED+15


SEMAPA (ED 16/5/01)
AD-15
AD-13
AD-11
AD-9
AD-7
AD-5
AD-3
AD-1
ED-1
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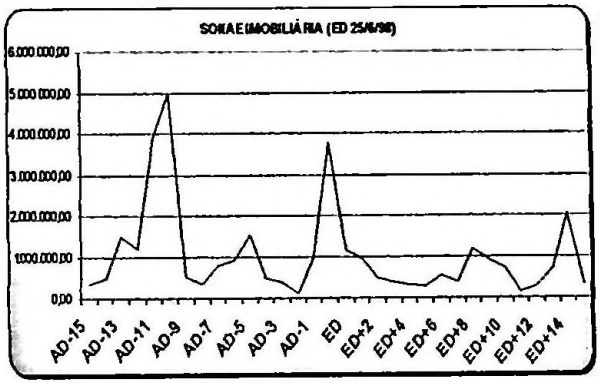
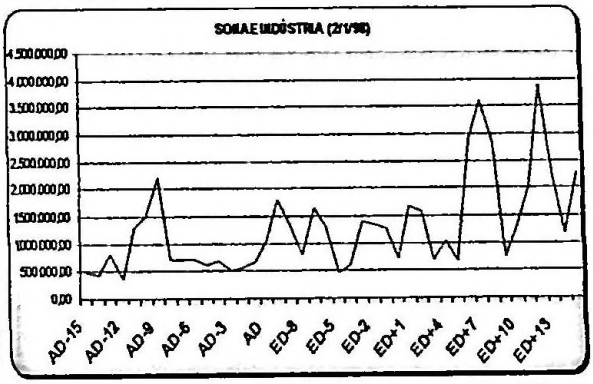
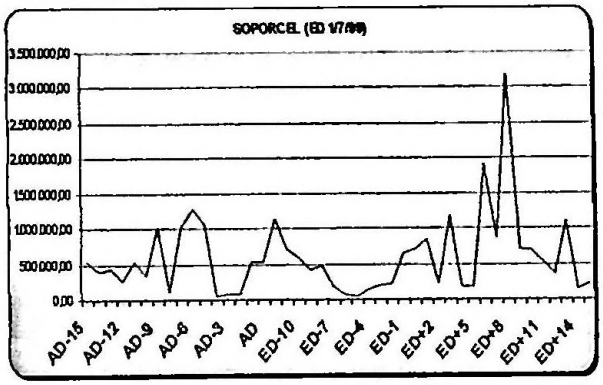
ED+5
ED+7
ED+9
ED+11
ED+13
ED+15


SONAE IMOBILIÁRIA (ED 25/6/98)
AD-15
AD-13
AD-11
AD-9
AD-7
AD-5
AD-3
AD-1
ED
ED+2
ED+4
ED+6
ED+8
ED+10
ED+12
ED+14


SONAE INDÚSTRIA (2/1/98)
AD-15
AD-12
AD-9
AD-6
AD-3
AD
ED-3
ED-5
ED-2
ED+1
ED+4
ED+7
ED+10
ED+13


SOPORCEL (ED 1/7/98)
AD-15
AD-12
AD-9
AD-6
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AD
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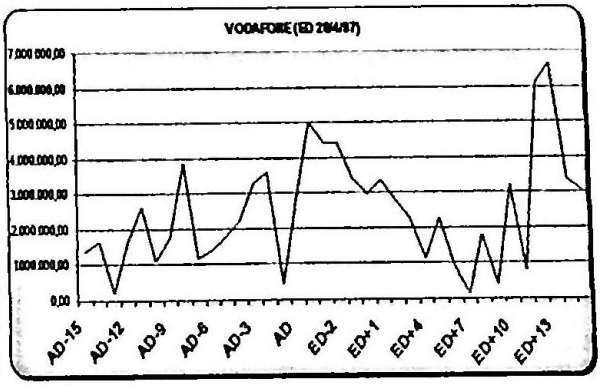
ED-1
ED+2
ED+5
ED+8
ED+11
ED+14


VODAFONE (ED 29/4/97)
AD-15
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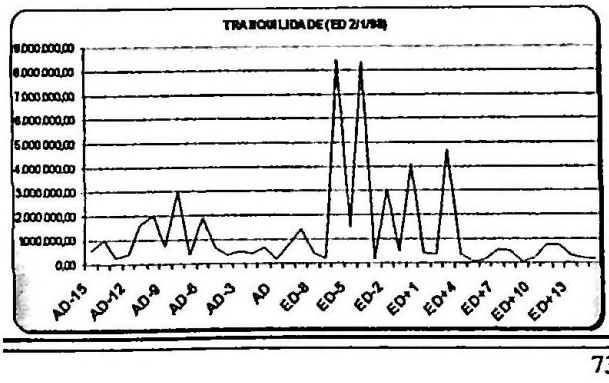
AD-9
AD-6
AD-3
AD
ED-2
ED+1
ED+4
ED+7
ED+10
ED+13


TRANSITLIDADE (ED 2/1/98)
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AD-12
AD-9
AD-6
AD-3
AD
ED-8
ED-5
ED-2
ED+1
ED+4
ED+7
ED+10
ED+13

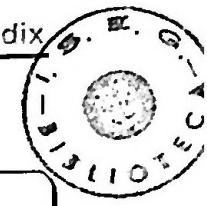
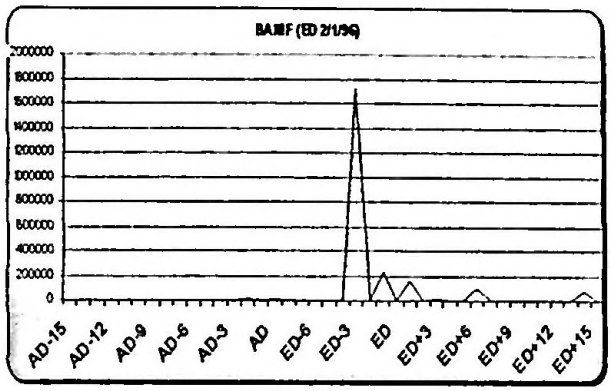
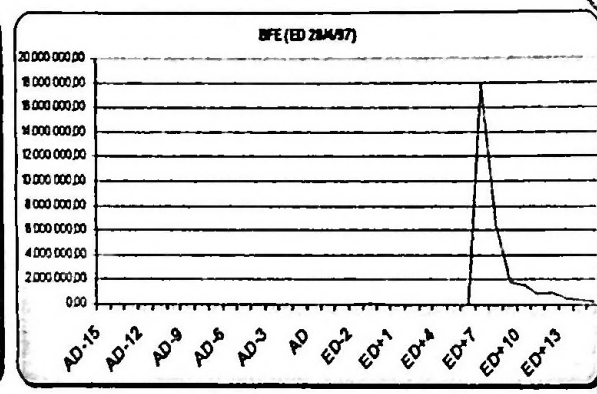
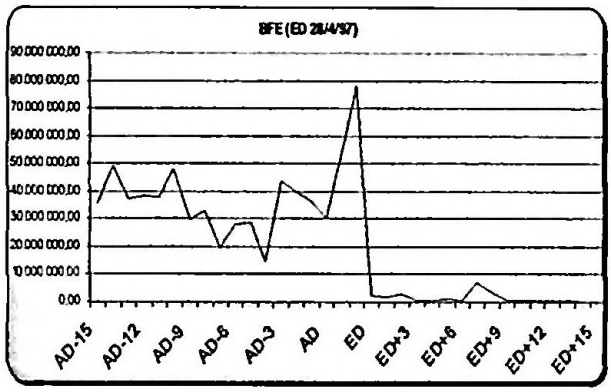
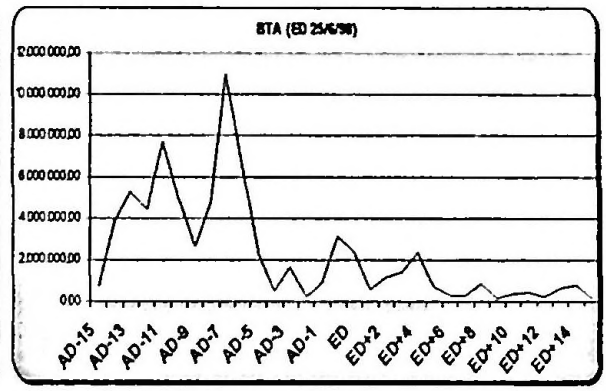


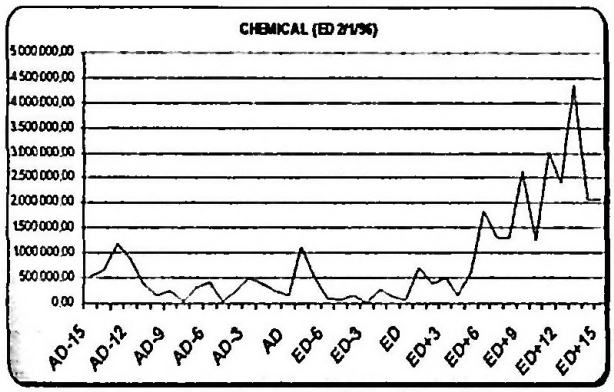
Figure 9 - Deleted stocks trading volume charts

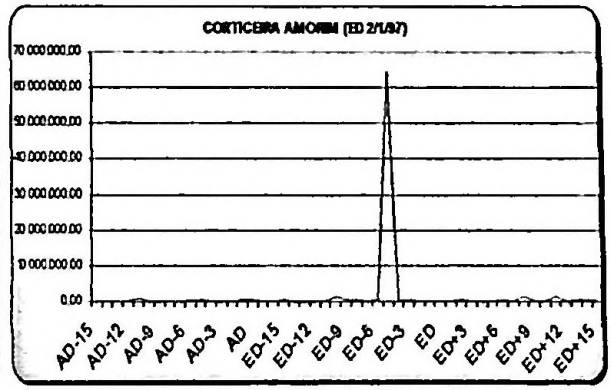


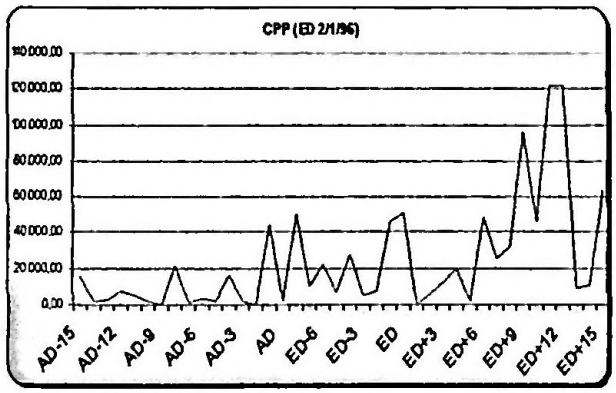


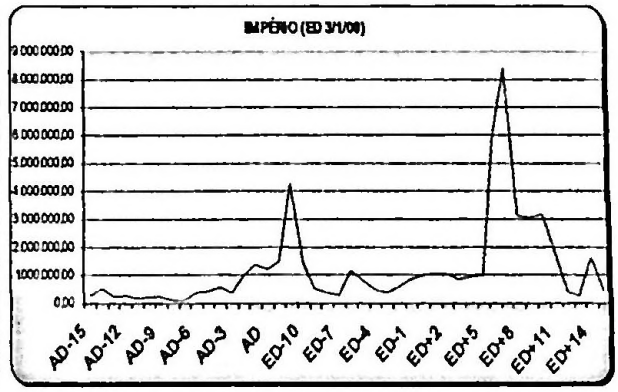


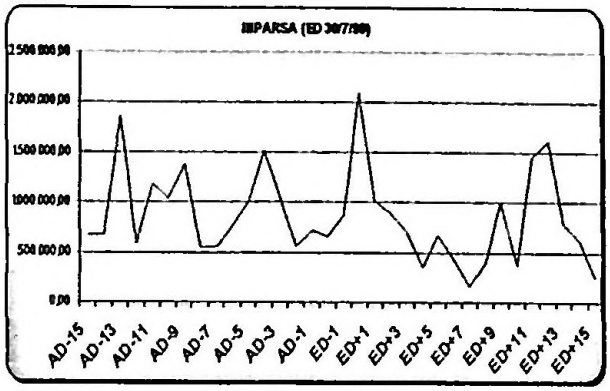


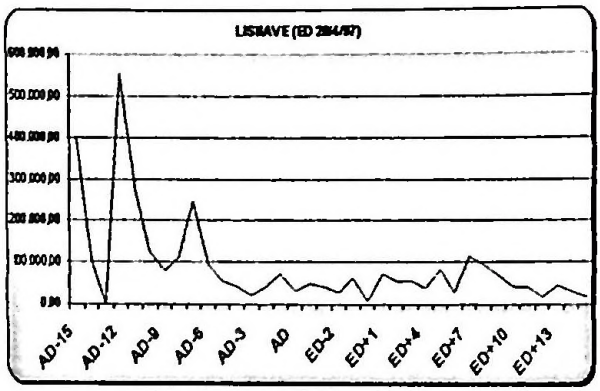









IIIPARSA (ED 30/7/98)
2 500 000,00
2 000 000,00
1500 000,00
1000 000,00
500 000,00
0,00
AD-15
AD-13
AD-11
AD-9
AD-7
AD-5
AD-3
AD-1
ED-1
ED+1
ED+3
ED+5
ED+7
ED+9
ED+11
ED+13
ED+15


LISNAVE (ED 28/4/97)
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500 000,00
400 000,00
300 000,00
200 000,00
100 000,00
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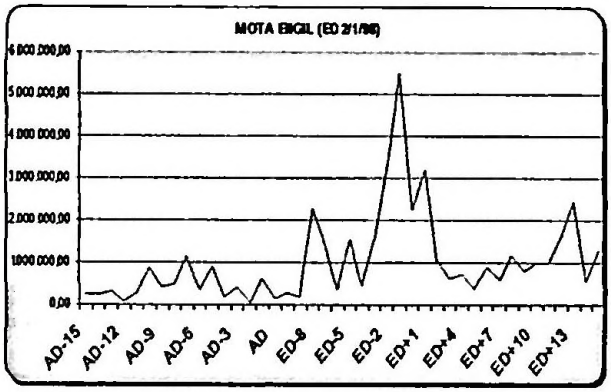
AD-9
AD-6
AD-3
AD
ED+2
ED+1
ED+4
ED+7
ED+10
ED+13


MOTA ENGIL (ED 2/1/98)
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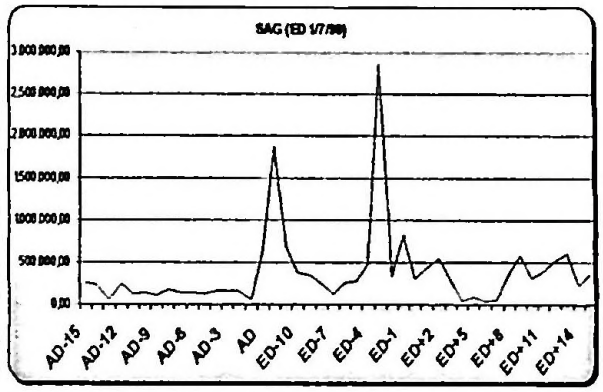
5 000 000,00
4 000 000,00
3 000 000,00
2 000 000,00
1000 000,00
0,00
AD-15
AD-12
AD-9
AD-6
AD-3
AD
ED-8
ED-5
ED-2
ED+1
ED+4
ED+7
ED+10
ED+13


SAG (ED 1/7/98)
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2 000 000,00
1500 000,00
1000 000,00
500 000,00
0,00
AD-15
AD-12
AD-9
AD-6
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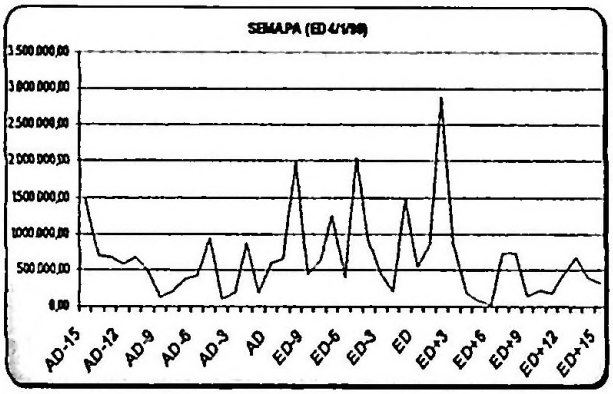
ED+7
ED+4
ED+1
ED+2
ED+5
ED+8
ED+11
ED+14


SEMAPA (ED 4/1/98)
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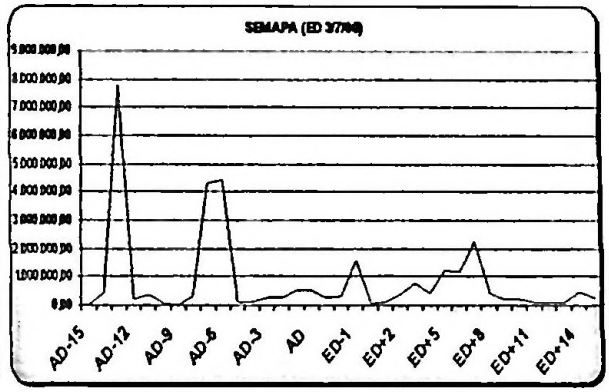
3 000 000,00
2 500 000,00
2 000 000,00
1500 000,00
1000 000,00
500 000,00
0,00
AD-15
AD-12
AD-9
AD-6
AD-3
AD
ED-9
ED-6
ED-3
ED
ED+3
ED+6
ED+9
ED+12
ED+15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8 000 000,00
7 000 000,00
6 000 000,00
5 000 000,00
4 000 000,00
3 000 000,00
2 000 000,00
1000 000,00
0,00
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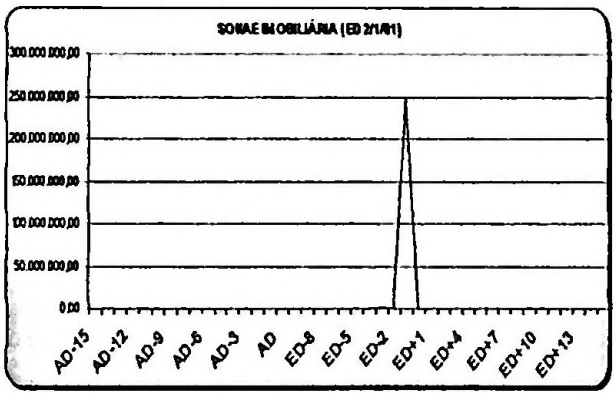
AD-6
AD-3
AD
ED-1
ED+2
ED+5
ED+8
ED+11
ED+14


SONAE IM OBILIÁRIA (ED 2/1/01)
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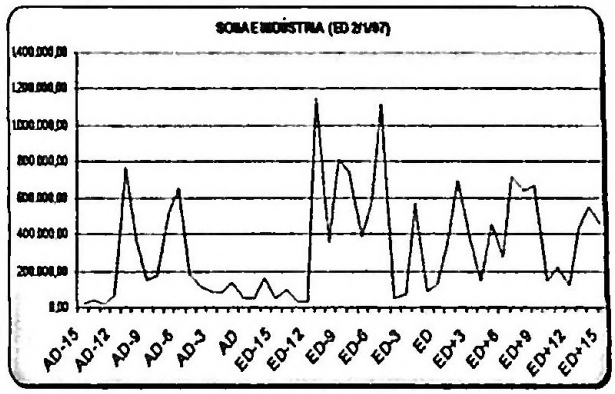
250 000 000,00
200 000 000,00
150 000 000,00
100 000 000,00
50 000 000,00
0,00
AD-15
AD-12
AD-9
AD-6
AD-3
AD
ED-8
ED-5
ED-2
ED+1
ED+4
ED+7
ED+10
ED+13


SONAE INDÚSTRIA (ED 2/1/97)
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1200 000,00
1000 000,00
800 000,00
600 000,00
400 000,00
200 000,00
0,00
AD-15
AD-12
AD-9
AD-6
AD-3
AD
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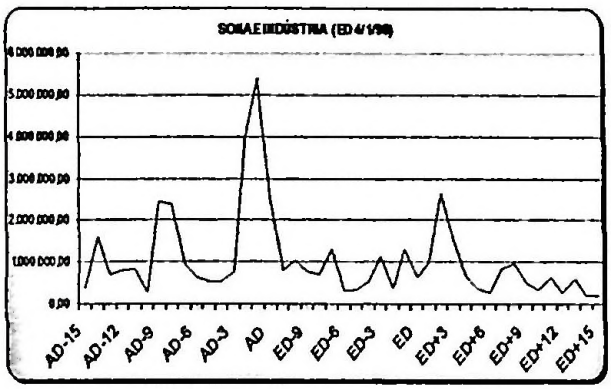
ED-12
ED-9
ED-6
ED-3
ED
ED+3
ED+6
ED+9
ED+12
ED+15


SOMA E INDÚSTRIA (ED 4/1/98)
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AD-12
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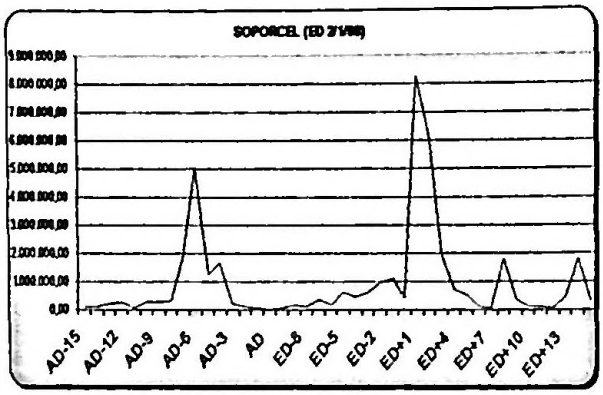
AD-3
AD
ED-9
ED-6
ED-3
ED
ED+3
ED+6
ED+9
ED+12
ED+15


SOPORCEL (ED 2/1/98)
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AD-3
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ED-5
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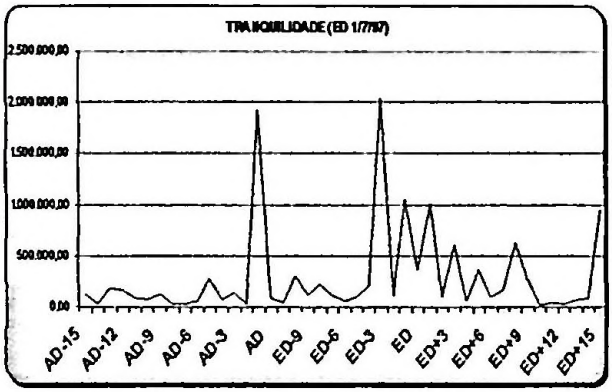
ED+1
ED+4
ED+7
ED+10
ED+13


TRAFICLIDADE (ED 1/7/97)
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AD-12
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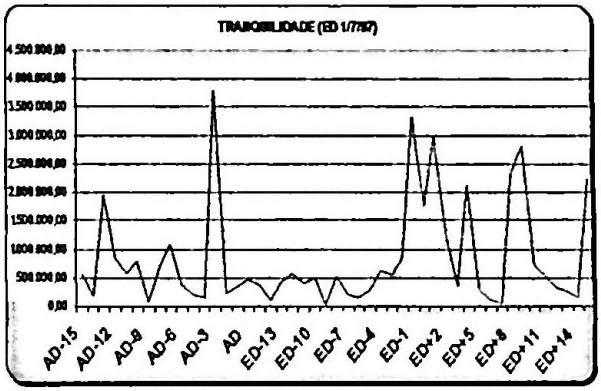
AD-3
AD
ED-9
ED-6
ED-3
ED
ED+3
ED+6
ED+9
ED+12
ED+15


TRAFICLIDADE (ED 1/7/97)
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AD-9
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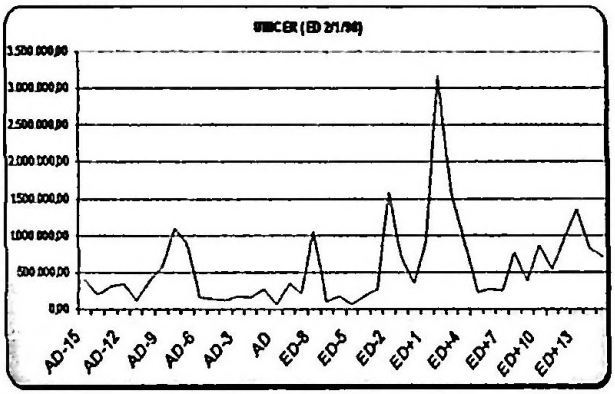
ED-10
ED-7
ED-4
ED-1
ED+2
ED+5
ED+8
ED+11
ED+14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AD-6
AD-3
AD
ED-8
ED-5
ED-2
ED+1
ED+4
ED+7
ED+10
ED+13